

# Guide to Undergraduate Mathematics at Oregon

## A Handbook for students

August, 2003

Most students get information about the department from fellow students, professors, peer advisors and their academic advisors. The point of this booklet is to supplement these sources, not to substitute for them. In particular, a student should take full advantage of opportunities for contact with his or her advisor. The Mathematics Department has an undergraduate affairs committee whose duties include advising all undergraduate majors. Students are assigned to advisors by the head advisor, currently Professor Sadofsky, either during introDUCktion, or at the fall meeting for new majors held during registration week, or at a later time by appointment with Professor Sadofsky in Deady 108A.

The department has a special advisor for majors going into secondary education. Currently this is Professor Libeskind.

### **1 Career Preparation - The employment outlook**

Mathematicians are employed as mathematicians primarily in the areas of teaching, government and industry. Industries employ mathematicians doing statistical and actuarial work (for example the financial and insurance industry, and healthcare), in accounting, computer software, and in engineering-related industries, like aerospace. Many mathematicians plan to enter other professions upon graduation, and many attend graduate or professional school in other areas (for example law, medicine, economics or physics). Much more detailed information about career options can be found at the websites of the mathematics professional societies (the American Mathematical Society, the Mathematics Association of America, and the Society for Industrial and Applied Mathematics).

Preparation for a career in teaching depends upon the level to be taught. In Oregon, a high school teacher is currently expected to have a bachelor's degree in the subject they wish to teach, and a master's degree in something (typically education). For community college or junior college, a master's degree in mathematics is generally required, and for 4-year colleges or universities a Ph.D. is required.

There are a challenging set of hurdles for students wishing to do actuarial work (employed by insurance companies, pension plans, HMOs, etc., actuaries use probability and statistics to predict the rates which need to be charged to keep these programs sufficiently funded). A large part of the training is done on the job after the candidate attains a bachelor's degree, but mastery of single and multiple variable calculus and statistics is helpful. At present the field is uncrowded and represents an excellent chance for a mathematician to get into management.

Many other industries count on training their employees themselves. They are looking for someone with mathematical ability who is trained in thinking analytically. The best way to prepare for such jobs is to discuss your career goals with your advisor and work out a program heavy in applied mathematics or statistics. In addition, some knowledge of computer science will be an asset in almost

any job a mathematician is likely to have. Students are encouraged to consult with a counselor at the university's Career Center (220 Hendricks Hall).

Students should be aware that the employment prospects for mathematicians at the Ph.D. level are somewhat limited. Accordingly, students should seek a broad training in mathematics, so they will have the flexibility to find job opportunities and fit into them.

## 2 Undergraduate course offerings and the math major

People have studied mathematics at least since the dawn of recorded history. Because mathematical study develops habits of disciplined and logical thought, it has always been considered an important part any educated person's background. Even if mathematics had no applications of consequence, it would be viewed as one of the core disciplines of the university, bridging the gulf between humanities and sciences and sharing some of the best features of both.

As it happens, mathematics has important applications to both the physical and the social sciences. The Mathematics Department has the dual function of teaching mathematics as an intellectual discipline and for purposes of application.

The account below gives an overall picture of the department's undergraduate offerings with some description of the sorts of courses likely to be appropriate for various career goals. A student may graduate in mathematics following a standard program or one with emphasis in graduate preparation, statistics, computer science, physical science, precollege teaching, social science of business, or actuarial science. The requirements appear in the University of Oregon Catalog.

### Course Requirements

Calculus is a core area of mathematics, and is a prerequisite for many courses required by the major. The major can be thought of as requiring a year of calculus at the outset (material prior to calculus must be made up first if it was not taken before entering the university). There are several calculus options open to potential math majors. Our standard sequence is Math 251-253 which emphasizes mathematical and physical applications of calculus. Math 246-247-253 emphasizes applications in the life sciences and is equivalent to 251-253 for purposes of math majors. Our honors calculus sequence (Math 261-263) covers the same material as 251-253 and in addition covers the theoretical grounding of calculus (*why* things work the way they do rather than just *how* things work). Because of this, students who take Math 261-263 are exempt from the requirement for Math 315. (Note that Math 241-243 is our calculus for business majors and is not appropriate for potential mathematics majors).

Math 231-233 is another sequence of courses covering topics outside of calculus at a serious but elementary level. This sequence covers *discrete* mathematics where calculus is concerned with *continuous* mathematics. Math 231-233 is essential for students with a major in computer science (or mathematics and computer science). Although not required for the math major, it is a valuable course for any student to take.

