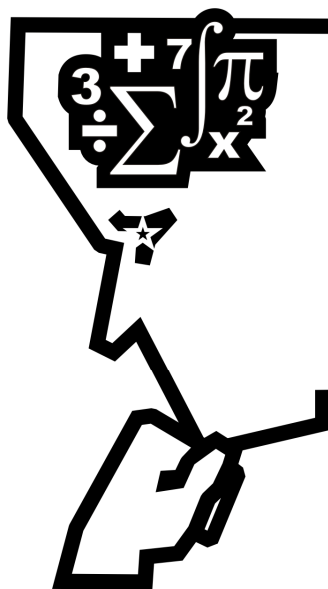




The University of  
**Montana**

## An Undergraduate Guide To The Study of Mathematics



**MATHEMATICAL  
SCIENCE S**  
The University of Montana

Updated May 24, 2011

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# 1. Introduction

## *Letter of Welcome*

*Dear Mathematics Student,*

*Welcome to the Department of Mathematical Sciences. This booklet, "An Undergraduate Guide to the Study of Mathematics" is designed to help you plan your studies. You will find a wealth of useful information in this guide. Read it and keep it for future reference. You can also find this information (and updated versions) on the World Wide Web at <http://www.umt.edu/math/undergraduate/guide.pdf>.*

*The Department is indebted to many faculty and alumni who have worked to make this document a useful guide. We are always looking for suggestions that would increase the value of the guide for our students.*

*The Department of Mathematical Sciences is a large department. We have more than 25 full-time faculty (21 tenure-track), 80 undergraduate majors, 35 minors and 25 graduate students. Approximately 2,700 students take classes in our department each semester. The Mathematics Building houses a Mathematics Learning Center and two mathematical computing laboratories. We have an excellent faculty that works very hard to help students succeed. Their expertise is varied and you can receive a strong background in several different areas: pure and applied mathematics, combinatorics & optimization, mathematics education and statistics. This guide will help you take full advantage of all the opportunities available to you while you are a student in our Department.*

*The Department hopes that all of its graduates will always feel at home here. We are proud of our graduates and are anxious to follow their careers. We invite you back to visit with us whenever you have a chance. Write and tell us about your jobs or graduate work. We are especially interested to hear how participation in our programs has (or has not) prepared you for what you are doing. Do keep in touch with us and make sure we always have your current address.*

*Leonid Kalachev, Chair  
MA 309, 243-4373, [kalachev@mso.umt.edu](mailto:kalachev@mso.umt.edu)*

## *Overview of the Undergraduate Guide*

Mathematics is more than just numbers. A mathematics student uses the ability to compute, to think logically, to solve problems and to analyze. All of these qualities characterize an educated individual and are valued by employers.

The subject of mathematics has a long history, and yet is continually evolving. Mathematics gives students flexibility in career choices and is also a viable way to prepare for graduate study in several fields. For example, fields such as computer science and chemistry require a great deal of mathematical skills. Mathematics is a challenging field that opens doors to many other subjects such as the physical sciences, engineering, computer science as well as the biological and social sciences.

This guide is meant to help students learn more about getting a degree in mathematics at the University of Montana. In this booklet you will find descriptions of the various options, the order in which the courses should be taken and what semesters they are offered.

The booklet also provides information about activities, facilities, financial assistance and career opportunities. You are encouraged to read through this guide to get as much out of your degree in mathematics and the Department of Mathematical Sciences as you can!

## *Mathematical Sciences Faculty & Staff*

Up-to-date listings of faculty and staff are available at the home page of the Department of Mathematical Sciences, <http://www.umt.edu/math/>. You can find a listing of all tenure-track faculty with their research areas at <http://www.umt.edu/math/profile/research.html>.

Note: There are **photographs** of all mathematics faculty, teaching assistants and staff in the hall next to MA 105.

### **Chair & Associate Chairs**

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## 2. Why Study Math?

### *What Can You Do with a Math Major?*

Even if you do not choose a career in the mathematical sciences, studying as much mathematics as you can is a good way to keep your options open. Mathematics is an excellent foundation for, and is usually a prerequisite to, all areas of science and engineering. Students in such areas as anthropology, sociology and psychology, as well as law, business and medicine benefit from a solid background in mathematics and statistics. In addition, mathematical training will help you to better understand science and technology and their effects on our world.

Because their skills are in demand, mathematical scientists often find they can follow a number of career paths which generally pay higher salaries. As you plan your future, remember that study in the mathematical sciences can lead to an interesting, rewarding and well-paying career.

It is not merely a conjecture that jobs in the mathematical sciences (pure and applied mathematics, operations research, statistics, management science, teaching and actuarial science) are “best.” According to the Jobs Rated Almanac, a 1999 publication of World Almanac Books of New York, NY, careers that require a very strong background in mathematics are listed as the five “best” jobs, namely web site manager, actuary, computer systems analyst, software engineer and mathematician.

*See Chapter 8 for much more information on possible career choices.*

(Some of the material in this section comes from *Careers that Count* (Association for Women in Mathematics) and *Mathematical Scientists at Work* (Mathematical Association of America).)

### *List of Job Titles of UM Math Alumni*

Account Executive	Corporate President	Mathematician
Account Representative	Data Processing Consulting	Medical Research Analyst
Actuary	Data Processing Manager	Meteorologist
Airline Captain	Deacon	Methods Analyst
Airport Services Agent	Dentist	Office/Data Processing Manager
Analyst	Director	Optometrist
Applications Engineer	Editor	Owner/President
Artist	Electrical Engineer	Peace Corps Volunteer
Assistant Professor	Engineer	Pilot Instructor
Attorney	Engineer Programmer	Principal
Bank Teller	Engineering Manager	Principal Analyst
Banker	Engineering Supervisor	Principal Engineer
Boiler Operator	Financial Manager	Procurement Manager
Casino Dealer	Geophysicist	Product Development
Chief Deputy	Industrial Analyst	Professor
Child Support Investigator	Instructional Designer	Program Analyst
Civil Engineer	Lease Consultant	Property & Tax Manager
Congressman	Leasing Agent	Proprietor
Communications Specialist	Librarian	Regional Director
Computer Analyst	Lodging Director	Registered Nurse
Computer Facilitator	Medical Doctor	School Psychologist
Computer Programmer	Magazine/Book Wholesale	Scientist
Computer Programming Analyst	Distributor	Small Business Owner
Computer Specialist	Major General	Social Worker
Computer Systems Operator	Management Analyst	Software Analyst
Consultant	Marine Colonel	Software Design Specialist

Software Engineer	Systems Programmer	Tutor
Software Instructor	Tax Preparer	Underwriter
Statistical Computation Consultant	Taxpayer Service Representative	Vice President & Trust Officer
Systems Analyst	Teacher	Vice Provost

### *Advice from Graduates of the UM Math Department*

A survey was taken of students who received B.A. degrees in mathematics at UM. These graduates were asked:

#### **“What advice would you give an undergraduate seeking a math degree?”**

Here are some of their replies:

