Preparing Doctoral Students for a BIG Career Path

Lisa G. Davis

One day my PhD student stated, "I don't think I want a job like yours. I don't want to teach. What do I do?" I replied with the typical suggestion that she should think about working at a national lab, but my answer lacked any further depth and specific actions. Like many university professors, I have spent my entire career in an academic setting. A long-time member of SIAM, I'm embarrassed to admit that I couldn't give my student a good description of how to become a nonacademic mathematician. That student pursued a career at a national lab, and she taught me a lesson about advising. Over the years, I've developed a mentoring style that considers the student's mathematical interests and goals as well as the student's career goals. This article describes some things I've learned about training and mentoring doctoral students who choose to pursue a career in business, industry, or government (BIG).

The AMS Annual Survey provides the discipline with insightful information on the career paths of our doctoral students through its section on the Employment Experiences of the New Doctoral Recipients (EENDR) Survey. The section contains information on the employment status of new doctoral recipients within the US. The report presents data for the number of recipients employed in each of three sectors—academic, government, or business/industry. It also includes data for the previous five years, and upon quick inspection, one finds that roughly half of the respondents to this survey obtain their first job in the academic sector while the other half obtain employment in the BIG sector. Half of our students are pursuing BIG careers, and yet I find that many academicians are more focused on generating a fleet of mini-me's than helping their students navigate their own career path. Traditionally, many mathematical sciences departments within PhD-granting institutions structure doctoral student duties around *teaching* mathematics or statistics. Far fewer have focused curriculum or established programs centered around preparation for a BIG career path.

Within the last ten years, the mathematics discipline has invested in the development of resources to help students and their mentors find the career path that best aligns with individual interests. Below is a list of resources that can be useful in achieving this goal.

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Professor Educate Thy Self

Programs funded by the MAA, NSF, NSA, and others have developed training programs and recommendations for best practices that teach faculty to mentor both undergraduate and graduate students aiming for an industrial career path. The PIC Math program (Preparation for Industrial Careers in Mathematical Sciences) https://www.maa.org/programs-and-communities/professional-development/pic-math teaches faculty how to establish industry connections that provide research experiences for their students to work on real-world BIG problems. Program participation requires a time commitment from the faculty and students, but the lessons learned can pay off for many future students as academic-industry relationships are established and cultivated by the faculty member.

In 2018, SIAM published the *BIG Jobs Guide* written by the founders of the BIG Math Network. The book contains good advice for students and for mentors on various aspects of preparation for a BIG career path. Tips on coursework choices, vita construction, securing internships, and the job search are included in the book. The BIG Math Network website https://bigmathnetwork.org contains blog postings from mathematicians who have pursued BIG careers, along with resource pages with suggestions for students and departments to help facilitate student transition into these careers.

Interdisciplinary Relationships

Leverage interdisciplinary faculty relationships within the institution to give students opportunities to work on research projects with an interdisciplinary component. Currently I'm the PI for a program at MSU called the MonTana Partnership for Enriching mAthematical Knowledge and Statistical skills (MT PEAKS) that is funded by the NSF. The program is a partnership between the Department of Mathematical Sciences and the Materials Science PhD program on campus. It enriches doctoral students' training through participation in activities that foster collaboration on interdisciplinary research projects and internships with BIG partners. Students participating in this program are exposed to cutting-edge research in a Materials Science laboratory, and they learn to interact with researchers from a variety of disciplinary backgrounds. Learning to communicate science with those who use discipline-specific language is a valuable skill that mathematics and statistics students don't typically develop in their traditional graduate training. The faculty and students involved in the projects forge relationships that extend well beyond the life of the initial research project, and these relationships can lead to future external research funding to support future student projects. Anecdotal evidence indicates that these activities prepare students for internships with BIG partners; indeed, the activities may even increase the variety of internships in which these students may be eligible to participate. Since the nature of so much industry work is interdisciplinary

and team-based, these activities provide a foundation for students to pursue a BIG career if they choose to do so.

National Labs

National laboratories provide a wide variety of internship and career opportunities for students who find scientific and interdisciplinary research projects appealing. There are seventeen national labs run by the DOE across the US, and opportunities for students to attend lab summer schools or internships are numerous. The programs give students short-term exposure to a government lab setting, and students can gauge their level of interest in pursuing that type of career after the experience. Doctoral students who excel during their internship increase the likelihood of landing a postdoctoral appointment within the same group or at the same lab if the interests of the group align with those of the student.

Career Fairs

Colleges and universities often host career fairs during the academic year. Invite a BIG representative with technical background in mathematics or statistics to speak in your departmental seminar while they are visiting for the career fair. These representatives typically have some team lead experience and can give students advice on the crucial skills needed to work at that company or even within that industry. They are often pleased to combine the career fair trip with an opportunity to discuss technical aspects of their work. This allows interested faculty and students to establish a professional contact with the guest. Cultivating these contacts increases the likelihood that students secure internships or positions within that organization in the future.

BIG Speakers

Academic departments can host colloquium speakers from BIG. During their visit, speakers can interact with students informally to share their experiences and to discuss BIG career options. If the speaker is local to the area, it's an inexpensive activity. I happen to be at an institution that is geographically isolated, and speaker travel is expensive for the institution and time-consuming for the speaker. SIAM Student Chapters are a great mechanism to help fund speaker travel costs for those departments with limited budgets. Getting students involved in these events can give them agency in the decisions. Be sure to set aside time for students to interact with the visitors in an informal setting. Graduate students who help spearhead and organize these activities develop leadership skills that benefit them no matter their career choice.

Alumni

Leverage connections to alumni who have chosen a career in industry or government. Former doctoral students may enjoy mentoring current students through advice on relevant coursework and skills that BIG employers find most attractive. Alumni also know your program, and they can act as formal or informal advisory board members to help academic departments make changes to curricula or other programs that will benefit future alumni.

Final Thoughts

This article contains just a few suggestions for helping doctoral students to chart a purposeful path towards a BIG career when that is the direction that appeals to them. As mentors, it's our job to listen to our students' goals and sometimes to help them identify the career path that best fits their own personality and lifestyle. Engaging in a variety of experiences during graduate school is a great way for students to try out a few career directions before committing to any one of them. The difficulty is always in balancing the amount of time a student spends on these experiences versus their own coursework and dissertation research. Among faculty, there is a wide range of opinions on the long-term value of these experiences, and I think that mentors should encourage individual students to assess that value for themselves. That requires mentors to be familiar with a number of options that are available to students, and then we can give an appropriate response the next time they tell us that they don't really want to grow up to be like us.

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Credits

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