Teaching Statement

Teaching and Research: I accord equal weight to teaching and research, as I believe they inform and reinforce each other. In my course preparation, I anticipate the questions that students might ask about the subject matter. Often, this process directly inspires my own research projects, especially in graduate teaching. For instance, while preparing a lecture on the method of maximum entropy on the mean, I realized that the method could be extended to a small-sample situation, an insight which led me down a path I had never before considered. Moreover, I believe teaching graduate students gives me deeper insight into the subject matter, as does fielding the challenging questions my undergraduate students ask. After explaining continuity and differentiability of a real valued function in calculus class, I wondered what the derivative of a digital image might be. If the discontinuities in an image are visually obvious, what is the link with the mathematical notion of continuity? This type of persistent inquiry stems from my view that scientific knowledge is not a closed set of concepts that students must memorize and recite back verbatim, but rather a collection of great ideas that should be worked and played with in order to garner a greater understanding. Like John Dewey, I believe that education should teach us how to think rather than what to think. What is more, I find this teaching philosophy helps reassure students anxious about and/or averse to mathematics.

Role as a teacher: In a related vein, my role as a teacher goes well beyond that of a simple top-down purveyor of information. I see myself as a resource center and / or a counselor, and always aim to guide my students to resources to facilitate reaching their personal goals. I always make myself available to them, and I encourage my students to be inquisitive and think scientifically. In keeping with this role, I am always the last person out of the classroom to give extra help to students with any lingering questions about mathematics. I welcome drop-in visits from students during my office hours, and have always maintained an open-door policy, leveraging this time to give extra help to my students and to resolve any administrative or academic problems they may encounter.

Creating material for a new course: I find creating a new course a most rewarding experience. I wrote lecture notes for the following two courses for which no textbooks were available: "Statistical Methods in Imaging" (co-listed in the Applied Mathematics and Statistics (AMS) and in the Biomedical Engineering department at Johns Hopkins University (JHU)) and "Data Mining," listed in the AMS department at JHU. These are four hundred level classes designed for fourth-year students and for masters and first year Ph.D. students. The topics presented are at the level of introductory research material. The objective of these courses was to show the students how to apply their current knowledge of mathematics to problem-solving in image processing, computer vision and to machine learning; by doing so, they learn new useful and effective mathematical tricks. I evaluated students both with problem-solving exams in class and required each of them to do a presentation during class time. I particularly enjoy working on the practical applications of mathematics with my students, and showing them via examples how to apply a theorem, as well as how to motivate mathematical thinking with real data.

Teaching large classes: I have taught many amphitheater classes to audiences of 100 or more students in elementary college mathematics courses. Some of these classes include: Calculus I and II, Linear Algebra, Discrete Mathematics and Introductory Probability and Statistics. In these classes, students

must learn an oftentimes new and occasionally off-putting scientific vocabulary, which many find extremely challenging. When I first taught a large class, in 1997, I made a very basic mistake. My early lectures were aimed at only a small number of particularly bright and well-informed students, who had taken certain prerequisite courses, and who were already familiar with mathematical notation. I have corrected this error by handing out introductory lessons and primer materials, as needed, to facilitate understanding the new material—e.g., the Greek alphabet, or, in elementary probability, finite and infinite unions and intersections, etc.

The science of learning: With the collaboration of four colleagues in my department, we were awarded an internal JHU grant. Our proposal entitled "Introductory Statistics through Case Study" consisted of changing the way we teach introductory statistics courses. Instead of starting from the theory, we proposed to start from scientific questions and data-sets, to help better motivate statistics theory and tools. We developed case studies, which now form an integral part of Stat 101. We also organized a short workshop designed to train teaching assistants for Stat 101, [1].

Teaching evaluations: Every class at JHU is evaluated by students, and these evaluations are available to the JHU community. I pay close attention to my student evaluations, and use the constructive criticism contained in them to improve the quality of my courses. Since 2011, the majority of student evaluations for the overall quality of the six courses I taught range between 3.5 and 4.3, out of a possible score of 5. As JHU students are very demanding, these scores are considered good to very good. I did, however, encounter one exception when I taught "Probability and Statistics for the life Sciences." Although my students gave me a score of 3 out of 5, which is still above average, I am quite dissatisfied with my teaching performance. This required course is offered to non-math majors, mostly students majoring in neuroscience, and it covers elementary biostatistics in a single semester from descriptive statistics to regression. This course is known to be very challenging to teach. I consider myself fortunate to have an opportunity to teach this class again in the spring semester of 2014. Consequently, I have taken several decisive steps to improve the quality of the course and my teaching performance. First, I found a new text book with a clearer, simpler better focused presentation of the material. Second, I have been consulting with a colleague who is an expert in teaching large scientific classes. Last, I designed special homework problems in collaboration with a colleague, who is a professor of neuroscience, and who has provided the context and the data from experiments performed in his lab. This way, the course has a more direct application to our students' studies. In addition, I have learned from our science of learning grant that this project-based approach has proven very effective at motivating students, and at helping them better understand the fundamentals of statistics.

Mathematical literacy: Teaching mathematics is also a means of fighting innumeracy or mathematical illiteracy. Striking examples of how numbers, shapes or chance can mislead just about anyone can be found [2-4]. I like to present a selection of challenging questions that are later solved or at least reformulated using the proper mathematical tools. Examples in probability include the "Monty Hall" problem and Bertrand's paradox.

Cultural competencies: I have been teaching mathematics for almost 20 years in both French and in English to a diverse array of nationalities backgrounds and social classes, ranging from some of the

wealthiest ones in France to some of the poorest. In addition to teaching calculus at all levels, I have also taught discrete mathematics, probability, statistics at all levels, biostatistics, machine learning, imaging and information theory. As a teacher and an academic adviser at Johns Hopkins University, I interact with students from a wide range of nationalities. I firmly believe that diversity is a huge asset for our academic environment and should be fostered in all universities.

To conclude, doing project-based work with my students has been a highpoint of my teaching career. For me, few pleasures rival seeing them actively engaged in problem-solving, and as excited and curious about mathematics as I am. As always, I look forward to this rewarding and interactive relationship that inspires, enriches and drives my own research. If I was asked "what is the best thing about being a university professor?" I would answer: "working with students".

References:

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3. John A. Paulos. Innumeracy: Mathematical Illiteracy and Its Consequences. Hill and Wang, August 2001.
4. Nassim Nicholas Taleb. Fooled by Randomness: The Hidden Role of Chance in the Markets and Life. Paperback: Random House. Hardcover: New York, and London: Thomson Texere, April 2004 (1st Ed. November 2001), 2004.