- ❖ My advice would be to explore other fields in conjunction with math, as some of the most interesting and rewarding careers are cross-discipline.
- ❖ Get some job-related experience or find an internship program before you graduate, so you have some direction before graduation arrives.
- ❖ Don't be afraid to visit with faculty, TA's, etc. Get some experience teaching math, tutor ...
- ❖ Take lots of computer science as well.
- ❖ Classes in math theory are equally as important as classes in applications. There is more to mathematics than plugging numbers into formulas. To check your result from a formula you have to know the why's. The why's can give you an approximate answer, the formula -- the exact answer!
- ❖ Too many good mathematicians are poor communicators and, therefore, poor teachers.
- ❖ Learn as much as possible about different career opportunities which build on a math background.
- ❖ It's a very valuable degree to have and in considerable demand. The skills from advanced courses (for advanced degrees) are also very valuable. I have found that my math skills have allowed me the freedom to essentially create my own position.
- ❖ To have a good idea as to what (s)he wants to do with the degree, and then to make sure the curriculum and courses will fulfill that need.
- ❖ I don't have much to tell someone who arrived at college with a lot of self-confidence and is in control of his or her classes. For the people who have some math anxiety, I do know its possible to work through the problem. It is possible to succeed in mathematics.
- ❖ Get a strong emphasis in computers, information management or business information systems.
- ❖ Consider it a language to be used in another field of science. If you can attain the degree in mathematics you have a strong advantage in exploring other fields of science.
- ❖ Get a very broad education. Take classes in all areas --especially communication, working in groups, interacting with others.
- ❖ To do it, opens up unlimited possibilities in many fields. When I graduated (1975) there were 3 students who gradated in non-educational math that year. Of the three, one is an attorney, one teaches chemistry at Berkeley (UC) and I'm a dentist. I take pride in my mathematics education and the future it has provided for me. I'm also proud of UM in general.
- ❖ Be open to all the different career paths which involve a strong background in math. I wish I had known about actuarial science and some of the business applications of math such as forecasting, regression, operations research (queuing theory and scheduling) and so forth.
- ❖ Two things. First, I recommend taking lots of computer science courses, and better yet, getting a minor or second major in computer science. I also recommend pursuing any second major, since straight math jobs are difficult to find. Second, I recommend trying to get involved in an internship during undergraduate years. It's good experience and you'll make contacts for future references. I believe networking is the best method for finding a job. Also, do some independent research. Its good to put on a resume.
- ❖ Expect that your life will be much different than you are planning.
- ❖ Take lots of CS. Double major with it even if it takes an extra year.

## 3. Math Majors & Minors

The University of Montana offers a B.A. with a major in mathematical sciences and an interdisciplinary B.S. with a combined major in computer science and the mathematical sciences. In addition, students can earn a minor in mathematics. At the graduate level, both M.A. and Ph.D. degrees in the mathematical sciences are available.

A career in mathematics, except for teaching at the secondary level, usually requires a graduate degree as preparation. In general, approximately two years of study beyond the bachelor's degree are required to obtain the master's degree and another three to four years beyond that to earn the doctorate (the terminal degree). For more information, see Chapter 8.

### 3.A The Math Major (Including its Options)

At the undergraduate level there are five available options: applied mathematics, combinatorics & optimization, mathematics education, pure mathematics and statistics.

*Students are not required to take a specific option and can acquire a mathematics degree by completing the requirements for a mathematical sciences B.A. degree discussed below. Mathematics majors are, however, encouraged to complete a specific option.*

For more information on a specific option, talk to the faculty members in that area (see the listing of faculty members by research areas at <http://www.umt.edu/math/profile/research.html>).

#### *What is the Applied Mathematics Option?*

Applied mathematics refers to those topics in mathematics that are most useful for analyzing real world applications in engineering, physics, chemistry, earth sciences and biological sciences. The emphasis is often on constructing a (sometimes nonlinear) model of the real world application, and then applying analytic and numerical/computational solution techniques to the differential, difference or integral equations that result. Job opportunities for applied mathematicians exist in most industries, as well as in the National Laboratories (e.g. Sandia, Los Alamos and Lawrence Livermore). Academic opportunities are also available for applied mathematicians with an advanced degree.

At UM, the applied mathematics group works in the areas of numerical analysis, perturbation methods and dynamical systems, with applications in astronomy, chemistry, biology, forestry, medical imaging, and pharmaceutical science, to name a few. Model development for problems in these studies is central, followed by the analysis of these models using numerical and analytical techniques, with the goal of a better understanding of the mechanisms at work in the phenomena. We offer courses in solution techniques (Ordinary Differential Equations, Partial Differential Equations, Numerical Methods, Linear Algebra) and modeling and qualitative analysis (Deterministic Models and Statistical, Dynamical and Computational Modeling).

The applied mathematics option also requires the ability to do rigorous analysis, so this option can be chosen by students planning to do graduate work in an applied science or in mathematics. Students in this option are urged to learn a computer language such as Matlab or Python, as these are often valuable in the analysis of applied problems.

#### *What is the Combinatorics & Optimization Option?*

For more information on this option, please contact one of the faculty members in this area (they are listed at <http://www.umt.edu/math/profile/research.html>).

#### *What is the Mathematics Education Option?*

Often students who are good in mathematics accept the challenge of developing mathematical power in others. The University of Montana mathematics program offers an option in mathematics education to train teachers of

mathematics. Graduates with this option are certified to teach mathematics in grades 5 through 12 in Montana.

This option contains a broad range of mathematics courses, including number theory, geometry, statistics, mathematical structures and the history of mathematics. Students explore the use of technology as a learning and teaching tool in the mathematics classroom. The option also includes the education, psychology, teaching methods and field experiences necessary for teacher certification.

The mathematics and general components of the mathematics education option reflect the developing changes in the secondary school mathematics curriculum. Prospective teachers are required to know enough about mathematics and enough about teaching to adapt to the increasing complexity of the interactions of learners with mathematics.

### *What is the Pure Mathematics Option?*

Students who find mathematics challenging, fascinating, beautiful or enjoyable will probably want to follow at least one of the sequences in the pure mathematics option. These courses will help build knowledge of, appreciation for, and experience with the abstract ideas at the heart of mathematics. Courses in this option will enhance your ability to do rigorous proof-oriented mathematics. The problems considered while not excluding calculation, often also involve constructing arguments and proofs related to these theories. If an advanced degree in mathematics is your goal, many graduate programs require familiarity with all or part of the material in the courses required for the pure mathematics option.

### *What is the Statistics Option?*

Statistics is the study of techniques for the collection, analysis, interpretation and presentation of data. Careers exist in fields from insurance to engineering, from biology to economics, from business to education; in fact, statistical concepts are used almost everywhere. Most careers in statistics require a master's degree. Undergraduate courses give a general background in the field, and more specialized courses are taught at the graduate level. For advanced work, a good knowledge of calculus, linear algebra and analysis is required. Numerical analysis and mathematical modeling are also useful. Computers are used extensively and many types of statistical packages exist. A good statistician also has good reading, writing, speaking and listening skills. The knowledge of a second discipline outside of the mathematics/statistics area shows scientific interest and flexibility in a student who wishes to pursue an industrial career.

