

# Graduate Schools and Fellowships in Mathematics

## (2007-2008)

### Choosing the Right Grad School

Your choice of a graduate school is a major step in your career as a mathematician. Below are some criteria you may consider for choosing the right school for you. Not all the criteria apply to everybody. We strongly urge you to seek advice from several faculty members familiar with you and/or your field of interest early in the fall semester of your senior year to try to sort out what may be the best “fit” between you and a graduate school.

### Thesis Advisor

A thesis (dissertation) advisor plays a **very** important role in the student’s graduate education. After all, a dissertation generally consists of making a new advance, solving an unsolved problem. And since the problem is not yet solved, the advisor, presumably, has no solution for it either. Therefore it takes a good mathematician, with sound intuition and deep insights to help his/her advisee choose a problem that will, on the one hand, not wind up being so hard that a student can’t solve it or parts of it, nor, on the other hand, so easy that a student wouldn’t get to learn a lot of beautiful mathematics on his/her way to solving the problem.

Most math departments do not have the resources to excel in all branches of mathematics. You should ascertain that a university you are planning to apply to has top-quality tenured faculty members pursuing research in your potential field of specialization. But you don’t necessarily have to go to a leading grad school to get a good advisor. There are a number of mathematics departments in this country which may not be at the top of the pack overall, but which have one or more top-quality mathematicians who can be excellent thesis advisors. Your academic advisor at Harvard can help you sort out which departments are strong in which areas.

### Breadth and Depth

As important as it is to choose a school with strong reputation in your field of interest, it is also important to balance this criterion with considerations about the overall breadth of the department. It is common for one’s interests to change as learning progresses, and you want to leave yourself the freedom to switch fields or advisors without leaving your chosen graduate department.

### The Strength of Your Peers

The quality of other graduate students in the program is also very important. During the first few years of graduate study you will learn much from other graduate students, so it is very helpful to have talented peers.

On the other hand, going to the most competitive school may not be the best decision for everybody. You can sometimes get more time and attention from faculty if you are

at the top of a weaker pack, rather than near the bottom of a stronger one. Again, your academic advisor can help you decide what would be best balance in your case.

### **The Student-to-Faculty Ratio**

An equally important factor is the student-to-faculty ratio. In some universities, it is not uncommon to have 10 to 15 grad students working under one advisor. Obviously under these conditions, some students won't get the attention they require.

### **Visiting the Schools**

When making a final decision on graduate schools, **visit** all your serious choices. Talk to faculty members about their research interests and the number of dissertations they are advising. Ask where their former students are employed.

A good source of information are the graduate students currently enrolled in the program. Talk to them about accessibility and reputation of potential advisors in your field of interest. Find out what is the average number of years students take to complete their dissertation, and (very important) what is the dropout ratio. Look into the housing options (very rarely do grad students live in the dormitories for more than a year, if at all) and the teaching load of teaching assistants. Try to decide if you will be comfortable spending some number of years at that university or in that town.

### **Getting Advice**

Finally, you should talk to your academic advisor, the Director of Undergraduate Studies, and other faculty you know well. They can evaluate your choices, give you the latest information about the departments you are considering, and help you decide what is best for you.

### **Applying to Harvard**

The Harvard Math Department encourages its own undergraduates to go elsewhere for graduate study because it is a good idea for a student to get to know other mathematicians, to be exposed to alternative tastes and styles of doing mathematics.

### **The Admissions Process**

#### **Recommendations**

An important criterion used by many admissions committees is the content of faculty recommendations. Graduate schools look closely at evidence not only of mathematical ability, but of motivation and tenacity. In contrast to college admissions, extracurricular activities and non-academic character traits are not given much weight. Usually two or three recommendations are required, and you should be making the effort throughout your undergraduate career to let a few faculty members know you well (e.g., by dropping by their office hours, inviting them to the semi-annual faculty dinners held at your House).

If you are writing a thesis, you might ask your thesis advisor for a letter of recommendation. Working on your thesis during the summer and fall of your senior year with your thesis advisor provides an opportunity for him or her to get to know you better.