Most mathematics majors will take courses in differential equations and vector calculus in the year after taking calculus. Typically this will be Math 256 and Math 281-282. Most majors will also take two terms of linear algebra (Math 341-342), which is a non-calculus based course in multivariable mathematics, and all majors must take Math 315 (Introduction to Analysis, which covers the proofs omitted from Math 251 and 253) unless they have taken Math 261-263. This group of six courses is typically taken more or less during the year following calculus.

After this, there are few standard courses taken by all students. Students not in the secondary education option often build their program around a selection of 400-level course. These include year long sequence of graduate preparation courses in algebra, analysis and topology/geometry,

applied courses in numerical analysis and differential equations, courses in statistics, combinatorics, dynamical systems and complex analysis. The specific courses chosen depend on the specialization and interests of the student.

Majors in the secondary education program will take a different set of courses. These majors should take (after a year of calculus) Math 315, Math 341, number theory (Math 346), abstract algebra (Math 391-393), advanced geometry (Math 394-395), introduction to statistics (Math 461) and CIS 122, or a comparable computer programming course to be approved by an advisor.

## Families of Courses

We make an attempt here to divide the courses in our undergraduate curriculum roughly into classical mathematical areas. Any such division is subjective, furthermore because most areas of mathematics have interesting and deep relationships with many other areas of mathematics, this attempt at such a division may be sometimes misleading. But these general terms are often used, and it is useful to understand how mathematicians use them.

### Analysis

The branch of mathematics dealing with calculus and its generalizations is called analysis. Courses in this area include advanced calculus, Introduction to Analysis, Functions of a Complex variable, Differential Equations, Fourier series, and Numerical Analysis.

Someone interested in a career in technology, applied mathematics, physics or economics will generally include plenty of analysis or applied analysis in his or her degree program, as well as numerical analysis (including approximate solution techniques and error analysis) and computer science.

### Algebra

Most of mathematics which does not involve limits or continuity in some way can be generally thought of as belonging to the area of algebra. Our courses in this area include Math 341, Math 342 and Math 441 in *linear* algebra; two sequences of abstract algebra (Math 391-393 and Math 444-446); and number theory (Math 346).

### Statistics

Besides Math 243 and Math 425-426 (which are aimed at mathematically unsophisticated students and thus unsuitable for majors), the department offers Math 461-463 on regression and analysis of variance, and Math 464-466 on mathematical statistics.

### Topology, Geometry and others

The department offers two terms of topology Math 431-432 and term of differential geometry (Math 433) as well as two terms of more classical geometry (Math 394 and 395). There are also courses in combinatorics, mathematical modeling, dynamical systems (including some chaos theory) and occasional special courses.

Students planning on graduate work are encourage to take courses in several fields to get some feeling for the breadth of mathematics.

## Courses outside the major

Language courses (French, German and Russian are the classical languages of mathematics besides English, and many Ph.D. programs require some fluency in some of these languages) and a thorough grounding in English composition have always been valuable to mathematicians. A concentration in pedagogy or one of the sciences has also been useful when beginning a career. A strong background in economics, business or finance is valuable, as is a background in computers science, although the situation is constantly changing. Students should have the goal of being able to relate mathematics to something outside of mathematics.

## General education requirements

Besides satisfying the departmental requirements in the major as summarized above (and discussed in detail in the Mathematics section of the *catalog*), students must satisfy the university's general education requirements. These requirements are discussed in detail in the *catalog* and in the university's *Student Handbook*.

- The *group requirements* are 16 credits in each of three areas (Arts and Letters; Social Sciences; and Science). Not all courses in these areas satisfy these requirements and the list of courses which do is in the *Student Handbook*. There are additional restrictions which are detailed in the *catalog* and student handbook. This provides an opportunity to concentrate on a field that is related to mathematics, and also provides an opportunity to learn about areas completely unrelated. The chance to study humanities, the arts and social science should not be passed up, as a student may never have the opportunity for formal study of these subjects after leaving college.
- The *multicultural requirement* is a requirement for one course in each of two out of three categories (American Cultures; Identity, Pluralism, and Tolerance; International Cultures). Again, the courses which satisfy this requirement are listed in the *Student Handbook*.
- The *writing requirement*, WR 121 and either WR 122 or WR 123.
- The *mathematics* requirement for the BS will be filled automatically by any math major, and if a student wishes to get a BA instead, there is a foreign language requirement.

Besides these there are various credit requirements for graduation. Transfer students need to be aware of the requirement for at least 62 credits of upper-division work (courses at the 300-level and above), and similarly, students who are attempting to finish their degrees while non-resident need to be aware of the requirement that at least 45 credits of work *after* the first 120 credits be done in residence at the university.

