

# NOTICES

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## 1988 ANNUAL AMS-MAA SURVEY

*(Second Report)*

Vital Statistics in the Mathematical Sciences:

Distribution of Undergraduate Enrollments, Faculty Characteristics,

Update on New Doctorates, Fall 1988

*Edward A. Connors*

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Vital Statistics in the Mathematical Sciences:  
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### HIGHLIGHTS

1. The final (spring) count of new doctorates in the mathematical sciences records 372 U.S. citizens among the 828 recipients of doctorates granted by U.S. institutions from July 1, 1987 through June 30, 1988. Thus the sum total of U.S. citizens receiving doctorates in the last two years is less than a single year total in the mid-1970's.
2. Respondents from Groups B, M and III (see box on this page for descriptions of the groupings used in this Survey) report that approximately 1-3/4% of their fall 1987 full-time faculty retired permanently or died by fall 1988. The comparable number for Groups I, II and III combined is slightly more than 1-1/2%.
3. Group I respondents (33 of 39 departments) report that 64% of the fall 1987 undergraduate enrollments are distributed as follows: 9% in remedial mathematics (arithmetic, high school algebra, and geometry); 17% in traditional pre-calculus; 38% in first-year calculus.

4. Women comprise 47% of the U.S. citizen graduate students in Group IV (statistics, biostatistics and biometrics). However, U.S. citizens comprise only 49% of all the graduate students in Group IV.
5. Women comprise 47% of the junior/senior mathematics majors in Group B in fall 1987, and 44% of those in Group M. In Groups I, II and III combined, women comprise 40% of the junior/senior mathematics majors.

A first report of the 1988 Survey appeared in the November 1988 *Notices*, pages 1301-1332. It included a report on the 1987-1988 new doctorates, starting salaries, faculty salaries, and a list of the names and thesis titles of the 1987-1988 doctorates. A supplementary list of 1987-1988 doctorates appeared in the April 1989 *Notices*.

The 1988 Annual AMS-MAA Survey represents the thirty-second in an annual series begun in 1957 by the Society. The 1988 Survey was under the direction of the AMS-MAA Committee on Employment and Educational Policy (CEEP), whose members were: Morton Brown, Stefan A. Burr, Edward A. Connors (chair), Phillip C. Curtis, Jr., David J. Lutzer, Donald C. Rung and James J. Tattersall. The questionnaires were devised by CEEP's Data Subcommittee whose members were: Edward A. Connors (chair), Lincoln K. Durst (consultant), John D. Fulton, James F. Hurley, Charlotte Lin, Don O. Loftsgaarden, David J. Lutzer, James W. Maxwell (ex officio), Donald E. McClure, and Donald C. Rung. Comments or suggestions regarding this Survey may be directed to the subcommittee.

**Groups I and II** include the leading departments of mathematics in the U.S. according to the 1982 assessment of Research-Doctorate Programs conducted by the Conference Board of Associated Research Councils in which departments were rated according to the quality of their graduate faculty.<sup>1</sup>

**Group I** is composed of 39 departments with scores in the 3.0-5.0 range.

**Group II** is composed of 43 departments with scores in the 2.0-2.9 range.

**Group III** contains the remaining U.S. departments reporting a doctoral program.

**Group IV** contains U.S. departments (or programs) of statistics, biostatistics and biometrics reporting a doctoral program.

**Group V** contains U.S. departments (or programs) in applied mathematics/applied science, operations research and management science which report a doctoral program.

**Group Va** is applied mathematics/applied science; **Group Vb** is operations research and management science.

**Group VI** contains doctorate-granting departments (or programs) in the mathematical sciences in Canadian universities.

**Group M** contains U.S. departments granting a master's degree as the highest graduate degree.

**Group B** contains U.S. departments granting a baccalaureate degree only.

<sup>1</sup>These findings were published in *An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences*, edited by Lyle V. Jones, Gardner Lindzey, and Porter E. Coggeshall, National Academy Press, Washington, D.C., 1982. The information on mathematics, statistics and computer science was presented in digest form in the April 1983 issue of *Notices*, pages 257-267, and an analysis of the above classifications was given in the June 1983 *Notices*, pages 392-393. For a listing of departments in Groups I and II see April 1988 *Notices*, pages 532-533.

