TEACHING STATEMENT FOR IVAN CORWIN

When I teach, whether to students or colleagues, I have the same goal: To enable my audience to understand in which ways my topic is simple and in which ways it is complex. Such an understanding is the basis for mathematical development because it naturally motivates mathematical ideas and approaches which all too often seem artificial and contrived. Of course, one can not expect an audience to understand immediately all of the complexities of a subject, and therefore I always offer a variety of illustrative examples and analogies.

I realize, however that unless a student goes into a field in which he or she constantly uses math, and unless a fellow researcher chooses to focus in my area, the exact content of my course or talk will eventually become a faded memory. What remains, though, from a good class or talk is an enhanced ability to recognize when a problem or issue is complex and worthy of a closer mathematical look. This view underlies my teaching and lecturing strategies and contributed to my high student ratings (4.45 out of 5 averaged over two Calculus I sections, Probability I and Analysis II) and student comments like: "He's very good at explaining problems so that I fully understand them," "Everything is explained extremely well and he knows how to relay information," and "Also [he] shared helpful ways to visualize concepts."

Rather than continuing abstractly, let me now illustrate my teaching philosophy by recalling a formative experience I had as a student and then highlighting a few examples from my own teaching. During my senior year of college I decided to take my first probability class. Half way through the class, the professor asked us to create a project to demonstrate a "paradox" of probability or statistics. I chose Simpson's Paradox, which shows one way that people can manipulate experimental results to lead others to the wrong conclusions[1]. Besides learning about a fascinating phenomenon, this project taught me a lasting lesson about how to recognize when data may have been manipulated to reach desired conclusions.

Probability and statistics are constantly used by a variety of people ranging from advertisers to politicians to doctors, and it is exceedingly important for people to develop the ability to "smell" bad mathematics and statistics. In my own teaching I have sought to impart this ability to students. When I was leading recitations for Probability, I spent a class emphasizing conditional probability and Bayes' Rule. It is far better to lead students towards recognizing the complexities of a problem, than to simply tell them. With this approach in mind, I focused on two pitfalls associated with Bayes' Rule – false positives[2] and size biasing. Drawing from these examples the students were able to generate the definitions of conditional probabilities and the rules for how to deal with them. Thus the algebra of conditional probabilities no longer seemed arbitrary.

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[1]Suppose an advertiser wants to conclude that people like beer A over B. They choose to survey whether people like beer A at a sporting goods store. Say 80% of the men and 55% of the women like A (however due to the location hundreds of men are surveyed but and only fifty women). They then move to a women's clothing store and survey's people about beer B. Of the few men there, 95% like B and of the many women there, 70% like B. Thus, it in each population B is preferred over A. However, when the populations are combined it appears that A is favored to B due to the disparity between the population sizes in the two sets of surveys.

[2]I started with the classic example of a test for AIDS in which there is a 5% false positive rate and asked: If you have no reason to believe you have AIDS, yet test positive, how likely is it that you actually have it? Initially most of the students concluded that you must have a grim 95% chance. Even when I brought up the fact that a very small portion of the population actually has AIDS most people did not waver in their guess. However, when I asked the class to imagine this problem not as percentages but as people in a population of a million, then the students started to get it. They realized that 5% of the non-AIDS population actually comprises a large proportion of the positive testing population and thus if you have no good reason to believe you had AIDS, you stand a very good chance of being in the large false-positive population rather than the AIDS population.

This approach is equally important in more abstract mathematical settings. While teaching Analysis II recitation I noticed that many students were struggling with the various theorems pertaining to the interchanging of limits and integration. Rather than just listing the theorems, I asked students to present each theorems on the board and to give counter-examples to demonstrate the necessity of the hypotheses. After I helped them develop a few concrete examples they began to see why we had defined concepts like absolute or uniform convergence and why they were necessary. A small collection of (counter-)examples go a very long way in mathematics.

A key to this approach is clarity and preparation. In Calculus I, students are just forming their mathematical views and it is thus very important to choose ways to illustrate ideas which will not lead to confusion later on. This approach carries with it some risk. Many students believe that mathematical prowess is simply a gift that some people have and others lack. This is often reinforced when a teacher is all too cavalier about presenting an issue so that it appears effortless for him. I try to be realistic with my students. I let them know that math is a process and not always immediately intuitive or easy. Students of mathematics, including myself, are continually coming to better appreciate and understand even the simplest of concepts.

In fact, for me, teaching is now one of the main ways I achieve a higher level of clarity for myself regarding both elementary (though not necessarily simple) and advanced concepts and topics. When I teach or lecture for high level seminars (such as my recent lecture series at U.C. Berkeley) I try to distill the essential ideas and approaches from an immense and technical literature. During my talks I try to ask the audience some of the same difficult questions I asked myself in learning the material. Then using these questions, I am able to motivate the conceptual and technical steps needed to answer them and understand the material.

I think it is important (especially in lower level courses) that students solve weekly problem sets which count for a large portion of their grade and that in recitation these problems are reviewed and explained to make sure that students understand why they have been assigned. However, one can not expect students to immediately understand all of these complexities and so I also like to ask students to hand-copy the proof of one chosen theorem each week. This immersion approach complements the more contemplative approach I take in my teaching and also helps students learn to write proper rigorous mathematical proofs.

My teaching experience spans from 2005 to the present. As I have previously noted, while at NYU I taught recitations for undergraduate Analysis II, Probability I and Calculus I (two sections) and received very high student ratings and excellent comments. At Harvard I taught recitations my senior year for Honors Linear Algebra and Real Analysis I and II. In the summer of 2009 I served as the teaching assistant at an MSRI workshop on random matrix theory. During the 2007-08 year I had a unique part-time job as the ninth grade math teacher at a school run by NYU's Child Study Center for students with Asperger's syndrome, a type of autism.

I also devote a significant amount of time to lecture series and speaking at seminars and conferences. This fall I was chosen to be a MSRI distinguished speaker at the MSRI/Evans Lecture Series. I have been invited to teach a two week long mini-course at the NSF Pan-American Advanced Studies Institute in Chile and Argentina during January 2012. I was also invited by Fraydoun Rezakhanlou to give a three week lecture series at U.C. Berkeley entitled "The Kardar-Parisi-Zhang equation". Vladas Sidoravicius has invited me to give a version of these lectures in Brazil at IMPA during. At Courant I gave eleven talks at a seminar I jointly organized in 2008-09 and three talks at a seminar I organized in the fall of 2009. Besides those above, during graduate school I will have given at least five invited conference talks (three international) and sixteen seminars (six international).

In all of my teaching opportunities I bring the same energy and teaching philosophy. Above all else I believe that it is important that my audience comes away having learned to grapple with some of the complexities of mathematics. With this understanding, mathematics no longer seems needlessly abstract or complicated and people can start to appreciate the many contributions that mathematicians have made towards resolving these complexities.