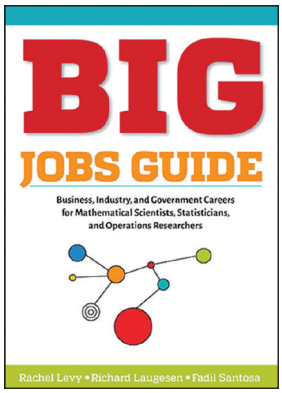
Review of the *BIG Jobs Guide*

Jake Levinson



How, and where, can a mathematician get a job outside academia? The realities of the academic job market have made this an important question for mathematicians at all career stages: undergraduate and graduate students looking to jumpstart their careers; postdocs weighing their job options; and faculty and department heads considering how best to advise and serve students. Rachel Levy, Richard Laugesen, and Fadil Santosa address this question in the *BIG Jobs Guide*[2] (2016, published by SIAM and the BIG Math Network); BIG stands for Business, Industry, Government, the book's focus.

The *Guide* covers a lot of ground in 137 pages: some labor statistics, career advice on preparing for and getting a BIG job, some first-person accounts of job searches and career transitions, and a number of suggestions for faculty and math departments seeking to foster connections to industry. The introduction makes clear that the book's message is meant for students and employed academics alike. That message—BIG jobs are plentiful, appealing, and achievable for mathematicians—is encouraging, and the job advice is practical and quite comprehensive. Still, in certain places I found myself wishing for more substantive examples of BIG jobs and the work they entail.

I was quite interested to read this book. During my postdoc at the University of Washington, I spent the 2018–2019 year on leave as a visitor to Google Research as part of Google's AI Residency Program. My time there, in an unusually research-focused job split between computer vision and statistical machine learning, left me with many positive and some negative impressions. On the whole, the experience was good enough that, had I not found my current academic position, I would have been pretty happy to move into industry. I also came away feeling that many math departments should think more about how their graduate programs might better serve students who will mostly not go on to be academics. Since that year, I've often been approached by students and academic acquaintances curious about my experiences. From these conversations, my sense is that there is broad awareness of careers for mathematicians in the three superstar areas of finance, tech, and data science, but not much beyond that. There's a lot of curiosity about what other jobs are out there; I myself had only a glimpse of the possible lines of work.

1. The job market. The *Guide* opens with a number of statistics, taken from AMS surveys of mathematicians and recent doctorates, to paint a picture of academic hiring that is… dire. Some 1900 PhDs in mathematics and statistics have been awarded annually in the US since 2013, compared to only about 900 tenured and tenure-track positions filled each year. The book's numbers are from 2011–2016, but the trend is unchanged according to the most recent AMS report.[3] The authors also point out that many of the available academic positions are precarious, underpaid, or overworked, and that many involve very little of the research or rewarding teaching that draws mathematicians into the profession. Mathematicians considering adjunct positions paid on a per-course basis are emphatically encouraged to move into BIG instead.

In contrast, the authors cite labor statistics showing that BIG jobs are plentiful, highly remunerated, and forecasted to grow by nearly 30% this decade. It should be noted that the salary gap compared to academia can be, well, BIG: the median salary of a new PhD mathematician—someone with five to seven years of post-college research and teaching experience—was around $60,000 in 2018.[4] In contrast, an entry-level software engineer at Google earns not a little but a lot more, around $130,000 (plus stock!), and the salary after 6+ years of experience would be higher still. And while money is far from the only factor in a career decision, the abundance of jobs and resources in BIG careers translates to a number of other benefits. The parental leave policies, mental health coverage, work-life balance, and geographic flexibility I witnessed at Google were all significantly better than they generally are in academia—practically night and day. Though Google may be an outlier, the *Guide* notes that BIG jobs are "consistently rated among the highest areas for job satisfaction and even happiness."