## Annual AMS-MAA Survey

## I. INTRODUCTION

We report on several items of general and specific interest to the mathematical community, based on our analysis of the data compiled in the 1988 Annual AMS-MAA Survey. We begin with an update on the size and employment status of the 1987-1988 class of new doctorates, and then we direct our attention to the information provided by the departmental responses to the surveys on Faculty Mobility and Enrollments and Departmental Size.

In contrast to prior years' reports, we chose not to extrapolate from the raw data. Thus, for example, we do not provide estimates of various faculty populations or course enrollments, as was done in past survey reports. Instead, we focus on faculty retirement and death rates (Table 3A), enrollment distribution patterns (Table 4), faculty composition by sex (Tables 3B and 3C), and percentages of women among our junior/senior level mathematics majors and graduate students (Tables 5 and 7). Some of the data on the male/female distribution among mathematics faculty and students appear in this Survey for the first time. We leave it to the 1990 Conference Board on Mathematical Sciences (CBMS) Survey to provide the next best estimates on various faculty populations and student enrollments.

**Table 0: Useable Responses  
(Percentage of Surveyed Departments)**

	Groups							
	I	II	III	IV	V	VI	M	B
Enrollments and								
Departmental Size*	79	84	73	68	35	68	44	38
Faculty Mobility	69	65	70	59	35	64	43	35

\*There are 4 parts to the Enrollments and Departmental Size form (Enrollments, Majors, Departmental Size, and Graduate Students). The number given is the number of returns with a useable response on the departmental size.

## II. UPDATE ON THE 1987-1988 NEW DOCTORATES

In the First Report of this Survey (November 1988 issue of *Notices*, pages 1301-1332) we reported 804 new doctorates in the mathematical sciences granted by U.S. universities—this is the fall count. There were an additional 24 new doctorates from U.S. universities with a Group I, II, III, IV or Va classification. We now update tables from the First Report (New Doctorates, Fall and Spring Counts, and New Doctorates awarded by Groups I-Va, VI, see November 1988 *Notices*, page 1302) with this new information to produce the 1987-1988 spring

counts: 828 new doctorates awarded by U.S. universities, 55 by Canadian universities, for a total of 883 (U.S. and Canada). Of the 828 new doctorates awarded by U.S. universities, 372 went to U.S. citizens (citizenship is known for 816 of the 828 new doctorates). Of the 372 U.S. citizen new doctorates, 294 were men, 78 women. The spring count for Canadian institutions is: 55 new doctorates—45 men, 10 women. Tables 1A, 1B and 1C give spring counts of new doctorates.

**Table 1A: New Doctorates  
U.S. and Canadian Institutions,  
Fall and Spring Counts**

	1982- 1983	1983- 1984	1984- 1985	1985- 1986	1986- 1987	1987- 1988
Fall	792	789	769	801	845	856
Spring	840	827	807	827	874	883

**Table 1B: New Doctorates  
U.S. Institutions, Spring Count**

1982- 1983	1983- 1984	1984- 1985	1985- 1986	1986- 1987	1987- 1988
796	775	765	782	808	828

**Table 1C: New Doctorates  
Awarded by Groups I-Va, VI, Spring Count**

1982- 1983	1983- 1984	1984- 1985	1985- 1986	1986- 1987	1987- 1988
767	735	755	743	809	815

Employment data for new doctorates are updated in Tables 2A, 2B and 2C. We do not, however, include the additional new doctorates in our updated employment matrices.

For the fourth consecutive year approximately 20% of the new doctorates reported taking foreign academic or nonacademic employment (Table 2A).

Women comprise 18% of the new doctorates. 23% of the 153 new women doctorates found employment in the doctorate-granting institutions, Groups I-V. Although only 15.5% of the new doctorates hired by the doctorate-granting institutions I-V were women, this is 3 percentage points better than last year. Women accounted for 18% of the new doctorates hired by Group M, and 20% of the new doctorates hired by Group B.

