TEACHING STATEMENT

SAM HOPKINS

I have experience teaching mathematics at a wide variety of levels, from advanced math for motivated middle schoolers to introductory graduate courses. I have been:

- A recitation leader for three first-year undergraduate courses at the Massachusetts Institute of Technology (MIT) from 2016-2018, while I was a PhD student there: linear algebra, probability and statistics, and differential equations.
- An instructor for a graduate combinatorics course at the University of Minnesota (UMN) during the Fall 2019 semester.
- An instructor for an undergraduate combinatorics and graph theory course at UMN. I taught this course during the Spring 2020 semester and will teach it again in Spring 2021.
- An instructor for the University of Minnesota Talented Youth Mathematicians Program (UMTYMP) course on discrete math during the Fall 2020 semester. UMTYMP is a program where high school students can take college-level mathematics courses at UMN.

In addition to these teaching experiences in a normal college classroom setting, I also have significant experience with student mentorship and teaching in nontraditional settings, including as:

- A mentor for two students in the Summer 2014 Research Science Institute (RSI) program at MIT. RSI is a program which brings high school students from around the country and world to MIT to work on research projects in STEM fields.
- A mentor for a group of four students in the Summer 2019 Research Experience for Undergraduates (REU) at UMN. UMN has a long-running and highly regarded REU program specializing in algebraic combinatorics.
- A faculty member in the Summer 2020 Bridge to Enter Advanced Mathematics (BEAM) Discovery Los Angeles program. BEAM is an organization dedicated to helping underserved students enter advanced study in mathematics. BEAM Discovery is a summer program where rising 7th grade students take a variety of math courses which expose them to content and perspectives they would not normally see in their public school education.
- A BEAM Saturday school instructor during the Fall 2020 semester.

I have consistently received excellent teaching evaluations. My average overall score as a recitation leader at MIT was 6.4/7.0. Some comments I received from students in those classes were: "[you] really seemed to know the material and how to present it in a way that would help me learn"; "I appreciated your willingness to answer questions and the way you engaged the class with questions of your own"; "hopefully another class will be lucky enough to get Sam." Furthermore, I earned a 5.7/6.0 overall score in both the graduate and undergraduate combinatorics classes I've taught at UMN. Some comments from students in those classes include: "He was amazing. He did a wonderful job with lecturing in balancing proofs with intuition"; "Sam was one of my favorite professors while at the U so far. He always held a deep understanding of the subject material and knew how to answer questions in a way that pushed us to think for ourselves."

My research mentorships have also been very successful. Both of the high school students I mentored in RSI did outstanding work, and I co-authored published papers with each of them. Similarly, the students I mentored at the Minnesota REU made significant progress on the problem I gave to them, and consequently wrote a paper which they've submitted for publication.

Finally, my experience as a faculty member at BEAM Discovery helped me learn a lot about the unique challenges facing students from underrepresented and marginalized communities. At BEAM I also developed skills for promoting an inclusive learning environment, including trauma-informed pedagogy. BEAM's focus on reaching students early in their mathematical lives is especially worthwhile because inequalities are often already appreciable and compounding by this point. I continue to teach BEAM students as part of its Saturday school program. I'm teaching voting theory, a topic that's really captivating the students. In future years I plan to keep contributing to organizations, like BEAM, which are dedicated to promoting diversity and inclusivity in mathematics.

Now let me briefly discuss my goals as a teacher. Too often students come away from grade school believing that math is about pattern-matching and applying some fixed set of rules. If nothing else, in my teaching I aim to convey that mathematics is fundamentally a *creative* enterprise. To accomplish this, I like to present students with a problem– one that I'm hopefully able to motivate either from some real-world application, or via prior mathematical knowledge, or if nothing else as an intriguing puzzle– and then work with the students on developing a theory to resolve the problem. As an academic researcher, I feel compelled to explain that this is really how it was and is done: we didn't start out knowing the formulas ahead of time!

However, I've seen some mathematicians take the "mathematics is not computation" dogma too far and focus exclusively on developing abstract theory, at the expense of working out examples. I believe that students getting their hands dirty by doing many computations and examples is crucial for their learning. In fact, I think a great thing for students is to consider several examples and then try to formulate their own conjectures about what the general pattern should be. In this way, mathematics can almost be treated like a laboratory science. I am fortunate to specialize in combinatorics, where answers are numerical and concrete examples abound; but this general idea of learning through examples applies across mathematical subfields.

These broad goals for teaching are reflected in the innovative classroom techniques which I have experimented with and will continue to experiment with. The probability and statistics course I taught at MIT was a "flipped classroom," where the students were expected to learn most of the material by reading the notes on their own time, and the classroom time was spent reviewing the core concepts in various applied contexts using the R programming language. Meanwhile, in several of the classes I've taught at UMN, I divided the classroom time between more traditional lecturing, and group problem-solving with guided worksheets. I'm especially fond of this "hybrid" style. I find that instruction time in front of the whole class is very valuable for establishing clear objectives. But, on the other hand, having students work through examples on their own is one of the only ways they can experience the creative side of mathematics.

This quest for balance between direct instruction and independent student investigation is a manifestation of what I've found to be the real key to success as a teacher: flexibility. Math teachers have to know when to emphasize heuristic explanations and rules of thumb, and when to employ more rigorous arguments (which should still be backed up by examples and intuition). And we also have to adroitly move between the various different ways of viewing the same problem. For example, when teaching linear algebra, one should explain both the "geometric" picture of intersecting lines and planes, and the "algebraic" picture of solving linear equations, and it is extremely helpful to know which picture works best for explaining each concept. Teachers also need to be flexible when dealing with students of varying backgrounds: sometimes we should focus on presenting the core course material in as clear and simple a manner as possible; sometimes we can mention more advanced directions as well.

I look forward to future teaching opportunities that will test and strengthen my abilities as a teacher. Sharing mathematics with younger generations is a real passion for me.