

**SOME PRACTICAL ADVICE ON RESEARCH AND
EDUCATION IN THE U.S.
FOR WOMEN IN MATHEMATICS
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1. INTRODUCTION

The opportunities for women to pursue advanced study and research careers in mathematics in the United States have never been better than they are today. However research mathematics is still clearly dominated by men, who are also the chairs and graduate directors of all but a few Ph.D. granting universities. My comments pertain primarily to the 48 Group I math departments in the country; (these are the doctoral-degree granting U.S. math departments, both public and private, with the highest ranking scores awarded in a National Research Council study). Women have made greater career progress in the masters-only and undergraduate math departments, which is a notable achievement, but is not the same as a career in research mathematics.

2. OVERVIEW OF THE PROFESSION AND TRAINING

Recent data from the AMS annual survey of 2003 shows that of the 1017 new doctoral recipients reported for last year, 48% are U.S. citizens and 30% are female, fairly evenly spread among Americans and foreigners. Of the Group I institutions, at the public universities 24% of the new hires were women while 19% were women at the private Group I institutions. But we need a little more data to see the complete picture: under 3% of the tenure track hires at Group I departments were women in the fall of 2002, the most recent year for which I have data. There were 1 woman and 100 men hired in tenure track positions at the 23 top private math departments. However among tenured faculty at the Group I departments 6.5% are women, so either we are going backwards or 2002 was an unusual year. Another way to slice up the numbers is to see that 22% of the Group I new doctorates were women while 24% of new hires were.

So the good news is that the top research universities are hiring back approximately the same percentage produced. The bad news is that the

top universities are not training a large percentage of women in their math departments and the women are not being hired for tenure track positions. I have worked at three Group I universities during the past 24 years: State University of New York at Stony Brook, Cal Tech (as a visiting assistant professor), and University of North Carolina at Chapel Hill. In each case there has been no woman hired on a tenure track job since I was there, and I have been at UNC 17 years!

While I do not believe the current culture of research training and job opportunities in mathematics treats women fairly, I do see small positive changes occurring every year. And if ϵ is greater than 0, and you add enough ϵ 's together, you will eventually have a noticeable sum.

3. GRADUATE TRAINING FOR WOMEN IN THE UNITED STATES

The decision about which graduate school to attend is an important one, and I always recommend including some highly ranked departments on the list of any solid undergrad math major. If one of the top 5 or 6 ranked math departments admits a woman she will usually attend; however admission at these departments is extremely competitive. After that, even among Group I departments women applicants are starting to choose departments with more women faculty or with more women grad students over those with reputations that they may not be welcoming to women. For that reason many excellent departments are searching for ways to attract and retain qualified women grad students. So I recommend applying to good departments that do not currently have many women in addition to the ones that do.

An example I have heard many times of why women choose not to attend a particular institution is that when they visit the department if they are told during what is supposedly a recruitment visit "It is very hard to get into this university, and even harder to pass our qualifying exams, and even much harder to finish your thesis," they will choose another department. Other departments will roll out the red carpet for their women applicants. So if you are thinking of applying to a U.S. graduate school and someone there makes disparaging remarks to you, check the data to see if maybe you are simply talking to the wrong person. Think seriously about going there if admitted. For if it is one of the best departments, then the statement has some validity, but so what?

The situation regarding funding of graduate students at American universities has changed a lot since I was a graduate student; I attended graduate school in England in part because I won a scholarship to go there while funding in the U.S. looked uncertain. A woman can now expect to receive

full funding if admitted to a graduate program in the United States. What does it take to be admitted and funded? I will list 4 things.

- (1) A solid background of coursework in analysis and algebra backed up by excellent GRE scores.
- (2) Strong letters of support from professors. If you can get at least one letter from a professor who has worked or is working in the U.S., that's optimal because she can comment on how well she feels you will fare in that system.
- (3) Demonstration of good English is important; much of the funding is linked to teaching duties or other jobs involving interaction with undergraduate students.
- (4) Good communications skills. I am rewording item 3 because it is so important, especially for non-native English speakers. Students who have trouble in their math course will blame a foreign instructor's language ability if that's a possibility. You need to avoid being passed over as a good prospect for a teaching assistantship.

If your language prevents you from receiving funding your first year, then immerse yourself in the culture and practice English. Most American universities have programs to help foreign graduate students learn the language and classroom culture to prepare them for teaching assistantships.