## Annual AMS-MAA Survey

Table 2A: Employment Status of 1987-1988 New Doctorates  
in the Mathematical Sciences

Type of Employer	PURE MATHEMATICS						Statistics	Computer Science	Operations Research	Applied Mathematics	Discrete Mathematics	Other	Total
	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability								
Group I	15	18	25	3	3	3		2	11	1	6		87
Group II	10	10	8	1	3	2	1	1	5		1		42
Group III	11	6	3	1		8			21	2	1		53
Group IV		1			3	28	1				1		34
Group V								5	5		1		11
Masters	13	9	11	1	2	14	2	3	14	2	6		77
Bachelors	17	17	7	4	1	4			15	1	5		71
Two-year College or High School	1	2				1			1	1	1		7
Other Academic Departments	6	6	1	2	2	21	2	7	15		16		78
Research Institutes	3	2	1			5		1	3		3		18
Government		1				8		3	1		2		15
Business and Industry	3	5	4		2	32	3	14	21	1	10		95
Canada, Academic	6	14	4	2	2	6	1	1	4	1	3		44
Canada, Nonacademic			1			1							2
Foreign, Academic	25	24	15	8	3	34	4	16	17	1	10		157
Foreign, Nonacademic	2	2	3			2	1	4	3		3		20
Not seeking employment		3		1		1	1						6
Not yet employed	2		2	1		1			3	1	1		11
Unknown	5	8	3		1	2		2	6		1		28
Total	119	128	88	24	22	173	16	59	145	11	71		856

Table 2B: Employment Status of 1987-1988 New Doctorates  
in the Mathematical Sciences  
Females Only

Type of Employer	PURE MATHEMATICS						Statistics	Computer Science	Operations Research	Applied Mathematics	Discrete Mathematics	Other	Total
	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability								
Group I	5		2					1	2		1		11
Group II	2	1	2	1	1		1	1	2				11
Group III	2	1		1									4
Group IV					1		7					1	9
Group V													
Masters	2		1		1	1	1		3	2	3		14
Bachelors	5	5				1			2	1			14
Two-year College or High School	1	1				1			1	1			5
Other Academic Departments	1			1		4		2			5		13
Research Institutes						2			1				3
Government		1				1		1					3
Business and Industry	2	1	1			9	1		4		3		21
Canada, Academic	1	3		1		1			1				7
Canada, Nonacademic						1							1
Foreign, Academic	4	4		1	1	10		1	1		2		24
Foreign, Nonacademic	1	1				1			1		1		5
Not seeking employment		1				1							2
Not yet employed									1				1
Unknown	1	2	1			1							5
Total	27	21	7	5	4	41	3	6	19	4	16		153

## AMS-MAA Annual Survey

Table 2C: Fields of New Doctorates

Number (Fall Count) Specialty:	Year Surveyed					
	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988
	792	789	769	801	845	856
Applied Math	103 (13%)	110 (14%)	115 (15%)	149 (19%)	142 (17%)	142 (17%)
Statistics	188 (24%)	173 (22%)	189 (25%)	171 (21%)	182 (22%)	173 (20%)
Operations Research	63 (8%)	66 (8%)	41 (5%)	62 (8%)	51 (6%)	59 (7%)
Computer Science	18 (2%)	20 (3%)	15 (2%)	16 (2%)	18 (2%)	16 (2%)
Total	372 (47%)	369 (47%)	360 (47%)	398 (50%)	393 (47%)	393 (46%)

The research fields of the new doctorates continue to have an applied flavor (see Table 2C). For the last five years half, or nearly half, of the new doctorates specialized in statistics, applied mathematics, operations research, or computer science. In fact, in each of the years in question between one-fifth and one-fourth of the degrees were in statistics.

Groups I-IV hired 214 new doctorates (23 more than last year) and Group M hired 77 (8 more than last year). The totals of new doctorates hired by business, industry or government, or appointed by research institutes, were down considerably.