### *The Requirements for a Math Degree*

The precise requirements for earning a degree from the University of Montana are detailed in the UM Catalog. The most important requirements are summarized in several documents, available both in the math office and online at <http://www.umt.edu/math/undergraduate/>.

**Caution:** These handouts are based on specific UM Catalogs. Which you can use depends on which UM Catalog you want to use (and can use) to satisfy the degree requirements. Students typically use the catalog under which they first enrolled at UM. But students may graduate fulfilling requirements in any University of Montana-Missoula catalog under which they have been enrolled during the six years prior to graduation. Precise details about this, including special rules for transfer students, can be found in the UM Catalog in the section "Catalog Governing Graduation".

The three **Advising Worksheets** spell out in detail the departmental requirements for math majors:

- ❖ Advising Worksheet for Mathematics Education Majors
- ❖ Advising Worksheet for the Combined Major in Mathematics and Computer Science
- ❖ Advising Worksheet for all other Math Majors. This includes:
  - Math majors who do not declare an option
  - The applied math option

- The combinatorics and optimization option
- The pure math option
- The statistics option

The **Advising Guidelines** summarize:

- ❖ Many of the requirements for a first bachelor degree from UM, including when to apply for graduation
- ❖ The departmental requirements for earning a B.A. in Mathematical Sciences

(For some catalog years, the Advising Guidelines are combined with the Advising Worksheets, and not available separately.)

You should also consult the **General Education Requirement Checklists** (GRE Checklists), which are available in the math office (and online at <http://www.umt.edu/uac/audiences/GERfall09.aspx>). Note that there are several GRE Checklists, depending on when you started studying at UM (more precisely, depending on which UM Catalog you can use to satisfy the General Education Requirements).

### *Graduation Application*

The graduation application must be submitted to the Registrar's Office the semester before you plan to graduate (usually early October for graduation in May, early February for graduation in August, and early March for graduation in December). The graduation application must be signed by the Associate Chair of the math department. You may graduate under any catalog under which you have been enrolled during the six years prior to graduation.

### *Advising*

Each mathematics major is assigned a faculty advisor who will give advice on courses, help plan class schedules and assist in career planning. Mathematics minors are advised by the associate chair of the department. If you do not know who your advisor is, ask in the Math Office (MA 102). Every undergraduate is required to meet with his or her advisor prior to registration. You must obtain your advising number from your advisor before you can register. Although a student's advisor provides guidance on course selection, the student is still responsible for making sure he/she has all of the courses required to graduate.

*If you would like to change your advisor*, that can be easily done; just contact the associate chair for the undergraduate program.

### *Math Major Database*

The mathematics department keeps a database of all math majors which is updated every semester. Being in the database helps the department know who you are and know if you are eligible for scholarships, contests, etc. You are automatically in the database if you have declared a math major. If you have not declared a math major, change of major/minor forms are available at Griz Central (Lommasson 201); these forms must be signed by the Associate Chair of the math department. It is important to fill these major/minor forms out so that the university knows from which department you are getting your degree and so that your major department can assign you an appropriate advisor.

### *Math Major Email List*

This email list is used to communicate information about items like scholarships, job and internship opportunities, research opportunities and special events like our Gambling Day (November) and the Math Film Festival (April).

This is a moderated, low-volume list intended only for announcements, not discussions. If you want to have an announcement posted, please send an email message to the associate chair for the undergraduate program (Professor Gregory St. George, [gregory.stgeorge@umontana.edu](mailto:gregory.stgeorge@umontana.edu)).

Every semester, the math office subscribes to this list everyone who seems to be a math major. Everyone is free to unsubscribe (or subscribe) to the list; you can do this at the list's web site, <http://lists.umt.edu/> (click on MATH-MAJORS-L), or by contacting Linda Azure ([azure@mso.umt.edu](mailto:azure@mso.umt.edu)). At the lists web site, there is also an archive of the messages.

### 3.B The Combined Major in Math & Computer Science

The purpose of this major is to provide a thorough background in both Mathematics and Computer Science, and to inculcate a deeper understanding of the goals and methods of these two allied disciplines. A student must complete 60 credits in the two disciplines: 30 credits in math courses and 30 credits in computer science courses. The detailed requirements for the combined major are in the UM Catalog, both in the Mathematical Sciences section and the Computer Science section.

The most important requirements are summarized in several documents, available both in the math office and online at <http://www.umt.edu/math/undergraduate/>.

**Caution:** These handouts are based on specific UM Catalogs. Which you can use depends on which UM Catalog you want to use (and can use) to satisfy the degree requirements. Students typically use the catalog under which they first enrolled at UM. But students may graduate fulfilling requirements in any University of Montana-Missoula catalog under which they have been enrolled during the six years prior to graduation. Precise details about this, including special rules for transfer students, can be found in the UM Catalog in the section "Catalog Governing Graduation".

The **Advising Worksheet for the Combined Major in Math and Computer Science** spells out in detail the departmental requirements for the combined major.

The **Advising Guidelines** summarize many of the requirements for a first bachelor degree from UM, including when to apply for graduation. (For some catalog years, the Advising Guidelines are combined with the Advising Worksheets, and not available separately.)

You should also consult the **General Education Requirement Checklists** (GRE Checklists), which are available in the math office (and online at <http://www.umt.edu/uac/audiences/GERfall09.aspx>). Note that there are several GRE Checklists, depending on when you started studying at UM (more precisely, depending on which UM Catalog you can use to satisfy the General Education Requirements).

Please see also the sections **Graduation Application**, **Advising**, **Math Major Database**, and **Math Major Email List** above. The math department strongly recommends that you meet with both your math and CS advisors each semester during the registration period.

### 3.C The Math Minor

There are two substantially different minors: the **mathematics minor** (math minor, for short) and the **mathematics education minor** (which is a teaching minor).

#### *The Math Minor*

If you like math, it doesn't take that much extra work to earn a math minor. For some majors (e.g., computer science and physics majors), it takes **only 2 additional courses** beyond the courses required by the major!

And there are quite a few advantages:

- ❖ A math minor looks good on your resume.
- ❖ It demonstrates you know quite a bit of mathematics or statistics.
- ❖ It demonstrates that you have rigorous reasoning and problem solving skills.
- ❖ Graduate programs in the quantitative sciences like it. And so do Medical Schools and Law Schools.

- ❖ It makes you more marketable.
- ❖ But most importantly: Earning a math minor is fun. And a challenge.

If you are interested in a **Mathematics Minor**, please look at the Math Minor Handout (<http://www.umt.edu/math/undergraduate/files/math-minor.pdf>). It contains a description of the requirements, including quite a few suggested curricula.

