TEACHING STATEMENT

ANTONI RANGACHEV

1. Introduction

Teaching has been always an important part of my life. In my high school, which is the premiere math educational institution in Bulgaria, I was often given the task by my teachers to lead the extracurricular sessions of the math club. At MIT I worked with very bright undergraduate and graduate students as a teaching assistant for the advanced undergraduate class 18.704 “Seminar in Algebra and Number Theory”, the graduate class 18.705 “Commutative algebra”, and as a tutor for undergraduate math classes at the tutoring center of the MIT math department. At Northeastern University I was frequently a TA for calculus for engineers classes and an instructor on record for calculus for business and economics majors. Apart from the classroom teaching experience, I have been involved as an academic tutor, lecturer and mentor in several programs for bright high school students such as the Research Science Institute (RSI) held annually at MIT and the High School Students Institute of Mathematics and Informatics organized by the Bulgarian Academy of Sciences.

2. Teaching

When lecturing to undergraduate students I emphasize understanding, motivation and applications. I always try to present the mathematical theory with just the right amount of rigor and focus on illustrating mathematical concepts with plenty of relevant down-to-earth examples. In the classroom I try to engage my students through Inquiry-Based Learning: I break my lectures with problems/examples and initiate discussions spurred by my questions getting involved in the process as many students as possible.

Sometimes I give my students a historical perspective of how certain results or concept were introduced and evolved throughout time. Last year, part of the final project for my business and economics students was to collect discrete data related to the marketing and production of a certain commodity. Then they were asked to produce a continuous model for the profits and expenditure, which in their case was a polynomial function in one variable that best approximates the data. Based on that model they were given the task to find the best marketing strategy.

Mathematically, this problem translates to finding the zeroes of the derivative of a polynomial. Some of my students approximated their data with a degree four polynomial of a single variable which meant that for the optimization they had to find the zeroes of a cubic equation. They asked me in class how to do it. I took the chance and told them about how the general formula for finding the solutions of a cubic equation was found in 16th century Renaissance Italy by Niccolo Tartaglia who won the mathematical competition of the university of Bologna outperforming his rivals by knowing the general method for solving this type of equations. Then the formula got stolen by Gerolomo Cardano which lead to a decade long rivalry between the two mathematicians. When my business students learnt about all the details surrounding this story some of them got so excited that they came to my office hours
and demanded I show them Tartaglia’s formula. Then they even asked me if such a formula 
exists for solving algebraic equations of any given degree which lead to another story about 
another great mathematician.

My calculus recitation and office hours have always been very interactive. I try to relate 
the new concepts and material to the students’ experience and things they have already seen 
before. I tend to give a different viewpoint from that introduced in class, which I believe 
helps my students mature and gain lasting understanding of the material covered. I always 
begin my recitations by reviewing some key examples that illustrate best the material covered 
in class. Then I proceed with solving problems suggested by the students by first asking for 
their input and suggestions about the kinds of approaches we should use for solving the given 
problem. At this stage of the recitation I often encourage for discussions among the students 
with an occasional intervention on my side.

It is very rewarding to see my students getting to appreciate mathematical ideas and master 
the mathematical tools that they will need later in their careers. It’s always nice to get positive 
feedback. The following are a few examples from my Fall of 2015 Calculus for Business and 
Economics majors:

“He is very enthusiastic about the course and it shows through his teaching. He cares about his students and wants them to do well. He is better than many teachers I have had.”

“He is very knowledgeable and enthusiastic. He is better than most math professors. Toni is a great professor and I would take another class with him if I could.”

“He is always willing to help students outside the classroom. He is probably the most enthusiastic about his subject. I do refer my friends to this professor. He is very willing to help outside the classroom through office hours, etc.”

3. Mentoring

Since 2006, while still a sophomore at MIT, I’ve been actively involved with mentoring high 
school students on research projects in mathematics. I have worked as an academic tutor at 
the Research Science Institute at MIT and a mentor, academic coordinator and lecturer at the 
High School Students Institute of Mathematics and Informatics (HSSIMI) at the Bulgarian 
Academy of Sciences. The RSI and HSSIMI are programs that provide talented students in 
the STEM fields with the opportunity to do research by pairing them with mentors who are 
professional researchers.

As an alumni of HSSIMI it was natural for me to go give back to the community that 
nurtured me. Every summer I take part in the Research Summer School of the program where I lecture and mentor three to four students on topics from combinatorics, algebraic 
number theory, geometry, etc. The summer school is meant to introduce students to research 
projects that they develop under the guidance of their mentors throughout the following two 
years and present them at number of national and international talent shows. It has been a 
very successful program so far, having hundreds of alumni for the past nearly 20 years, many 
of them already successful professional researchers in math and computer science.

It is with no small amount of pride that over the past ten years I have watched many 
of my students choose to major in mathematics in college, and some of them already have 
started graduate school. Here are some successful examples: Galin Statev did a two year 
long project on Fermat-Euler dynamics, graduated from MIT in 2013, and now is a PhD 
student in applied math at the Munich Technical University, Katrina Evtimova did a project
on number theory, graduated from Harvard in 2013 and now is a graduate student in applied
math at NYU; Momchil Konstantinov did a two year long project on the Chebotarev’s density
theorem, graduated from Oxford in 2014, and now is PhD in symplectic geometry at ULC;
Georgi Kerchev did project in arithmetic dynamics, graduated from Princeton in 2014, and
is currently a PhD at Georgia Institute of Technology.

Teaching and mentoring whether it’s with college or high school students has been an
enormously fulfilling experience that complements the pleasure of doing research mathematics.
As I progress with my career I look forward to mastering my teaching abilities and support
more high school students at the early stages of their mathematical upbringing.

(Rangachev), Department of Mathematics, Northeastern University, Boston, MA 02215, In-
stitute of Mathematics and Informatics, Bulgarian Academy of Sciences, Akad. G. Bonchev,
Sofia 1113, Bulgaria