Is the graduate education of women different from that of men? I don't believe so, certainly not on the institutional level, but there are two places where I have seen differences. First, if a department's graduate program has a poorly organized system of communicating the degree requirements, expectations, and changes in any of these, I've noticed that the women are more likely to suffer. I am not sure why that is, but I've seen it over and over. In particular if the ambiguous requirements about passing level cannot be pinned down, many women leave the program. Departments are now making greater efforts to be clear about the degree requirements and what constitutes a passing performance.

The second difference occurs in the letters. It is still customary to use adjectives like "pleasant, friendly", and "vivacious" to describe a young women mathematician while using "collegial, ambitious," and "intellectually curious" to describe the same qualities in a male. This hurts women in graduate admissions and in the job market. Fortunately this is becoming increasingly rare among American letter writers but still dominates the letters written by mathematicians from other countries, many of whom are teaching in our Group I departments. Try to get at least one woman letter writer if possible - I've never seen a woman math faculty member fall into that letter-writing trap.

4. ACADEMIC CAREERS FOR WOMEN IN THE U.S

Choosing a career as a research mathematician is not easy, however I feel it is an attainable goal for many of you. When getting started, it is advisable to apply at many levels of the job spectrum.

I have noticed that women apply for jobs below their ability more often than men do. Family reasons, mainly employment exigencies for a husband or fiancé are the reasons I hear the most. The reasonable expectation of being rejected from a Group I school might deter many qualified applicants as well, but it shouldn't. In addition some women are reluctant to enter into what is perceived to be a very competitive environment at Group I universities, but I don't like that reason either since it applies at every level of the job market. If your advisor or one of your professors knows a faculty member where you apply, consider asking that professor to inform the department that you have applied. Departments are supposed to read all files carefully, but it helps to ensure that your file is read by sending a personal reminder to the department.

If your personal situation allows you to move around for the first few years, starting with a two to three year postdoctoral position in the best department possible is the ideal way to get your research program under way. The AMS statistics show that many women are being hired as postdocs at top math departments. It will help your research to look for a postdoctoral position with the fewest teaching duties, even if you love teaching. If you can get a temporary job with no teaching, take it. Day to day duties are the same for women as for men. All young faculty have to publish papers, usually while juggling some teaching. My advice is to publish your thesis results and move on to your second paper quickly, before you have time to think about how hard it all is. One thing I've noticed is that women have fewer psychological blocks than men about getting the first post Ph.D. paper out; maybe it's because it's a hurdle that's completely under our own control and does not depend on the help of others. Don't avoid coauthors altogether though.

I feel that applying for an National Science Foundation grant is a necessary part of a research career in the U.S. once you get your first job there. I firmly believe it is harder for women to be funded than men but we can change some aspects of that simply by applying. It is a peer review system and as such, when the competition for resources is fierce I see the women dropping out of the application process and being dropped first from the short list of recommended proposals. However I know NSF officers make sure this does not occur all of the time. I have been on two panels in the past 6 months where I have seen the best and worst of the system, and I will apply next year for a research grant.

Getting tenure cannot happen until all of the above activity occurs, so I will not address that here. While in a tenure track job if you can tune out external annoyances and publish papers, I believe that the system (usually) works and you will get tenure.

5. WOMEN MATHEMATICIANS AS EDUCATORS

As educators, women face the same stereotypes as the ones existing when they were trained: students will at first glance assume you don't know as much math as their male professors. If they sense hesitation they will exploit you by wasting precious class time. I will pass on a few bits of advice I wish someone had given me when I first started teaching in the U.S.

- Establish yourself as the boss of the classroom and course material expert from the first lecture.
- You should feel free to evolve into a benevolent ruler, but you must learn to accept the role of leader of the classroom even if it feels unnatural at first.
- Communicate your expectations early and unambiguously in writing, and stand by them.
- If English words do not come naturally to you, speak slowly and write clearly on the board.
- Don't forget to enjoy the teaching.

You and your students will likely exceed each others' expectations, and your job will become easier.

6. CONCLUSION

A career as a research mathematician is simultaneously satisfying and frustrating. No two days of work are ever the same; but you never go home at the end of the day saying "My job is done." I have never heard a mathematician say she was bored, but I have known many who have left the profession for a less competitive lifestyle. For a woman, the convenience of an academic schedule is excellent for having and raising a family. The pay is good, the hours are flexible and in a well-run department you are your own boss. In order to survive and thrive as a mathematician you need to be able to accept criticism, improve your work based on the constructive criticism, and ignore the ridiculous comments. It takes some time to recognize the difference. It is particularly important for a woman in math to have a support system such as a more senior faculty mentor or a supportive family to help her feel worthy of continuing when many outside indicators point to possible failure.

If you love math, I encourage you to pursue this career; we need more good women doing math research.

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