Mathematics Majors 2002

David J. Lutzer

Three recent reports contain important and sometimes conflicting data on undergraduate mathematics majors. The first is the Conference Board of the Mathematical Sciences (CBMS) report *CBMS2000: Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States* [4], published by the AMS and available on-line at `http://www.ams.org/cbms/`. The second is part three of the AMS-IMS-MAA-ASA Joint Data Committee annual report [1], [2], available online at `http://www.ams.org/employment/surveyreports.html`. The third is the National Science Foundation (NSF) report *Science and Engineering Indicators 2002* (SEI-02) [5], available at `http://www.nsf.gov/sbe/srs/seind02/start.htm`.

The first two reports deal directly with the mathematical sciences, while NSF's SEI-02 report [5] deals with science, very broadly defined. As a result, to get data on the nation's effort in undergraduate mathematics, one must consult the report's appendix tables, available at `http://www.nsf.gov/sbe/srs/seind02/pdf_v2.htm`.

Unfortunately the three reports disagree with each other, sometimes markedly, and it is a challenge to understand what the facts about mathematics majors really are. But even with their conflicts, the three reports identify some common trends and have something important to say about how many undergraduate students major in mathematics, where they study, and who they are.

David J. Lutzer is professor of mathematics at the College of William and Mary, Williamsburg, VA. His email address is `Lutzer@math.wm.edu`.

Majoring in Mathematics

According to SEI-02 (Chapter 2, p. 18) about 25%–30% of entering freshmen intend to major in a science (including mathematics) or engineering field. SEI-02 does not present separate data on the percentage of entering freshmen who plan to major in mathematics, but combining certain figures in different parts of SEI-02 allows us to estimate that about 0.6% of entering freshmen intend to be mathematics majors.

SEI-02 Appendix Table 2-11 presents data on the intended major of entering freshmen by ethnic group. It shows some differences between ethnic groups as well as a decline in every ethnic group since 1985 among freshmen who want to major in mathematics (see Table I).

Table I: SEI-02: Percentage of Freshmen Intending to Major in Mathematics by Ethnic Group

SEI-02 Ethnic Group	1985	1990	1995	2000
White	1.1%	0.9%	0.7%	0.7%
Asian American	1.1	0.9	0.6	0.6
Black	0.7	0.5	0.7	0.5
Mexican American and Puerto Rican American	0.7	0.8	0.5	0.6
Other Latinos	NA	NA	0.5	0.3
American Indian	1.0	0.5	0.4	0.4

Of course, incoming freshmen often change their minds about their majors by the time they graduate. SEI-02 Appendix Table 2–17 allows us to compare the number of bachelors' degrees in mathematics (not

Table II: SEI-02: Bachelors' Degrees Awarded				
	1985	1991	1995	1998
All U.S. bachelors' Degrees				
	990,877	1,107,997	1,174,436	1,199,579
Mathematics bachelors' Degrees				
	15,267	14,784	13,759	12,363
% of Mathematics Degrees Among All bachelors' Degrees				
	1.54%	1.33%	1.17%	1.05%

including computer science) with the total number of bachelors' degrees awarded in all disciplines.

While the decline in the percentage of baccalaureates awarded in mathematics is disappointing, it is still worth noting that the percentage of undergraduates receiving mathematics degrees remains higher than the percentage of freshmen intending to major in mathematics. One optimistic interpretation is that students' college mathematics experience attracts them to major in mathematics and that, to some degree, freshman and sophomore mathematics courses *are* acting as a pump rather than a filter.

Data from SEI-02 Appendix Table 2–16 show that the percentage of women among mathematics majors has held steady at the 46%–47% range since 1985. This is consistent with, but slightly higher than, the 41%–42% range reported by CBMS surveys in 1995 and 2000.

The CBMS survey reports [3], [4] disagree with SEI-02 data about the total number of mathematics baccalaureates granted, and the CBMS surveys give much more detailed data (see Table III). The annual reports of the Joint Data Committee [1], [2] present a third picture of the number of mathematics majors. The Joint Data Committee estimates the number of junior and senior mathematics majors based on its annual survey of departments (see Table IV).

It is not surprising that the three estimates—from CBMS, NSF, and the Joint Data Committee—are different, if only because they use different

Table III: CBMS2000 Data on Bachelors' Degrees in Mathematics and Statistics Departments		
	CBMS1995	CBMS2000
Mathematics	14,294	13,664
Mathematics Education	4,829	4,991
Statistics	1,031	644
Total	20,154	19,299

Table IV: Joint Data Committee: Number of Junior and Senior Mathematics and Statistics Majors		
	1995	2000
Junior & Senior Mathematics Majors	67,100	59,400

data sources. SEI-02 draws its data from reports by colleges and universities to the U.S. Department of Education, and in these reports only primary majors are considered. Thus a physics major who added mathematics as a second major would not be included in the mathematics major total. By contrast, both CBMS2000 and the Joint Data Committee rely on surveys completed at the department level, and these surveys do not distinguish between primary and secondary majors. Another contrast is that both CBMS and SEI-02 data count the number of mathematics bachelors' graduates, while Joint Data Committee figures are based on departmental reports of the total number of junior and senior mathematics majors. Thus, to compare Joint Data Committee reports on the number of majors with SEI-02 and CBMS figures, presumably one would need to divide the Joint Data Committee figures by about 2. But even after this division, a very large disparity remains, and the extent of the disagreement among the three data sources about the number of mathematics majors in the U.S. is perplexing.