### *The Mathematics Education Minor*

This is a teaching minor for students who plan to be certified as secondary teachers not only in their major teaching field but also in mathematics. The precise requirements are specified in the UIM Catalog. From the Mathematical Sciences section of the 2011-2012 Catalog:

For a teaching minor endorsement in the field of mathematics, a student must complete M 171-172, 221, 301, 307, 326, 439 (MATH 152-153, 221, 301, 305, 326, 431), and STAT 341 (MATH 341). Students also must complete C&I 430, gain admission to Teacher Education Programs and meet the requirements for teaching licensure (see the Department of Curriculum and Instruction section of this catalog). All courses counted toward the minor must be passed with a letter grade of C– or better.

(Note that Licensure Requirements stipulate a cumulative GPA of 2.75 in the courses listed above.)

## 4. Course Offerings

### *Planning Ahead*

It is important for undergraduates to understand that many courses are *not* offered every semester and some courses are offered alternate years. Be aware of this when planning your program! Year-long sequences are often available only on a basis of one course per semester throughout the academic year; therefore, you need to enter the sequence in the fall semester. Plan your schedule very carefully so that you do not miss a course you need because it is not offered the semester or year you preferred to take it.

### *Prerequisite Graphs for Math Courses*

Are you wondering which courses you have to take until you are ready for, say, Number Theory? Our two prerequisite graphs can help you. The first, [http://www.umt.edu/math/undergraduate/files/prereq\\_graph\\_2011.pdf](http://www.umt.edu/math/undergraduate/files/prereq_graph_2011.pdf), lists the prerequisites of the mathematics and statistics courses based on Calculus I/II, through the 300-level.

The second, [http://www.umt.edu/math/undergraduate/files/prereq\\_graph\\_math\\_minor\\_2009.pdf](http://www.umt.edu/math/undergraduate/files/prereq_graph_math_minor_2009.pdf), is mostly of interest to students minoring in mathematics; it lists all mathematics and statistics courses based on Applied Calculus.

### *Usual Course Offerings*

Courses Offered both Fall <u>and</u> Spring Semesters	
M 121 (MATH 111)	College Algebra
M 122 (MATH 112)	College Trigonometry
M 151 (MATH 121)	Precalculus
M 162 (MATH 150)	Applied Calculus
M 171 (MATH 152)	Calculus I
M 172 (MATH 153)	Calculus II
M 221 (MATH 221)	Introduction to Linear Algebra
M 273 (MATH 251)	Multivariable Calculus
M 300 (MATH 300)	Undergraduate Math Seminar
M 307 (MATH 305)	Introduction to Abstract Mathematics
STAT 341 (MATH 341)	Introduction to Probability and Statistics

<b>Courses Offered Fall Semester Only</b>	<b>Courses Offered Spring Semester Only</b>
M 181 (MATH 152-80) Honors Calculus I	M 182 (MATH 153-80) Honors Calculus II
—	M 210 Intro to Mathematical Software
M 225 (MATH 225) Intro to Discrete Mathematics	—
—	M 274 (MATH 158) Intro to Differential Equations
M 301 (MATH 301) Math Technology for Teachers	—
M 311 (MATH 311) Ordinary Differential Eqns/Systems	M 412 (MATH 412) Partial Differential Equations
—	M 326 (MATH 326) Number Theory
M 362 (MATH 382) Linear Optimization	M 361 (MATH 381) Discrete Optimization
M 381* (MATH 351) Advanced Calculus I	—
—	M 414* (MATH 414) Deterministic Models
—	M 429 (MATH 406) History of Mathematics
M 431 (MATH 421) Abstract Algebra I	M 432 (MATH 422) Abstract Algebra II
M 439 (MATH 431) Euclidean & Non-Euclidean Geom.	—
—	M 440* (MATH 471) Numerical Analysis
M 445* (MATH 475) Statistical, Dynamical and Computational Modeling	—
M 473* (MATH 451) Intro to Real Analysis	M 472 (MATH 452) Intro to Complex Analysis
M 485 (MATH 485) Graph Theory	—
STAT 421 (MATH 441) Probability Theory	STAT 422 (MATH 442) Mathematical Statistics
STAT 451 (MATH 444) Statistical Methods I	STAT 452 (MATH 445) Statistical Methods II

\*These courses are offered every other year, or intermittently. The semester in which they are taught may be fall or spring, but usually is the semester which is indicated.

## 5. Activities & Facilities of the Math Department

### *Math Club*

The Math Club at The University of Montana is comprised of students who are interested in mathematics. The club meets each Tuesday afternoon at 3 pm (in Math 103) for the undergraduate mathematics seminar. Attending these seminars is a great way to learn about various areas of mathematics, become acquainted with professors, encounter a few things you might not see in your traditional course work, and provide a broader background in mathematics. Every member of the Math Club is also a member of the student chapter of the Mathematical Association of America (MAA); as a member you receive a subscription to the magazine *Math Horizons*.

The Math Club sponsors several events each year—Gambling Day, Pi Day and a film festival. During Gambling Day we play various games of chance, which have included black jack, craps and Texas hold ‘em (with Math Club money!), and learn the mathematics behind them. The math film festival is held each year during Math Awareness Month. Can you guess the date of Pi Day?

The University of Montana Math Club is a combination of the Mathematical Association of America UIM Chapter, the Undergraduate Math Seminar, and the Pi Mu Epsilon Chapter (a mathematics honorary society). Information about Pi Mu Epsilon can be found in Section 6. Undergraduates are strongly encouraged to participate in the meetings whether a member of one of these organizations or not. For more information see <http://www.math.umt.edu/mathclub> or contact the faculty advisor, Professor Gregory St. George (MA 313, 243-4146).

### *Undergraduate Math Seminar (M 300)*

The Undergraduate Math Seminar meets on Tuesday afternoon at 3 pm in Math 103. The seminar is intended for all students who are interested in mathematics. You can register for the Undergraduate Math Seminar (M 300) for 1 credit, or you can simply attend whenever possible.

The weekly seminar series gives student the opportunity to explore various areas of mathematics that might not otherwise be encountered in traditional coursework. The seminars provide students with a broader background in their discipline and acquaint them with a variety of professors, alumni and other professional. The seminar series also includes lectures on careers, culture and popularization of mathematics. Past presenters have included, among many others, representatives of the US Forest Service, the National Council of Teachers of Mathematics, and UM Career Counseling.

### *Mathematics Association of America UM Chapter*

The Mathematical Association of America (MAA) is a national organization of mathematicians. The MAA student chapter program was launched in January 1989 to encourage students to continue study in the mathematical sciences, enable them to meet with other students interested in mathematics, provide an opportunity for students to interact with prominent mathematicians at national meetings and provide information about careers in the mathematical sciences.