If you took a course from a professor and did relatively well, you may want to ask him or her to write a letter of recommendation right away. He or she may not remember all the details of your performance a year or two later. The recommendation can later be fine tuned to address specific graduate schools or fellowships. If you are thinking of taking some time off after college and applying later, you may still want to get your recommendations written while you are in school. Remember that faculty members often take sabbaticals, change universities, etc. Ask your recommenders to send copies of your recommendations to your undergraduate house to be included in your personal folder; they may be useful later on. To place a copy of your recommendation in your undergraduate house file you need to obtain a form from your House's Senior Tutor. Harvard will keep these files indefinitely, and will mail the letters you want to graduate schools or employers at your request.

## **Essays**

You will be required to write one or two application essays. Typically you will need to describe your academic background, your achievements to date, what experiences led you to want to get a Ph.D. in math, and what areas of research interest you most. Those essays give you an opportunity to explain away some bad grades you may have had, to demonstrate your new-found love of math and resolve to succeed, and convince the admissions committee that you not only have the requisite intellect, but that you are going to persevere through some tough moments in your career and finish your dissertation. They want to make sure that you aren't going to grad school just because you could think of nothing better to do, or because you missed the LSAT deadline. You don't have to feel that you should know your dissertation topic by your senior year in college. You should merely demonstrate that you really are interested in mathematics and are relatively focused and determined.

## **Grades and Test Scores**

Besides recommendations and essays, other criteria for admissions include grades and scores on the Graduate Record Examination (GRE). Most selective math departments do not put too much weight on the differences between good and great scores, but having poor grades in math courses or poor GRE scores can hurt your chances of admissions. Many schools look at your transcript to see evidence of substantial exposure to serious mathematics (e.g. some graduate level courses) and are quite understanding about some poor grades.

## **Taking the GRE**

Most universities require applicants to take two parts of the GRE — the general and the subject tests. The general part is similar to the SAT. The questions on the subject test in Mathematics may be quite different from the math most students learn at Harvard, and you are well advised to look over the material tested ahead of time. Even if many of the problems may seem easy, you have less than a minute per question, and if you have

to derive everything, you won't finish the test.

GRE, at least in the usual "paper and pen" format, is offered only 3 times a year: in October, December and April. Although you *can* take both the general and the subject part on the same day, most students prefer not to. Therefore many take at least the general part of the GRE during their junior year. In any case, it's a good idea to get the GRE out of the way soon. When you start working on your thesis and filling out applications for grad schools and fellowships, worrying about the GRE will be the last thing you will want to do.

Also keep in mind that you have to register to take the GRE more than a month in advance; if you want to take the test at a place somewhere near Cambridge, you should get moving several months before the test date. For example, if you plan to take GRE in October, and would prefer to take it in Boston rather than, say, in Swampscott (remember, you have to be there at 8am) you should register as early as July. GRE information pamphlets are available from OCS, from the GSAS admissions office at Byerly Hall. You can also obtain them from ETS web page, <http://www.ets.org/index.html> or from <http://www.gre.org>.

Note that if you apply for National Science Foundation (NSF) Graduate Fellowships, then the NSF will actually pay for your GRE test – provided you take it in December. See the NSF application for more information.

## Deadlines

The deadlines for graduate school applications range from late December to early March. Most schools usually require you to complete your application folder by January 1st or 15th. The deadlines for fellowship applications start as early as October.

## Fellowships and Financial Aid

Unlike what many people think, **you don't need to pay to go to graduate school in mathematics.** Grad students are usually paid (albeit not much) to study. There are several ways post-graduate education in mathematics is financed.

## National Fellowships

A few students are able to win national fellowships. The national fellowships are awarded by various government and private foundations, and pay rather large (\$12,000 to \$17,000 a year) stipends plus tuition for the first three to five years of graduate school. Currently, we are aware of support being offered by the following organizations:

- The National Science Foundation, NSF, is the largest funding agency for graduate work in mathematics, offering both regular Graduate Fellowships and some special ones for minorities. The deadline for submitting the first part of the application is usually in November. NSF will even pay for you to take your GRE's in December! The NSF web page is <http://www.nsf.gov> or go directly to *fastlane*, the electronic fellowship application submission web page, <http://www.fastlane.nsf.gov>.
- The Fannie and John Hertz Foundation, a private foundation that purports to support only students in "applied physical sciences", but, in reality, often funds study

for 5 or more years in many areas of pure mathematics. It also has one of the most lucrative stipends. Their web site is at <http://www.hertzfdn.org>.

- The Department of Defense. It funds the National Defense Science and Engineering Graduate Fellowships (NDSEG). This is a 3-year fellowship, and it is *not* similar to ROTC — you don't have to promise to serve in the military or have any other special obligations to the government if you win a fellowship. To get the application and information, check their web site at <http://www.asee.org/ndseg/>. The application deadline is usually the first week of January.