Finally, we note that the names of the 1987-1988 new doctorates and their thesis titles were published in the *Notices* (November 1988 issue and a supplemental list in the April 1989 issue).

### III. FACULTY CHARACTERISTICS

In Table 3A we provide the attrition rates of full-time faculty and full-time doctoral faculty by groups. The numbers we report are obtained from the departmental response to our request for the numbers of full-time faculty (doctorate and non-doctorate) in fall 1987 who had permanently retired or died by fall 1988. The 1989 AMS-MAA Survey will attempt to ascertain more

information on age distribution of full-time faculty and thus better analyze the greying of the contemporary mathematical sciences faculty.

Table 3A: Faculty Attrition\*

Group	Full-time Faculty	Full-time Doctoral Faculty
	%	%
I	1.26	1.27
II	1.65	1.69
III	1.76	1.62
I+II+III	1.57	1.52
IV	.99	1.03
V	.88	.9
B	1.72	1.52
M	1.73	1.19
B + M	1.72	1.34

\*Percentage of full-time faculty who were in the department in fall 1987 but were reported to have retired (and not seeking employment) or died by fall 1988.

In Table 3B we provide percentages of women among the full-time doctoral faculty in Groups I-V, M and B and in Table 3C we give the percentages of women among full-time faculty in Groups M and B.

## Annual AMS-MAA Survey

**Table 3B: Percentage of Women among Doctoral Full-time Faculty**

Groups							
I	II	III	I+II+III	IV	V	B	M
4.4%	6.5%	7.7%	6.2%	10.8%	3.4%	16.3%	12.7%

**Table 3C: Percentage of Women among Full-time Faculty, Groups B and M**

Group B	Group M
24%	20%

**IV. UNDERGRADUATE ENROLLMENT PROFILE AND MAJORS**

In Table 4A we give the percentage change from fall 1987 to fall 1988 in undergraduate enrollment in mathematical sciences.

In Table 4B we provide the undergraduate enrollment distributions in remedial mathematics (defined on our survey forms as arithmetic, high school algebra or geometry), traditional pre-calculus, and first-year calculus. We do not distinguish between hard core and soft core first-year calculus. It is somewhat startling, but by no means novel, that approximately 65% of the undergraduate enrollments in Groups I and II are in these three course groupings and, indeed, that 10% or nearly 10% is in remedial mathematics courses. Yet the 10% rate is only slightly more than half the comparable rate for the Group B respondents. As we wrote in last year's report, "remedial mathematics and 'pre-calculus' continue to consume a considerable chunk of collegiate mathematics education." Given the current state of K-12 mathematics, what will be the size of the chunk when this year's kindergartners enter college at the dawn of the 21st century?

**Table 4A: Percentage Change from fall 1987 to fall 1988 in Undergraduate Enrollments**

Groups				
I	II	III	B	M
-3%	0%	+2%	+3%	+3%

**Table 4B: Undergraduate Enrollments Distribution**

Group	Remedial Math. (arith., h.s. alg., geometry)	Remedial Math. + pre-calculus	Remedial Math. +pre-calculus +1st-yr. calculus
	%	%	%
I	9	26	64
II	10	36	65
III	16	39	62
I+II+III	12	35	64
B	19	36	51
M	17	34	50
M+B	18	35	50

It is often thought, and sometimes expressed, that one of the reasons for the sizes of the cohort of women among the new doctorates in the mathematical sciences (roughly 20% among U.S. citizens for the past six years) is a correspondingly low rate among undergraduate mathematics majors. This misconception persists perhaps because the data are not so widely publicized as the doctoral data. In Table 5 we provide the percentages of women among junior/senior mathematics majors. Note that these percentages are 47% and 44% in Groups B and M respectively.

