AFTERMATH

Does the Masters Degree in Mathematics Get too Little Respect?

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If you think about the history of science, mathematics sits in a unique position: everything that has ever been true in mathematics is *still* true! We no longer believe that the elements are Earth, Air, Fire, and Water, for example, but Euclid's description of geometry in the plane is still correct. Modern physics rests on developments from the late 19th century onwards, with recognition that Newton's discoveries provide a working foundation. Modern chemistry is largely a 20th century science, and molecular biology starts with the discovery of the role of DNA in the mid-20th century. A fundamental difference between undergraduate education in mathematics and that of the other sciences is that we (mostly) take students to the early 20th century or so, while the other sciences take students to the research forefront.

As an example, a few years ago I taught a course on computational neuroscience for juniors and seniors with a mathematical background *or* a biological background (pre-requisites: two semesters of calculus for biology students and courses through differential equations for math students, *and* at least junior standing in a mathematics, statistics, engineering, or biological sciences major. Note that *no* biology prerequisites were asked of the math students). During the semester, we read a research paper from 1988. The math students were astonished: they mostly had never seen a research paper, or if they had, they had never seen one that new! The biology students were also astonished: they had seen many research papers, but they had never seen one that *old*!

Thus our science colleagues have a quite different perspective on undergraduate and graduate education than we do. A Ph.D. in chemistry at Purdue University requires two (two!) classroom courses and the rest is research. A Ph.D. in mathematics usually includes 10 – 15 classroom courses!

My own opinion is that the study for the M.S. degree is the most intensive learning experience in the mathematical sciences. Much more mathematics is learned than at the undergraduate level because the study is so much deeper, and more is learned than at the Ph.D. level because there the learning is specialized and research-focused. Thus, first and foremost, I regard the M.S. as the time when students acquire a broad and deep understanding of mathematics.

Further, most of the M.S. degree program is devoted to studying late 19th, 20th, and 21st century mathematics. Indeed, an M.S. program should put a student close (say 1950's – 1970's era) to the research forefront in at least one area. Most M.S. programs include Ph.D. qualifier-level courses. This is fundamental, broad, and deep material in comparison to undergraduate work.

As a profession, we put too little emphasis on the M.S., and give it too little respect. We should be encouraging many more of our undergraduate students to go to graduate school and get an M.S. degree. Mathematics faculty are good at encouraging our "best" students to go to graduate school, but we should be encouraging the top third of our students to go on—they are surely qualified for the experience and would benefit greatly from the added education.

Moreover, the job surveys I'm familiar with suggest that the M.S. is the most marketable degree in the mathematical sciences. This is a consequence, I believe, of the fact that M.S. students know much more mathematics than undergraduates, and are less likely than Ph.D.'s to be "distracted" by research interests (in the minds of those who are looking for mathematical expertise in filling their job openings).

There are several important career paths for M.S. degrees. The M.S. in statistics is the professional degree for a statistician. As I understand it, except for specialized areas such as the pharmaceutical industry where the Ph.D. is preferred, most "working" statisticians have an M.S. in applied statistics or biostatistics. The Two-Year-College faculty member in mathematics is usually expected to have a "vanilla" M.S. in mathematics with enough statistics background to be able to teach beginning statistics courses. Both of these career paths are full of opportunities!