Students wishing to become a member of the MAA (in addition to membership in our local student chapter) can complete an application on-line. Student members need not be mathematics majors, nor do they need to have a particular class standing or grade point average. The program seeks to “offer all students interested in exploring mathematics outside of the regular classroom a chance to challenge their intellect and learn more about the role of mathematics in our world.” Every student member of the MAA receives a copy of “Math Horizons” magazine and the MAA’s newsletter, FOCUS. Math Horizons is a magazine written primarily for undergraduate students, with the purpose of introducing students to the world of mathematics outside the classroom. Each issue centering a variety of articles as well as a problem session and book reviews. (See <http://www.maa.org/mathhorizons/> for

more details.) There are three other publications that an MAA member may receive: the *College Mathematics Journal*, *Mathematics Magazine*, and the *American Mathematical Monthly*. In addition to receiving their choice of journals, students will receive discounts on meeting registration fees and other MAA publications, information on graduate study and career opportunities, information about speakers, and opportunities to participate in student paper sessions at section meetings. For more information see <http://www.maa.org/students/>.

## *Undergraduate Study Lounge, Information Board & Lockers*

### **Undergraduate Study Lounge**

The undergraduate study lounge in MA 212 is set aside as a study area for undergraduate students and has many algebra and calculus textbooks one can use for reference. There are tables for group study, as well as comfortable chairs and a couch. This is a great place to meet with fellow students to work on assignments, and to have close accessibility to the computer lab as well as professors' offices during office hours. Students find that the study lounge is a convenient place to study between classes. With group studying, the noise levels can occasionally get loud, but more often it is a quiet study environment.

### **Undergraduate Information Board**

Also available in MA 212 is the undergraduate information board. Information about scholarships, internships, department job openings and general math information is posted on this board. Math magazines, journals and newsletters are displayed here as well. Math majors should check this board periodically.

### **Lockers for Math Majors and Minors**

There are lockers in the basement of the math building for the use of math majors and minors, provided on a "first come, first served" basis. The department provides the lock, and the only fee is a refundable security deposit of \$25. See the math office for more information.

## *Computing Facilities*

The mathematics department operates two PC computer labs, in MA 206 and MA 306. MA 306 is mostly used for teaching classes which require the use of computers. MA 206 is a computer lab which students can use for math-related work. The software currently available includes: Autograph, DPGraph, Fathom, GAP, GAUSS, Geometer's Sketchpad, LINGO, Maple, Mathematica, MATLAB, Microsoft Office, Maxima, R, Scientific Workplace, SciLab, SPSS, TinkerPlots, and WinEDT.

In order to access the lab, an undergraduate must have a special ID card. The card must be presented to the lab monitor upon entering the lab. ID cards are available to students in particular classes or on the recommendation of a professor. A lab schedule is posted each semester.

The Information Technology office operates several computer labs across campus; you can find schedules and locations at <http://www.umt.edu/it/learning/computerlabs.aspx>. Also the Mansfield Library has quite a few computers accessible during their regular hours, see [http://www.lib.umt.edu/hours\\_text](http://www.lib.umt.edu/hours_text).

## *Senior Projects & Watkins Scholarships*

### **Senior Thesis**

The Department of Mathematical Sciences encourages math majors to fulfill the Upper-Division Writing Requirement by writing a senior thesis (M 499). Students who plan to write a senior thesis should select a research topic during their Junior year. The best way to do this is to approach a professor with whom you would like to work and ask for suggestions of possible research topics. A one-credit independent study (Junior Honors Project, M 392) is usually offered in the fall semester to help students explore a research topic and write a senior thesis proposal.

Writing a senior thesis improves students' writing skills as they produce polished mathematical documents that they can share with pride. Revision and resubmission of drafts following the advisor's comments are required. All senior theses are assessed using the Senior Thesis Assessment Rubric included in the Senior Thesis handout posted at <http://www.umt.edu/math/undergraduate/>. For more information, please contact Professor George McRae (MA 310, 243-2502).

### **Watkins Scholarships**

Each year the Davidson Honors College awards up to 16 Watkins Scholarships to fund a senior project. Each recipient receives a stipend of \$2,000. Students with a GPA of 3.4 or higher who will have senior status at the beginning of the next fall semester are eligible to apply. The student must plan on working on a senior project which will be directed by a faculty member in the College of Arts and Sciences. Applications for the scholarships are due on April 10. If you are interested to apply, see Dr. George McRae (MA 310, 243-2502) well in advance of the deadline, preferably during the fall semester. More information about Watkins Scholarships is available from the Davidson Honors College website at <http://www.dhc.umt.edu/scholarships/dhc.cfm>.

## *Modeling Contest, Putnam Exam, Lennes Exam*

### **Modeling Contest**

The Mathematical Contest in Modeling (MCM), an international contest for college undergraduates, is held every February. The MCM is designed to stimulate and improve problem-solving and writing skills in a team setting. The official website <http://www.comap.com/undergraduate/contests/> has previous problems and commentary about solutions. At UM, Dr. George McRae (MA 310, 243-2502) is the advisor in charge of organizing teams for the event. Each department may enter one or two teams of three members each. The MCM starts on a Thursday evening at 8PM EST and continues through the weekend (usually the third weekend in February). Each contest has two problems and each team can choose which one they will work on. Once a problem is chosen and work begins, the team may discuss aspects of the problem only among themselves. The team can use any inanimate source of data or materials: computers, software, references, web sites, books, etc. The solution must be typed in English and submitted electronically before 8PM EST on the subsequent Monday. Top solutions will be recognized as Honorable Mention, Meritorious or Outstanding. The 2006 UM team received an Honorable Mention. All successful participants will receive a certificate. Outstanding teams will receive bronze plaques and their solution papers will be published in a special issue of *The UMAP Journal*. To participate in MCM, you are encouraged to enroll in the Problems and Contests Seminar (M 394, <http://www.math.umt.edu/394/>) offered each semester. This seminar looks at old Modeling Contest problems and uses them for practice.

### **Putnam Competition**

The William Lowell Putnam Mathematical Competition is a competitive examination in collegiate mathematics sponsored by the Mathematical Association of America. This examination is held the first Saturday of December. The competition is open only to regularly enrolled undergraduates in colleges and universities of the United States and Canada who have not yet received a college degree. The official website <http://math.scu.edu/putnam/> has the complete announcement and rules; our local web-page <http://www.math.umt.edu/394/putnam.html> has links to websites with previous problems (and solutions).

The examination consists of two three-hour sessions with a two-hour break for lunch. Each session has six problems, solving two or three is a significant achievement. All work must be done "by hand"; no calculator or computer may be used. All the necessary work to justify an answer and all the necessary steps of a proof must be shown clearly to obtain full credit. Partial credit may be given, but only for significant progress toward a solution.

The five highest ranking individuals are designated Putnam Fellows by the Mathematical Association of America. Prizes will be awarded to each of these individuals and to each of the next twenty highest ranking contestants. A

college or university with at least three registered entrants obtains a team rank through the positions achieved by three designated contestants. (Each contestant, even if designated as a team member, must work independently on the examination problems.) Prizes are awarded to the mathematics departments of the institutions for each of the five winning teams.

If you have any questions about the Putnam Exam or would like to participate, contact Dick Lane (MA 005, 243-5207) or George McRae (MA310, 243-2502). Also, you are encouraged to participate in the Problems and Contests Seminar (M 394, <http://www.math.umt.edu/394/>) offered each term. Old Putnam Exam problems are considered in this seminar and used to practice for the next exam.