**Table 5: Percentage of Women among Junior/Senior Majors (including double majors)**

Groups							
I	II	III	I+II+III	IV	V	B	M
36%	39%	42%	40%	43%	34%	47%	44%

**V. GRADUATE ENROLLMENTS IN THE MATHEMATICAL SCIENCES, SEX AND CITIZENSHIP**

Table 6 provides the percentage change in enrollments in graduate courses in the mathematical sciences, from fall 1987 to fall 1988. In Table 7 we provide the percentage of women among the U.S. citizens in the graduate populations. Table 8 gives fall 1988 data on U.S. citizens in the graduate cohort.

Annual AMS-MAA Survey

**Table 6: Graduate Enrollments**  
Percentage change fall 1987 to fall 1988

	Groups				
	I	II	III	I+II+III	IV
	%	%	%	%	%
First year, full-time	-8	-6	-1.2	-6	+2
All years, full-time	+5	-1	+4	+3	+6

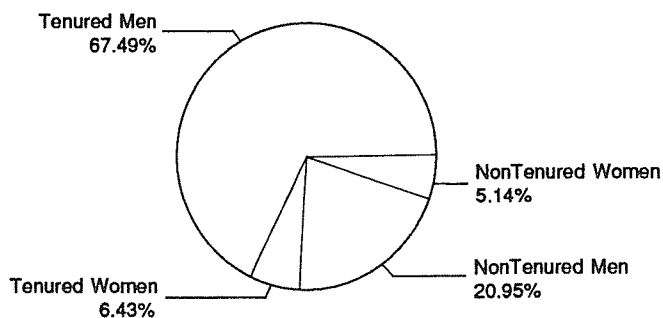
**Table 7: Percentage of U.S. citizen women among U.S. citizen graduate students**

	Groups						
	I	II	III	I+II+III	IV	V	M
	%	%	%	%	%	%	%
First year, full time	27	30	42	33	48	40	40
All years, full-time	24	29	38	29	47	20	40

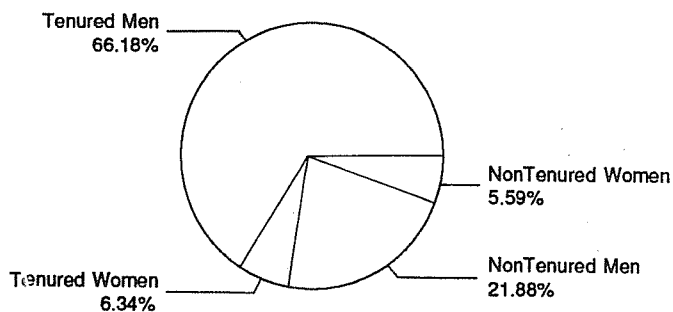
**Table 8: Citizenship of Graduate Students**  
(Percentage of U.S. Citizens among Graduate Students whose citizenship is reported as known) Fall 1988

	Groups				
	I	II	III	IV	M
	%	%	%	%	%
First year, full time	59	60	63	53	81
All years, full-time	54	53	61	49	74

Data drawn from the 1988 Survey on Faculty Salaries, Tenure and Women, show the following picture of the composition of doctoral faculty in the mathematical sciences. These data are based on responses slightly different from those responses providing the data presented in Tables 3B and 3C.



**Fig. 1: Composition of Professorial Ranks with Ph.D., 1988-1989 (All Groups)**



**Fig. 2: Composition of faculty with Ph.D., 1988-1989 (All Ranks, All Groups)**

**ACKNOWLEDGEMENT**

The Annual AMS-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical scene vital to the entire mathematical community. Yearly, collegiate departments in the United States, and the doctorate-granting departments in Canada, are provided the opportunity to respond. The quantity and quality of the responses directly determine the quality of the information in these reports. Without the dedicated cooperation of the secretarial and administrative support staff in the mathematical science departments we would not be able to conduct a survey, nor be confident in our analysis of its results. We are, unfortunately, unable to thank personally all the departmental assistants for their cooperation, but it is nonetheless appreciated. However, we are able to thank the administrative support staff of the AMS, especially Marcia Almeida, Monica Foulkes, and James W. Maxwell, whose efforts are acknowledged and appreciated.

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## Annual AMS-MAA Survey

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