The Early Career Section offers information and suggestions for graduate students, job seekers, early career academics of all types, and those who mentor them. Angela Gibney serves as the editor of this section. Next month's theme will be research.

Jobs in Business, Industry, and Government

Enjoying Graduate School

Karen E. Smith

Several recent studies point to a mental health crisis among graduate students, who suffer much higher rates of anxiety and depression than control groups of peers with similar education levels.[1] This matches my own anecdotal observations: Despite the tremendous quantity of good advice available today on succeeding in graduate school, student anxiety levels seem higher than ever. In recent years, I've met several PhD students worried about their future to the point of incapacitation.

Certainly, we professors need to think about how to systematically improve our programs to address this issue, which is of course connected to deeper societal issues. But in this column, I hope to share some simple words of comfort gathered from many conversations with successful and happy alumni from the University of Michigan's math PhD program.

First, there has never been a better time to find mathematically satisfying and highly paid work. The data revolution has created a tremendous demand for high-level research mathematicians.[2] Mathematicians do deep work in cryptography[3] at national labs, conduct research on topological data analysis[4] (and its applications, for example, to fighting money laundering and fraud[5]), develop artificial intelligence for better tumor detection,[6] run their own businesses, and enjoy basic research jobs in quantum computing.[7] Highly trained mathematicians are desperately needed in data-intensive fields[8] and will be of critical importance in solving pressing global challenges such as climate change[9] and cybersecurity.[10] Mathematics PhDs can and do find meaningful mathematical careers in finance, technology, consulting, K–12 education, public policy, public service, and social justice work.

Countless Michigan math PhDs have shared with me that they love their jobs in industry. One combinatorist who published many research papers during a high-powered postdoc now lives in San Francisco teaching and researching machine learning at a large tech company. He told me:

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[1] https://www.insidehighered.com/news/2018/03/06/new-study-says-graduate-students-mental-health-crisis

[2] *McKinsey Global Institute, Big data: The next frontier for innovation, competition, and productivity, Report, May 2011.*

[3] bit.ly/2r2Tz6U

[4] bit.ly/385c0Zs

[5] https://www.ayasdi.com

[6] bit.ly/34QKzQM

[7] https://www.dwavesys.com/quantum-computing

[8] https://mck.co/2Rg07cS

[9] https://www.ams.org/fcarc-climate

[10] https://www.csis.org/analysis/cybersecurity-workforce-gap

"If I had had any idea of how easy it is for a math PhD to find a fascinating six-figure job in an amazing city, I would have worried less and enjoyed my academic career more."

Of course, being a math professor is a great gig for those of us who especially love teaching. But it is only one of the many great jobs for PhD mathematicians, and one of the harder jobs to land. The recent AMS hiring survey[11] makes clear that if you are determined to be a math professor, you may have little ability to choose where you live, you may have to compromise on the preparation of the students you wind up teaching, and it may be some time before you can really settle down. On the other hand, it is easy to step off the academic track at any time, so feel free to enjoy your research and teaching with confidence that you have many career options.

No special preparation is required: with an open mind and the internet, you will easily find resources, such as the BIG Math Network,[12] to help you understand the landscape of math jobs in business, industry, and government. You can quickly pick up skills through Coursera or training programs such as the IMA math-to-industry bootcamp.[13] Just by talking to alumni or old conference buddies, you can learn about the amazing things people like you are doing with their mathematics training in nonacademic settings. You will also learn that your PhD work builds many transferable job skills, such as public speaking, technical writing, the ability to manage a complex project, mentoring, and fortitude in the face of technicalities.

Even if you are certain you will become a research math professor, please be open-minded about nonacademic career opportunities so that you can better advise your own students someday; for simple numerical reasons, most of them are unlikely to become a professor like you.[14] Call out people who use phrases such as "they're leaving math" to describe someone who has *chosen* a nonacademic path. It is absolutely reasonable to seek a job in a particular city, or to strive to make a more immediate impact on society, or even to want to make a lot of money. Likewise, it is completely acceptable to try out an internship for a summer or longer. In fact, I've found that students who have worked for a year before graduate school are often happier and more productive—they better appreciate the student lifestyle and have a more organized work ethic. Don't get brainwashed by our culture into thinking that academia is the only respectable career for a math PhD.

Second, you can enjoy math right now. Working on a PhD is an amazing opportunity to immerse yourself in the study of a beautiful subject for half a decade while (usually) making a living wage. This is a tremendous privilege, provided only by the most enlightened of human societies and available only to a select elite. Relish it! Enjoy the freedom to think about whatever you want, whenever you want, and with almost anyone you want.

It helps, I think, to view your PhD program as an opportunity to get paid to be a scholar now rather than as job training. The goal is not to "find a job" at the end, but rather to delve deeply into your intellectual passion and make your own contribution to humankind's most sophisticated creation, mathematics.

Completing a PhD is a significant achievement worth celebrating in its own right, independent of what comes after. With a PhD in mathematics, be confident that your degree will be highly valued and that rewarding careers await. You can sort out the details later.

Most importantly, have a life! You will be in a PhD program, or PhD-followed-by-post-doc-program perhaps, for a substantial percentage of your adult life. Enjoy that life. Do not compare it to the lives of others. Deepen your relationships, build community, enjoy art and music, give your time and energy to others, take care of your emotional and physical health, connect with nature, pursue a hobby, have children if you want. Graduate school is not just one phase to be endured, putting your life on hold until you are "done." It *is* your life during your very best young adult years.

Never have I heard an alumnus say that they wish they'd done more textbook exercises or read one more preprint. Many, however, have confided that they wish they'd wasted less time worrying. Your future is bright. There is so much math and so much life to enjoy right now!

Karen E. Smith

Credits

Author photo is courtesy of the author.

[11] *Report on 2017–2018 Academic Recruitment, Hiring, and Attrition, by Amanda L. Golbeck, Thomas H. Barr, and Colleen A. Rose, February 2020* AMS Notices.

[12] https://bigmathnetwork.org

[13] https://www.ima.umn.edu/boot-camp

[14] https://www.ams.org/2017Survey-NewDoctorates-Report.pdf