### **Lennes Exam**

The N. J. Lennes Exam is a competitive examination given annually by the Department of Mathematical Sciences. The exam is named in honor of Professor Nels Johann Lennes, who was chairman of the department from 1913-1944. N. J. Lennes wrote numerous mathematics textbooks. He built the house that is currently the home of the president of The University of Montana. Zero, one, two, three or more prizes may be awarded at the discretion of the judges. Awards are typically in the \$50-\$200 range. The exam may be taken by any undergraduate student, whether a mathematics major or not. Students who have taken one year of calculus are encouraged to take the exam. The initial endowment for these awards was donated by members of the extended Lennes family.

## *Working for the Mathematics Department*

The math department hires undergraduates for several types of positions. These include grading, tutoring and monitoring the computer labs. Information about each job follows. Inquire in the math office for more information or for applications.

### **Computer Lab Monitor**

There are two computer labs in the math building (MA 206 and MA 306). The math department hires students to monitor the computer lab in MA 206 to make sure the appropriate people are using the lab, and to answer minor questions. Applications are taken at the beginning of each semester if positions are open.

### **Grader**

Graders assist professors in the grading of homework and quizzes. Graders are usually asked to be graders in courses in which they have performed well.

### **Math Tutoring Center Assistants**

Tutors are hired by Emily Haverhals (MA 004E, [emily.haverhals@umontana.edu](mailto:emily.haverhals@umontana.edu)) to staff the two math tutoring centers on campus. Both centers provide free walk-in assistance to students. The Mathematics Learning Center (MLC) is located in the basement of the mathematics building in room MA 011. Students enrolled in Precalculus and Calculus classes are tutored in the MLC. Math@Mansfield is located in the Mansfield Library on the main floor. This location provides tutoring for students in Prealgebra through Probability & Linear Math, as well as Math for Elementary Teachers. Applications are taken for employment at the beginning and end of each semester.

### **Private Tutoring**

If you wish to tutor for any math course, you can put your name, number and hourly charge on a tutor list that is available on the math department website. This tutor list is provided to students seeking a tutor for a math class.

## 6. Scholarships, Honors & Awards

### *Scholarships*

The Department of Mathematical Sciences has a number of scholarships and awards available to undergraduate students. The number and amount of awards vary year to year. For example, in spring 2009, the department awarded 11 scholarships totaling over \$15,000. The undergraduate awards are primarily funded through several endowments: the George and Dorothy Bryan Endowment, the Mac Johnson Family Endowment, and the Joseph Hashisaki Memorial Scholarship Fund.

Applying for the scholarships is easy: it only involves filling out a two-page form (plus a one-page statement for students interested in the Undergraduate Teaching and Tutorial Scholar Program).

For more information, visit <http://www.umt.edu/math/undergraduate/#awards> : There you will find descriptions of the various scholarships, eligibility information, and the application form. Applications are usually announced sometime in February, and are due three weeks later.

### *Travel Support*

Undergraduate math majors may request travel funds from the Department of Mathematical Sciences to attend professional meetings. Requests will be considered by the department's Policy Committee.

1. Applications will be considered twice a year; the deadlines are the second Friday in October and the first Friday in March.
2. Each semester, the levels of the travel allocations will be set by the Policy Committee. They will be higher for students presenting a paper than for students attending a meeting without presenting a paper.
3. The department will pay up to two thirds of the approved and documented travel expenses; the remaining third must be paid by the student or from other sources. The department strongly encourages students to apply for travel funds from other sources.
4. While it is possible to receive funding for more than one trip during an academic year, preference will be given to applicants requesting funding for the first trip.

The application form is posted at <http://www.umt.edu/math/undergraduate/#awards>.

**Travel support from other sources:** The Provost's Office provides travel support through its Student Programs (<http://www.umt.edu/provost/students/default.aspx>); application deadlines are the 5<sup>th</sup> of each month during the academic year. If you want to attend an undergraduate research conference or a national meeting of the Mathematical Association of America or of Pi My Epsilon, travel support is often available from the organizers, in particular for students giving presentations.

### *Pi Mu Epsilon*

*(A National Mathematics Honor Society)*

Pi Mu Epsilon is an honor society whose purpose is the promotion and recognition of scholarly activity in the mathematical sciences among students at the academic institutions that have been chartered as chapters of the society. Pi Mu Epsilon accomplishes its goals by promoting and recognizing scholarly activity among students through active, vibrant chapters that:

- 1) Elect members on an honorary basis according to their proficiency in mathematics;
- 2) Engage in activities designed to promote the mathematical and scholarly development of its members; and
- 3) Take other measures designed to further the purposes of the society.

The University of Montana chapter of Pi Mu Epsilon (Montana Alpha) was established in 1925 and was the 9th chapter ever to be established. Montana Alpha was the first chapter in Montana and also the first chapter established in the West! Members of Pi Mu Epsilon are entitled to wear the purple and gold honor cords at graduation.

A person meeting any *one* of the following four sets of qualifications may be elected to membership by a chapter. This election shall be irrespective of sex, religion, race, or national origin:

- 1) Undergraduate students who have completed at least the equivalent of two semesters of calculus and two additional courses in mathematics, at or above the calculus level, all of which lead to the fulfillment of the requirements for a major in the mathematical sciences. In addition, such students must have maintained a grade point average equivalent to that of at least 3.0 on a 4 point scale, both for all courses that lead to fulfillment of requirements for a major in the mathematical sciences, and also for all courses that lead to fulfillment of requirements for an undergraduate degree.
- 2) Graduate students whose mathematical work is at least equivalent to that required of qualified undergraduates, and who have maintained at least a B average in mathematics during their last school year prior to their election.
- 3) Members of the faculty in mathematics or related subjects.
- 4) Any persons who have achieved distinction in a mathematical science.

Qualified students of the University of Montana are sent an invitation to join in spring semester of every year and are inducted during the Department's Awards Ceremony in April. For more information see <http://www.pme-math.org>, or contact Professor Gregory St. George (MA 313, 243-4146).

## 7. Internships, Research Experiences, Conferences, and more

### *Internships*

Often employers desire their employees to have prior work experience. An excellent way to get work experience is through internships. Internships also give students the opportunity to learn more about a particular field, job, or area. Internship Services (Lommasson Center 154, 243-2815) can help you find an internship, whether the internship is for the summer or school year. It is often possible to find internships both locally and out of the area. See <http://www.umt.edu/internships/> for more information. You can also visit a website of the American Mathematical Society, which has many links to internship opportunities for undergraduates: visit both <http://www.ams.org/employment/undergrad.html> and <http://www.ams.org/employment/internships.html>.

