

# The Sky Is Falling

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The reason for writing this piece is our belief that our profession is in desperate trouble—immediate and present danger. The absolute numbers and the trends are clear. If something is not done soon, we will see mathematics department faculties decimated and an already dismal job market completely collapse. Simply put, we are losing our students.

In 1989, concerned by dropping undergraduate enrollment in mathematics courses during a period when the use of mathematics in other fields had grown dramatically, we conducted a new type of study. This study, supported by the Exxon Education Foundation, looked at the enrollment in mathematics courses above the level of calculus being offered in departments other than mathematics. To avoid possible confusion, we chose to exclude those courses taught in departments of statistics.

We published a pamphlet, “Math Outside of Math” [1], with our findings and sent a copy to every mathematics department chair. The *Notices* [2] published an article containing the major results of the survey. Briefly, we found that enrollment in advanced mathematics courses offered in non-math departments in the academic year 1988–89 was 173,200 (plus or minus 28,500). The figure for enrollment in mathematics department advanced courses for 1990, as given in the 1990 Conference Board of Mathematical Sciences (CBMS) Survey of

Mathematics [3], was 119,000. This figure, however, covers just the fall semester.

In addition to the raw data in the quantitative part of our survey, we asked the responding departments why they in fact offered what were essentially advanced mathematics courses. A summary of their responses was included in the pamphlet and in the *Notices* article. We note here that three of the major reasons given were that some of the material they wished to cover was not offered in their math department; that some of the material they wanted was indeed offered in the math department, but in too many courses to fit their majors’ schedules; and that our courses had no useful applications in their field.

The penultimate paragraph of our report is worth repeating: “We are anxious to get the reactions of the broader mathematical community. Towards that end we have written to chairs and put an article in the *Notices* summarizing our findings in order to begin a public debate....” The *Chronicle of Higher Education* wrote an article about our study before its publication. In two weeks we received some 250 letters—none from mathematicians. After the publication of the *Notices* article, we received nine letters from mathematicians, only two of whom expressed alarm (the other seven basically said, so what?). We began to feel like Cassandra or, more to the point, Chicken Little.

But now with the publication of the 1995 CBMS Survey [4], it is clear that the sky is actually falling. The survey divides undergraduate mathematics classes into four categories: Remedial, Pre-Calculus, Calculus, and Advanced. Here are the figures for 1985, 1990, and 1995 in thousands for four-

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year colleges and universities. For an excellent summary of the data, see [5].

	1985	1990	1995	% Change 1990-1995	% Change 1985-1995
Remedial	251	261	222	-15	-12
Pre-Calculus	593	592	613	4	4
Calculus	637	647	539	-17	-15
Advanced	138	119	96	-19	-30

While we do not claim to know the reasons for each of these declines and it is likely that they are quite different for the different course groupings, the net result has strong implications for the academic job market. Even if we leave out the Remedial courses, totaling the remaining three groups, we have a drop of 17 percent in the past five years—130,000 students. Even with an overestimate of average class size of 40 students, that means a loss of 3,250 sections. With a teaching load of four courses, we just lost over 800 jobs. See [6] for actual trends in faculty composition data.

It is important to emphasize what we know and what we need to learn more about. Our original study of advanced enrollment was to our knowledge a base-line study. We documented what was (to us) a surprisingly large undergraduate enrollment in advanced mathematics courses in non-math departments. We now note a further decline in advanced mathematics enrollment, as documented by CBMS. It is conceivable that this falling enrollment is due to some other factors such as a drop in total enrollment in advanced quantitative work. However, given our fears and the draconian nature of the recent CBMS numbers, we are committed to undertaking a Math Outside of Math II study to see if in fact the decline in advanced enrollment within mathematics departments is matched by an increase in enrollment outside of math departments. Based on our prior experience and anecdotal data, we firmly believe this to be the case. But whatever the reasons, one fact stands out—in the ten-year interval from 1985-95 we have lost 30 percent of our enrollment in advanced mathematics—30 percent!

We have more numbers, more charts. But we want to stop here to reiterate our main points. The 1995 CBMS report shows a marked decrease in enrollment in mathematics courses at four-year colleges and universities. It clearly shows that calculus and especially advanced enrollment are in sharp decline. We believe that this decline is an extension of a trend we pointed out in 1990, namely, that students are increasingly taking their advanced mathematical training in non-mathematics departments. These trends taken together are costing jobs and, we fear, eventually whole departments.

We would like to be wrong. There is very little pleasure (well, maybe a wee bit) in saying we told

you so. What is important is the future of undergraduate mathematics instruction—for our students and ourselves. We have to take a long look at what is actually happening. Where and how is mathematics being taught at our nations' colleges? We are especially concerned, as this is yet another example of a phenomenon which may handicap new faculty, whom we are training for a world which may no longer exist. We have to stop eating our young!

We would like to close with one more thought. This is not an issue of left or right, of reform or status quo. This is an issue of survival. We are losing students; we are losing faculty. We need to understand why and, if possible, find ways to reverse these trends. If we decide not to or we are not capable of doing so, then we must plan for the new reality and train our graduates accordingly. To quote from the last line of Geoff Davis's recent *Notices* article [7]: "The future of the profession and the next generation of mathematicians depend upon it."

## References

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- [5] DONALD C. RUNG, *A Survey of Four-Year and University Mathematics in Fall 1995: A Hiatus in Both Enrollment and Faculty Increases*, *Notices Amer. Math. Soc.* **44** (September 1997).
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