## 3 Other resources

### Hilbert Space

The department has a center for undergraduate mathematics majors in Deady 107-108. The center contains couches, tables, chairs, computers and blackboards (of course!). There is also information on employment opportunities, graduate school and other topics.

This also functions as the peer advising center, and students can go there to get information from other students about the major, classes, and instructors. It can be a good place to sit down and study for an hour between classes in Deady Hall, and a good place to meet students with whom you share classes and discuss lectures and assignments.

## Math Library

The university's main collection of math books and journals is in the math library. The entrance is the reading room at 210 Fenton Hall. During term, the library is open 8-6 M-F, and 1-4 on Sundays.

Most of the books and journals are in the stacks behind the reading room, and there is some (quiet) space to work in the stacks. Browsing through the stacks is a good way to get some idea of the breadth of mathematics beyond what is covered in your course work.

## Mathematical Association of America

Mathematics majors are encouraged to join the Student Chapter of the Mathematical Association of America. The MAA is a national professional society whose major concern is with mathematics at the college level. Its journals, the *American Mathematics Monthly*, *Mathematics Magazine*, the *College Mathematics Journal* and *Math Horizons* contain articles of particular interest to teachers and students, and often challenging problem sections!

Browsing these journals is a good way for students to see some of the breadth of mathematics as well as the power of the mathematics a student has already learned.

A student membership in the MAA currently is only \$20 per year, and includes a subscription to *Math Horizons* and to the MAA's newsletter. The other MAA journals cost \$10 additional each per year for student members.

## Honors Degrees

Students wishing to graduate with "honors in mathematics" are required to complete two theoretical sequences in mathematics (usually chosen from Math 413-415, Math 431-433, Math 444-446 and Math 464-466) with an average grade of "B" or higher and to write a thesis indicating mastery of an advanced topic studied independently.

Any student wishing to do this should notify the head mathematics advisor and seek out an advisor to supervise their independent project by the beginning of the first term of their senior year.

A degree with honors indicates ability to do extra work independently and to communicate mathematics in clear English, so it can be helpful in obtaining a good job or graduate fellowship.

## Prizes

The department has a number of prizes which it awards to undergraduates at graduation. They are detailed in the Mathematics section of the *catalog*. The most distinguished is the De Cou prize, awarded annually to the outstanding graduating senior with a mathematics major. This was established by friends and family of Edgar E. De Cou who was the first chairman of the math department and a professor of mathematics here from 1902-1944.

## Putnam Exam

The Putnam Examination is a nationally administered college mathematics exam, given each year in December. Schools which participate often enter a team of three persons, but it is not necessary to be a member of such a team to take the exam.

The exam consists of two 3-hour sessions. The problems are extremely challenging - the median score for the (120 point) exam is often 0 or 1, and this is an exam only taken by students who are

good at and interested in mathematics. There are prizes awarded to the top finishes nationally, but any decent score at all is something to be pleased about.

In the fall, the department usually runs a seminar aimed at preparing for the Putnam Exam. This typically meets once a week and involves practicing by solving old Putnam Exam problems and related questions.

## Grading jobs

The Mathematics Department hires undergraduate students to grade homework for lower-level mathematics courses. To qualify for such a job, students need sufficient time, at least one year's experience in college mathematics, and a decent G.P.A. Information about this can be obtained in the department office: 218 Fenton Hall.

## Undergraduate teaching assistants

There are a few courses for which the department employs undergraduate teaching assistants after applicants demonstrate satisfactory performance in a training seminar. See Cathie Trigueiro (Deady 108) about these positions.

## Peer Advising

Students may consult an experienced undergraduate prior to (or in addition to) meeting with their faculty advisor. Peer Advisors can be found in Hilbert Space (Deady 107-108). Students who have been peer advisors have usually found the experience interesting and enjoyable. College credit is available if desired. Juniors and advanced sophomores interested in being peer advisors should consult Cathie Trigueiro in Deady 108.

## 4 Additional informaton

To find out more about the department, a student can go to the Mathematics Department Office (218 Fenton) where someone will either be able to answer their question or refer them to someone else who can.

Other source of information mentioned in this guide:

- The University of Oregon Catalog
- The Student Handbook for the University of Oregon (you should have received one of these at your initial introduction to the university)

Useful websites:

- <http://www.ams.org/> The American Mathematical Society
- <http://www.maa.org/> The Mathematical Association of America
- <http://www.siam.org/> The Society for Industrial and Applied Mathematics
- <http://www.tscp.state.or.us/> The Teacher Standards and Practices Commission
- <http://uocareer.uoregon.edu/> The University of Oregon Career Center
- <http://www.beanactuary.com/> Career advice from the Society of Actuaries
- <http://www.ams.org/careers-ed> The AMS page on careers in mathematics and further education.