### *MILES Fellowships*

The Montana Integrative Learning Experience for Students (MILES) Program is a Howard Hughes Medical Institute (HHMI)-funded undergraduate research program in the computational and biological sciences. The mission of MILES is to link faculty and students from diverse backgrounds in an effort to provide undergraduates with an innovative and preferably interdisciplinary research experience. MILES provides such opportunities for students to conduct original research through honors fellowships and seed grants. Fellowships are awarded for one year and carry a stipend of \$8,000 for research conducted during the fall, spring, and summer semesters. Fellowships are awarded through a competitive review process where students are required to submit a research proposal which includes a summary, background, research objectives and hypotheses, significance of the research, a summary of any previous work, research methods, integration of computational and biological sciences, a timeline, budget, transcript, and letters of support.

As part of this fellowship, students are required to take a 2-credit Fundamentals of Scientific Research course during both the fall and spring semesters, and present their research at The University of Montana Conference on Undergraduate Research (UMCUR), the Office of Research and Educational Opportunities for Students (OREOS) Undergraduate Research Symposium, or a professional research conference. The research course provides a formalized approach to learning how to conduct interdisciplinary research and assists students in the development of their research plans. In summary, the MILES program provides an excellent opportunity and funding resource for undergraduate math majors, especially those with interests in the natural sciences, to embark on a research project with a faculty member. If you are interested in learning more about this opportunity or have questions about the program, feel free to contact Professor Jon Graham (Math 204, 243-2561) or visit the MILES website at <http://miles.dbs.umt.edu/index.php>.

### *Research Experiences for Undergraduates (REU)*

The National Science Foundation funds a large number of research opportunities for undergraduate students through its REU Sites program. An REU Site consists of a group of ten or so undergraduates who work in the research programs of the host institution. Each student is associated with a specific research project, where he/she works closely with the faculty and other researchers. Students are granted stipends and, in many cases, assistance with housing and travel. Undergraduate students supported with NSF funds must be citizens or permanent residents of the United States or its possessions. An REU Site may be at either a US or foreign location.

By using the web page [http://www.nsf.gov/crssprgm/reu/reu\\_search.cfm](http://www.nsf.gov/crssprgm/reu/reu_search.cfm), you can find the REU sites in the Mathematical Sciences. The American Mathematical Society also has a list at <http://www.ams.org/employment/reu.html>.

If you are interested in participating in an REU, discuss this as soon as possible with a faculty member.

(Part of this information was taken from the NSF web site in May 2011; for current information, visit <http://www.nsf.gov/crssprgm/reu/>.)

### *Conferences for Undergraduate Math Majors*

The American Mathematical Society provides links to conferences specifically for undergraduate math majors, for example, the Nebraska Conference for Undergraduate Women in Mathematics. Visit

<http://www.ams.org/employment/undergrad.html>.

### *Semester Programs at Other Universities*

The American Mathematical Society provides links to semester programs, for example, the famous “Math in Moscow” and “Budapest Semesters in Mathematics”. There are also some programs in the United States. Visit

<http://www.ams.org/employment/undergrad.html>.

# 8. Career Planning

## *Web Resources*

There are many excellent web sites with career information for students majoring in the mathematical sciences:

- ❖ **Sloan Career Cornerstone Center:**  
<http://www.careercornerstone.org/mathematics/mathematics.htm>
- ❖ **Mathematical Association of America:**  
<http://www.maa.org/careers/> (see also <http://www.maa.org/students/>)
- ❖ **American Statistical Association:**  
<http://www.amstat.org/careers/>
- ❖ **“Be a Math Teacher”** (National Council of Teachers of Mathematics):  
<http://www.nctm.org/resources/content.aspx?id=530>
- ❖ **“Be an Actuary”:**  
<http://beanactuary.org/college/>
- ❖ **Careers in Applied Mathematics** (Society for Industrial and Applied Mathematics):  
<http://www.siam.org/careers/thinking.php>
- ❖ **Case Studies – Math in Industry:**  
[http://www.hsor.org/case\\_studies.cfm](http://www.hsor.org/case_studies.cfm)
- ❖ **American Mathematical Society:**  
<http://www.ams.org/employment/undergrad.html>  
(links on sites with career info (see Careers), links for students considering graduate school, links to sites with Job and Internship info.)
- ❖ **Early Career Profiles:**  
<http://www.ams.org/profession/career-info/early-careers/early-careers>
- ❖ **Women in Math** (a brochure from 1991):  
<http://www.awm-math.org/ctcbrochure/toc.html>
- ❖ **“Is Graduate School for You?”:**  
<http://www.maa.org/students/gradschool.pdf>
- ❖ **“Preparing for Graduate School in Mathematics”** (Saint Louis University):  
<http://mathcs.slu.edu/undergrad-math/preparing-for-graduate-school-in-mathematics>  
(aimed at students at SLU, but also gives good, general advice.)
- ❖ **National Security Agency:**  
[http://www.nsa.gov/careers/career\\_fields/mathematics.shtml](http://www.nsa.gov/careers/career_fields/mathematics.shtml)  
(The NSA is the largest employer of mathematicians in the United States.)

## *Actuarial Science*

Mathematicians apply their skills in many fields, one of which is actuarial science. Actuaries work for insurance companies or government agencies assessing risks and solving financial problems. An actuary's job may include placing a price on a company about to merge with another business, estimating the impact of seat belt laws in automobile losses and determining appropriate rate discounts, determining why malpractice insurance costs for doctors are skyrocketing, collecting and investing enough money so that an insurance company can pay claims, estimating the cost of a major earthquake, determining premium rates for different insurance risks and much more. Actuaries are hired by insurance companies, consulting firms and many big businesses. Mathematics majors, especially those with a statistics emphasis, are good candidates to excel as actuaries. To become an actuary, there are a series of examinations to take administered by the Society of Actuaries and the Casualty Actuarial Society. You can find out details about the exams by visiting <http://www.beanactuary.com/exams/> and <http://www.casact.org/admissions/syllabus/>.

For more information on careers in actuarial science or the actuary exams, contact Dr. David Patterson (MA 208, 243-6748).

## *Teaching*

Many mathematics graduates choose to pursue a career as a secondary teacher. As mathematics literacy is becoming increasingly important in the work force, so too is the need for capable mathematics teachers. There is a national shortage of mathematics teachers. Teachers today are responsible for helping students understand mathematics as a tool for understanding the world.

Educators are discovering that advances in technology are bringing about a challenging and exciting era. There have recently been two large NSF-sponsored educational grants at The University of Montana, the Six Through Eight Mathematics (STEM) project and the Systemic Initiative for Montana Mathematics and Science (SIMMS) project. The goal of these projects was to analyze and reform middle school and secondary mathematics curricula in order to increase students' ability to explore, conjecture, and reason logically.

Besides the usual teaching jobs, there are also a variety of opportunities to teach mathematics in a nontraditional setting. For example, the Peace Corps provides opportunities for mathematics majors to share their skills and energies with people in developing countries. Often volunteers teach mathematics, an option in which a teaching certificate is not required. Most former Peace Corps volunteers have valued the opportunity to put their skills to work. To obtain more information about the Peace Corps, visit its web site: <http://www.peacecorps.gov/>

## *Business, Industry & Government*

There are numerous opportunities in business, industry and government for mathematics majors. Many math majors will find employment in one of these areas. The "List of Job Titles of UM Math Alumni," in Section 2 of this guide, lists jobs held by some UM math graduates. The wide range of occupations listed should convince you of the value and versatility of mathematical training. Often employers find mathematics majors bright and flexible and hire them for positions that may involve considerable training on the job, even though the position requires very little formal education in mathematics. These employers hire math majors because of their general background in problem solving and incisive reasoning abilities rather than mathematical knowledge.

