TEACHING STATEMENT

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Teaching is a key part of my mathematical career, first as a graduate student at the University of Washington (UW) and now as a postdoctoral fellow at Queen's University. It is my strong belief that the way to understand the essence of any subject is to figure out how to explain it to others. In undergraduate classes, I encourage my students to explain their ideas to each other, to write clear and complete solutions, and to talk to me whenever they need help or have an idea or question they want to share. Participating in reading groups and seminars has been an excellent way for me to learn new topics and to improve my understanding of old ones, and I've tried to provide similar experiences for advanced undergraduates and graduate students at UW and Queen's.

I've taught a variety of first- and second-year courses: precalculus, first and third quarter calculus, and linear algebra at UW, and two different calculus sequences: one for economics and one for engineering students, at Queen's. Most of my teaching at UW consisted of night classes of 25–35 students with no teaching assistants, so I was responsible for organizing group work and quizzes as well as lecturing and writing exams. My current calculus class at Queen's, on the other hand, is a larger lecture of 100 students, with teaching assistants and graders. Two other instructors are teaching sections of the same class and we're working closely together on preparing lectures, quizzes and exams.

In lectures, I try to write the essential steps on the blackboard but to add lots of remarks and questions to what I say, and to vary my pacing so that students at different levels feel that the lectures are worthwhile. During group work, I walk around the room and ask students to explain the progress they're making: often several students show me an idea (whether helpful or not to solve the problem) that hadn't occurred to me, and I can sometimes change my explanation of the solution based on these ideas. A challenge in my current large class is to figure out how well the quieter students are following the lecture; fortunately the classroom environment has been friendly and a fair number of students are willing to ask questions. Even questions such as "what's that word on line two" help me clarify the lecture. Questions in office hours often show me what to stress in class. In winter 2004, I was the teaching assistant for a combinatorics class which turned out to be unexpectedly difficult for many students. The instructor and I realized from their questions that manipulation of generating functions, while elementary, involves tricks that are not obvious to many students, so we added appropriate examples to the lectures. Office hours are also an opportunity for students to talk to me about applications of the course material in their own work or future plans; the most rewarding example of this was a student in my third-quarter calculus class who planned to work with differential equations in biochemistry.

When I taught third-quarter calculus (sequences and series, vectors, and partial derivatives) in the spring of 2004, I experimented with a new approach: instead of quizzes, I required each student to solve one difficult homework problem, write it up carefully, and present it to the class. This forced

students at least once in the quarter to make sure they could produce a complete solution with no mistakes and to be willing to show everyone their prepared work. The drawback, I discovered, was that many students were poor presenters, often just transcribing their written solution on the board while saying little or nothing, so that other students felt their time being wasted. Nonetheless, I would try student presentations again in a similar class, making sure to do good and bad model presentations myself beforehand. I believe it is important that students learn how to present their mathematical work and now realize that many have had little experience in doing so.

Some of my most enjoyable teaching experiences have been in small undergraduate and graduate seminars. In 2004-05 at UW, I co-organized a seminar with fellow graduate students Eric Bahuaud and Brant Jones as part of the UW math department's VIGRE program. The idea of the seminar was to give undergraduate math majors a sampling of the objects studied in mathematical research without the full detail that would be presented in a graduate course. Among the examples we presented were homology of triangulated surfaces, an explicit model of hyperbolic geometry, and the symmetric group. Students were invited to present aspects of each topic and to ask any type of mathematical question on their minds. Some of the stronger students gave full-length presentations in the seminar, including one on the Banach-Tarski paradox. The presentations were in some cases the first chance for the students to explain advanced mathematics to a group. Recently I've also spoken in graduate-level seminars on toric varieties and on invariant theory. Preparing such talks has allowed me to think about topics related to my research in a new way. I'm constantly learning from watching other speakers in these seminars: most notably, when it is best to give complete proofs, when to highlight only their main points, and when to omit them in favor of illustrative examples. I believe this experience will help me teach advanced undergrduate courses and advise reading courses and projects.