2. Getting a BIG job. The major part of the *BIG Jobs Guide* consists of advice for students on coursework, resumes, internships and networking (Chapters 3–6 and 9–10), and advice for math departments on improving student preparation for BIG careers (Chapters 11–13). The advice for job seekers covers each of the steps in preparing for and executing a career transition, and the authors often highlight differences in culture and objectives between BIG and academia: "focus on translatable skills" in the research and teaching parts of a resume, and include only relevant publications; develop an 'elevator pitch' about your skills and professional goals. Some of the tips are more basic

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[2] https://bookstore.ams.org/bigg/

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[3] *For a recent discussion in the* Notices, *see* https://www.ams.org/journals/notices/202201/rnoti-p96.pdf.

[4] *Report on the 2017–2018 New Doctorate Recipients,* Notices of the AMS, *Volume 67, Number 8.*

("have you gotten to know your advisor?"), but the advice is concrete and comprehensive; readers considering BIG jobs will find a lot of insights.

I also enjoyed the later chapters' suggestions for how math departments can support BIG careers. The over two dozen detailed suggestions range from low-cost ways to provide BIG job information to students, to more involved faculty initiatives and events to foster networking opportunities and ties to industry. The authors are cognizant of the time and effort some of these ideas would take; they propose starting small and seeing what makes sense in a particular department. One chapter discusses international student visas and work visas in the US. Having experienced the intricacy of American student visa law myself, I was happy to see a clear compilation of the options.

A fair amount of the advice for students is geared towards applied math: to study topics like stochastic processes and mathematical modeling, and to complete REUs and internships in industry. (The *Guide* is for "mathematical scientists, statisticians, and operations researchers," though the text often refers simply to "mathematicians.") It makes sense that these steps would provide the most preparation. There is some dissonance, though, between the near-absence of pure math from the discussion, and the broader argument that (all) mathematicians are well equipped for BIG jobs. But maybe that's the inconvenient truth: that a majority of pure math students would benefit from a lot more emphasis on applied topics.

3. But what are BIG jobs? Despite the title, the *BIG Jobs Guide* is more of a guide to *getting* a BIG job than a guide to BIG jobs themselves. This last topic is partly addressed in Chapters 7–8, "What jobs are out there?" and "What is it like to take a BIG job?". The authors briefly describe some major sectors: research, tech, finance, consulting, and data science; there is also a table of potential job titles to search for. Chapter 8 is particularly interesting as it contains six first-hand accounts of BIG career transitions by mathematicians. Three accounts touch briefly on the nature of the work, for instance "develop[ing] numerical and computational techniques [for] extremely large scale scientific problems" and "estimat[ing] underwater bathymetry[5] in environmental flows." There is one more detailed description from a software engineer at Google. The other accounts and the surrounding discussion focus more on the process of career transition, and on comparing different workplaces and career trajectories: startups versus large companies or government labs; technical work versus management.

It's all interesting reading, albeit not quite the trove of diverse examples of mathematical jobs I had hoped to read about, particularly outside of tech. This, then, is my only criticism: I think, even within the framework of an advice guidebook, the *BIG Jobs Guide* would have benefited from a few more examples to showcase the variety of BIG jobs. The primary barrier I have felt in considering such paths for myself, or in recommending them to students or colleagues, has always been that I don't know many real examples of interesting mathematical work in industry. The authors themselves remark that "[the] hidden nature of the mathematical sciences in the workplace makes internet searches for jobs […] somewhat challenging." By contrast, even as an academic I have found it relatively easy to hear about high-profile jobs in tech and finance, and to find professional advice on CVs and interview skills, such as when I applied to Google.

The last chapter of the Guide points to supplemental references for this, including the BIG Math Network's[6] own website; another title that caught my eye is the MAA's *101 Careers in Mathematics: Fourth Edition* (2019, ed. Deanna Haunsperger and Robert Thompson). Readers considering a BIG mathematical career might like to supplement the *Guide* with these other references. I should also note that Chapters 6 and 10 provide actionable advice for readers actively planning a job search, including two lists of professional job boards that would no doubt lead to many interesting options.

It's clear that the 'career question' will continue to loom large in academia in the near future. The extensive roadmap, thoughtful advice, and upbeat vision offered in the *BIG Jobs Guide* make it a welcome addition to this ongoing conversation.

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Credits

Photo of Jake Levinson is courtesy of Simon Fraser University.

[5] *bathymetry: the measurement of depth of water.*

[6] `https://bigmathnetwork.org/`