The following information highlights a few fields in business, industry and government that employ math majors:

- ❖ Operations research analysts are often employed by manufacturing plants, airline industries, and the military to help coordinate and operate the running of these organizations in the most efficient manner.
- ❖ Statisticians are employed by business, industry and government in a wide variety of areas. They use statistical techniques to analyze data from scientific experiments, to conduct surveys, and to develop quality control tests in developing a new product.
- ❖ Applied mathematicians solve practical problems in business, government, engineering and the sciences

using mathematical modeling and computational techniques.

- ❖ The National Security Agency hires mathematicians to be cryptologists. This job involves the development and analysis of coding schemes for the transmission of classified material.

The web sites listed at the beginning of this chapter have a great deal more information about employment in business, industry and government. Many mathematicians find interesting and very satisfying careers in these work arenas.

## *Graduate Schools & the Graduate Record Exams*

### **Graduate Schools**

There are several math-related disciplines that you can study at the graduate level after obtaining an undergraduate degree in mathematics. Students who earn a graduate degree of some form generally enter careers that pay higher salaries.

Mathematics is used extensively in fields such as computer science, economics, engineering and even law or medicine. Many jobs in mathematics are now requiring degrees beyond a B.A. Students planning to go to graduate school should consult early on with their advisors and with faculty in their fields of interest. Topics to discuss include which courses to take, and which schools to apply to. If you want to go to graduate school in the mathematical sciences, you should take as many upper-division mathematics and statistics courses as you can; just fulfilling the minimum requirements for a math major will not get you into a good graduate program.

Graduate education can often be financed with a teaching or research assistantship or a fellowship. A good source of information about graduate programs in the mathematical sciences at individual schools is the publication, *Assistantships and Graduate Fellowships in the Mathematical Sciences*, published annually (in December) by the American Mathematical Society. You can download it: <http://www.ams.org/employment/asst.pdf> (but beware, the 2009 edition was a 20 MB file). The publication contains data about faculty, enrollment, facilities, as well as information about fellowships and teaching assistantships and programs of study available at universities that offer graduate degrees in the mathematical sciences.

Degrees earned in graduate school are usually Master of Arts, Master of Science, Master of Teaching, and Doctor of Philosophy. A master's degree will take anywhere from two to three years to complete, while a Ph.D. could take five to seven years.

Information on graduate schools can be obtained from a variety of sources. Since UM has a subscription, you can access **Petersen's "Testing and Education Reference Center"** for free from the Mansfield Library's web site (this might only work from campus). Go to <http://www.lib.umt.edu/>, select the tab "Search Everything", click on "Database A-Z List", and find "Testing & Education Reference Center". Once you are there, click on "Graduate school search" and follow the links. (When you look at the information for a particular graduate program, click on "Print" to get a display with all available information.)

The bulletin board in the hallway on the second floor of the mathematics building has information on graduate schools as well.

Note:

- ❖ Application deadlines start as early as December or January.
- ❖ Applications to graduate schools often require the following:
  - Completed application form
  - Official transcript(s)
  - Three letters of recommendation
  - Scores for the Graduate Record Examination (GRE described later)
  - Non-refundable application fee (usually \$50-75)
  - Bachelor's degree completed by the time of enrollment

## Graduate Record Exam

Before being admitted into graduate school, you will usually have to take the Graduate Record Examination (GRE); see <http://www.gre.org/>. This exam is similar to the SAT or ACT taken for admission into college. There are two types of GRE tests, general and subject. The general test is taken by students in any major who plan to go to graduate school. The subject test is specific to your major or particular subject. For example, there is a subject test in mathematics. Most universities will require your general GRE scores for admission to their graduate program. Many schools also require a subject test. It is suggested that this test be taken during the fall of your senior year while the material is still fresh in your mind. While the general test is offered throughout the year, the subject test is offered only a few times each year, so plan ahead. For example, during 2010-2011, the GRE subject tests were offered in October, November and April.

In preparation for the GRE, you should at least take a sample test or two, available at <http://www.gre.org/>. There you can also find other free test preparation materials. In addition, it might help to work through a study guide (available, for example, from the UM BookstoreO.

You can take the GRE tests at UM's Testing Center in Lommasson Center 154; see <http://life.umt.edu/testing/name/GRE>.

## *Career Services*

The Office of Career Services at The University of Montana is an educational based program that provides a full array of services to assist students, as well as alumni, with any and all aspects related to career and academic decision making, career development, job search preparation and employment.

The range of services for students and alumni include: career counseling; personality and career/interest assessments; assistance with choosing a college major; administering the UM student employment program; career workshops and classroom presentations; Ask-an-Alum career networking program; various annual career/job fairs; career information resource library and computer lab; mock interviews; resume, cover letter and job application consultation; professional credential files and the online Griz eRecruiting career management system for accessing and applying for jobs, posting resumes online, and on-campus interviewing.

Career Services also administers the University Testing Services operation. Testing Services offers computer-based national standardized tests for both the campus and local/regional communities in various areas including: personality and career assessments, college and graduate school admissions tests, academic proctoring, professional certification and licensing examinations, including information technology based certifications.

Career Services is located in Lommasson Center 154 (243-2022). For more information, visit <http://life.umt.edu/career/>.

# Appendix

## Mathematical Organizations & Related Agencies

1. American Mathematical Society (AMS)  
<http://www.ams.org/>  
<http://www.ams.org/employment/undergrad.html>
2. American Statistical Association (ASA)  
<http://www.amstat.org/>
3. Association for Women in Mathematics (AWM)  
<http://www.awm-math.org/>
4. Conference Board of the Mathematical Sciences (CBMS)  
<http://www.cbmsweb.org/>
5. The Institute for Operations Research and the Management Sciences (INFORMS)  
<http://www.informs.org/>
6. Mathematical Association of America (MAA)  
<http://www.maa.org/>  
<http://www.maa.org/students/>
7. National Association of Mathematicians (NAM)  
<http://www.nam-math.org/>
8. National Council of Teachers of Mathematics (NCTM)  
<http://www.nctm.org/>
9. National Science Foundation (NSF)  
<http://www.nsf.gov/>  
<http://www.nsf.gov/crssprgm/reu/>
10. Peace Corps  
<http://www.peacecorps.gov/>
11. Pi Mu Epsilon (National Mathematics Honorary Society)  
<http://www.pme-math.org/>
12. Rocky Mountain Mathematics Consortium (RMMC)  
<http://rmmc.asu.edu/>
13. Society for Industrial and Applied Mathematics (SIAM)  
<http://www.siam.org/>  
<http://www.siam.org/students/>
14. Society of Actuaries (SOA)  
<http://www.soa.org/>