Where Do Undergraduates Major in Mathematics?

SEI-02 uses Carnegie Classifications to subdivide colleges and universities into groups. (The precise definitions of these Carnegie groups appear on page 10, Chapter 2, of the SEI-02 report.) SEI-02 reports that, while Research I and II universities enroll only 19% of the nation's students, they grant about 42% of all science and engineering bachelors' degrees.

To determine the situation in mathematics, the best we can do is to look at Appendix Table 2–5. Unfortunately, SEI-02 lumps mathematics and computer science together when studying which kinds of universities give bachelors' degrees in various disciplines. Table V shows the Carnegie classifications, the number of universities in each classification, and SEI-02's estimate of the percentage of all U.S. mathematics and computer science bachelors' degrees given by each type of school. The data come from SEI-02, Chapter 2, p. 9, and from Appendix Table 2–5 and deal with 1998.

CBMS2000 [4] also presents data on the number of mathematics bachelors' degrees awarded by various kinds of departments, based on the departmental classification (Groups I, II, III, M, and B)

typically used in AMS data. The CBMS2000 data deal with the 1999–2000 academic year and lead to conclusions that are quite different from those suggested by SEI-02 data for 1998 (see Table VI).

There are many possible explanations for the disparity between SEI-02 data and CBMS data about where mathematics bachelors' degrees are granted. The first is that SEI-02 lumps together mathematics and computer science majors, while the CBMS surveys do not. Second, the highest degree offered by a school's mathematics department might not be the same as the school's Carnegie Classification: for example, a Carnegie doctoral school might have only a bachelors'-level mathematics department. Third, as noted earlier, CBMS surveys count all mathematics majors, both primary and secondary, while most federal data count only primary majors. Fourth, SEI-02 data did not include mathematics education majors as mathematics majors, while the CBMS report did.

Table V: SEI-02: Mathematics and Computer Science Bachelors' Degrees by Carnegie Classification in 1998

Classification	Number of Schools in Group	Percentage of Mathematics & CS bachelors' Degrees
Research I & II	127	28.6%
Doctoral I & II	108	15.1%
Master's I & II	529	38.3%
Liberal Arts I & II	1,600	17.9%

Table VI: CBMS: Percentage of Bachelors' Degrees Awarded by Various Types of Departments: 1999–2000

Year	Degree Area	Ph.D. Dept.	M.A. Dept.	B.A. Dept.
1995	Math & Stat only	35%	28%	37%
1995	Math & Stat & Math Ed	31%	29%	40%
2000	Math & Stat only	33%	17%	50%
2000	Math & Stat & Math Ed	28%	20%	52%

What Percentage of Mathematics Majors Get Ph.D.'s?

The SEI-02 report shows the number of mathematics bachelors' degrees awarded to U.S. citizens. When combined with information from the Joint Data Committee on mathematical science doctoral degrees granted to U.S. citizens, the SEI-02 data allow us to give a rough estimate of the percentage of U.S. mathematics majors who eventually get a doctoral degree in the mathematical sciences. One approach is to compare the number of U.S. citizens receiving mathematics bachelors' degrees with the number of U.S. citizens receiving Ph.D. degrees in the mathematical sciences about six years later. Appendix Table 2–17 of SEI-02 shows that in the mid-1990s, about 13,000 U.S. citizens received bachelors' degrees each year in mathematics and statistics, a figure that is generally consistent with the number of bachelors' degrees in mathematics and statistics found by CBMS1995 [3]. Joint Data Committee figures (available in the 2000 Third Report at `http://www.ams.org/employment/deptprof.html`) show that 566 U.S. citizens received doctoral degrees in 1999–2000, and preliminary estimates show that at least 496 U.S. citizens received mathematical sciences Ph.D. degrees in 2000–2001. Computing the ratio 500/13,000 suggests that about 3.8% of U.S. citizen mathematics majors go on to receive doctoral degrees in the mathematical sciences about six years later.

Clearly, that 3.8% estimate is very rough: for example, it ignores students who might have an undergraduate major other than mathematics and who move into mathematical sciences during graduate school. It would be interesting to have better estimates of the percentage of U.S. mathematics majors who go on to complete various levels of graduate education in the mathematical sciences.

References

[1] D. Loftsgaarden, J. Maxwell, and K. R. Priestly, 2000 Annual Survey of the Mathematical Sciences (third report), *Notices Amer. Math. Soc.* **48** (2001), 819–28.

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[3] D. Loftsgaarden, D. Rung, and A. Watkins, *Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States: Fall 1995 CBMS Survey*, MAA Reports Number 2, Mathematical Association of America, Washington, DC, 1997.

[4] D. Lutzer, J. Maxwell, and S. Rodi, *CBMS 2000: Statistical Abstract of Undergraduate Programs in the Mathematical Sciences in the United States*, American Mathematical Society, Providence, RI, 2002.

[5] National Science Board, *Science and Engineering Indicators 2002* (NSB-02-1), National Science Foundation, Arlington, VA, 2002.