Canadian students should check out the following: (NOTE — The deadlines for these lie early in the fall semester!)

- The Natural Sciences and Engineering Research Council (NSERC), which provides scholarships for graduate study. For information check their web site at <http://www.nserc.ca/index.ht>

The flyers put out by some of these fellowships are posted on the undergraduate bulletin boards (one is opposite room 320 and another is opposite room 503) and many are listed in Office of Career Services' (OCS) "Guide to Grants". For others you may have to get the addresses and deadlines yourself either by perusing the heaps of books and pamphlets available at OCS or by writing to the relevant organizations. You should get to know OCS very well. Its library is full of information on fellowships and its staff can help you enormously in your pursuit. Generally undergraduates are urged to try their luck in all nationwide fellowships. Harvard students have been very successful in winning these awards. Some fellowships have early deadlines (as early as October) and some pay more attention to GRE's and grades than university admissions offices generally do.

## University Fellowships

A university itself may also offer a number of fellowships for students who will accept its offers of admission. These can be as lucrative as the nation-wide fellowships, and you generally don't need any separate application — your application for admission automatically enters you into the competition.

## Teaching Assistantships

Students who do not get fellowships usually receive teaching assistantships. Those generally carry a tuition waiver and a stipend that is sufficient for living expenses in exchange for teaching, grading, or assisting in low-level math courses. (There are some departments that won't let first-year students teach. These often pay incoming students a stipend, and have them begin teaching in their second year). Some students can get research assistantships which let them stop teaching and concentrate exclusively on research.

## Masters Degrees

Few students enter graduate school in mathematics for an M.A. However, if you think that this is something you may want to do, you should discuss your situation with your academic advisor or the Director of Undergraduate Studies. In many schools, masters degrees are awarded only on the route to a Ph.D.; also, students who drop out from a

Ph.D. program after a year or two are often able to get the masters degree on their way out (you should check the policies of individual departments). If you are applying for a masters program only, you may have less (in some universities, significantly less) chance of getting financial aid. Some universities do not admit students who want to get a terminal M.A. degree.

### Harvard's A.B.–A.M. Degree Program

Harvard students with Advanced Standing may wish to apply for the A.B.–A.M. degree. These students must meet both the academic and course requirements for each of these two degrees. A given course can be counted for only one of the two degrees, i.e., one course cannot meet the requirements for the A.B. degree and then be counted again for the A.M. degree. In addition to the course requirements, any candidate for the A.M. degree in Mathematics at Harvard *must take a special language exam* to demonstrate the ability to read mathematics in either French, German or Russian. These tests are administered by the department only once a semester. For more information on the language exams please contact the Graduate Studies Coordinator, Irene Minder (rm. 329, irene@math). Any undergraduate who wishes to apply for the A.B.–A.M. degree must file an application form for the graduate program in mathematics just as any other student files for graduate work at Harvard. For information on the degree, contact the office of Advanced Standing.

### Study Abroad

There are many fellowships and scholarships for study abroad. Information about them can be obtained from the Office of Career Services (OCS) or from your House Fellowships Tutor. Particularly useful are the *Guide to Grants* and the *Guide to Study Abroad*, published annually by OCS. Some of the math/science oriented fellowships are the:

- **Churchill Scholarship** (for study at Cambridge University),
- **Herschel Smith Harvard Scholarship** (also Cambridge),
- **Weizmann Institute of Science Scholarship** (the Weizmann Institute in Rehovot, Israel).

In the past, math majors from Harvard have also been particularly successful in competing for the **Marshall Scholarships**, and for the **Fulbright Grants**, especially for study in Israel (it seems that at least one grant a year almost always goes for a math student to study Logic at the Hebrew University of Jerusalem, and Israel is one of the very few countries where one does not have to know the native language in order to receive a Fulbright grant to study there). Application deadlines for some of the these fellowships start as early as September.

### Further Information and Advice

For further information and advice about graduate programs and fellowships in mathematics, please talk to the Director of Undergraduate Studies, Professor Peter Kronheimer,

your faculty advisor or the House Fellowship Advisor. They can greatly assist you in determining what recommendations and information outlined here applies in your case, and may help you get more information. And watch for advertisements from fellowships and graduate programs on the undergraduate bulletin boards.