NOTICES
OF THE
AMERICAN MATHEMATICAL SOCIETY

1992 Annual AMS-MAA Survey

(Second Report)

Enrollments, Faculty Characteristics, and
Update on New Doctorates

Donald E. McClure

Reprinted from *Notices*, July/August 1993

Printed in the United States of America

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1992 Annual AMS-MAA Survey

(Second Report)

Enrollments, Faculty Characteristics,

and Update on New Doctorates, Fall 1992

Donald E. McClure

This is the second report of the 1992 Survey. A first report appeared in the November 1992 *Notices*, pages 1026–1060. It included a report on the 1991–1992 new doctorates, starting salaries, faculty salaries, and a list of names and thesis titles of the 1991–1992 doctorates. A supplementary list of 1991–1992 doctorates appears in the April 1993 issue of the *Notices*.

The 1992 Annual AMS-MAA Survey represents the thirty-sixth in an annual series begun in 1957 by the Society. The 1992 Survey was under the direction of the AMS-MAA Data Committee whose members are Edward A. Connors, Lincoln K. Durst (consultant), John D. Fulton, James F. Hurley, Don O. Loftsgaarden, Charlotte Lin, David J. Lutzer, James W. Maxwell (*ex officio*), Donald E. McClure (chair),and Donald C. Rung. Comments or suggestions regarding the Annual Survey may be directed to members of the AMS-MAA Data Committee.

For these reports, departments are divided into groups according to the highest degree offered in the mathematical sciences:

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.[1]

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 that report a doctoral program.

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

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.

[1]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 the *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 the April 1988 *Notices*, pages 532–533.

Highlights

- The final (spring) count of new doctorates shows a total of 1062 doctorates in the mathematical sciences awarded by U.S. institutions in the period July 1, 1991, through June 30, 1992. This is 6% less than the peak 1990–1991 count.
- The final count shows 446 U.S. citizens among the 1042 doctoral recipients whose citizenship status is known. This is the second highest count of U.S. citizen new doctorates in the last ten years but is 7% below last year's final count.
- A total of 596 non-U.S. citizens were awarded doctorates in 1991–1992. This count remains near the record high of 611 in 1990–1991 and is the first decrease in the number of non-U.S. citizens since the persistent growth in numbers started in 1978–1979.
- Recruitment of new faculty showed a sharp decrease for the second year in a row. The mathematics departments in the U.S. attempted to fill 9% fewer full-time positions in 1991–1992 than in 1990–1991. The cumulative effect of the two-year decline translates into recruitment for 28% fewer positions in mathematics departments in 1991–1992 than in 1989–1990.
- The final unemployment figure for 1991–1992 new doctorates represents a record high rate of 6.7% at the time of the spring update of employment status. An additional 4.3% of the new doctorates took part-time employment. Total employment of new doctorates decreased in doctorate-granting departments and in the nonacademic sector (government, business and industry) from levels of the previous year.
- For the second year in a row, the number of undergraduate, junior/senior majors in mathematics departments increased. In fall 1992 there were approximately 73,000 majors in mathematics departments in the U.S. of whom 44% were women.

I. Introduction

The Annual AMS-MAA Survey collects information each year about departments, faculties, and students in the mathematical sciences at four-year colleges and universities in the United States. This article reports results from two parts of the 1992 Annual AMS-MAA Survey. First, we update information about new doctorates reported earlier in the November 1992 issue of the *Notices* (see pages 1026–1033). Second, we present results about the characteristics of faculties and of instructional programs at the undergraduate and graduate levels.

In the interest of continuity in the analysis and presentation, and to make year-to-year comparisons possible, we report the same kinds of information that were included in last year's Second Report. New details are presented concerning employment patterns for new doctorates, the distribution among departments of women faculty, and distribution of enrollments in different types of departments.

We follow the procedure started in last year's Second Report of reporting projections of survey responses to the entire population of mathematical sciences departments. The projections of survey responses to the entire population are done within strata defined by the survey Groups. For example, on the part of the Departmental Profile Survey concerned with faculty, there were 35 usable responses from the 39 departments in Group I (see Table 3A). The 35 responding departments reported 49 full-time faculty to have retired or died, and this tally was multiplied by 39/35 to obtain the projected value of 55 for the Group as a whole.

We caution the reader that the survey responses and the proportional projections are potentially biased due to (i) selection bias of the responding departments and (ii) inhomogeneity of departments within the survey Groups. Indeed, we know that the four nonresponding Group I departments in the 1992 Annual Survey are larger departments on the average than the four nonresponding Group I departments in the previous year's survey. The responses and projections for total faculty size are slightly affected by this bias. Nonetheless, the problems of a possible selection bias are mitigated by the generally high response rates to the Annual Survey. In Groups with lower response rates (e.g., Groups M and B), there is greater risk of biased projections. We are currently experimenting with recently developed methods for controlling for nonresponse in surveys and are likely to use these methods as soon as statistical software for their implementation becomes generally available.

II. Update on the 1991–1992 New Doctorates

Information about new doctorates awarded between July 1, 1991, and June 30, 1992, was collected from doctorate-granting departments in late spring 1992 and from a follow-up census of individual degree recipients. The First Report of the 1992 Annual Survey (November 1992 issue of the *Notices*, pages 1026–1033) presents the survey results obtained about new doctorates up to late September 1992. Here we update the earlier figures on the basis of more complete returns.

Table 1: New Doctorates, Fall and Spring Counts

	1987–88		1988–89		1989–90		1990–91		1991–92	
	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
U.S.	804	828	905	919	933	950	1074	1125	1050	1062

The spring count of new doctorates (Table 1) shows a total of 1062 doctorates in mathematical sciences awarded by U.S. institutions. The final count is a 6% decrease from the previous year. Still, it is 12% greater than the 1989–1990 count and 31% greater than the count of five years ago (808 in 1986–1987).

Citizenship status is known for 1042 of the new doctorates. The total of 446 U.S. citizens is 7% lower than the previous year's spring count but remains the second highest tally in the last ten years. The percentage of U.S. citizens (43%) has held constant at its all-time low of 43% since 1989–1990.

For the first year since 1978–1979, the number of non-U.S. citizen new doctorates has shown a slight decline. The final spring count shows 596 non-U.S. citizens, a decrease of 2% from last year's record high of 611. The number of non-U.S. citizens is 110% greater than the count in 1981–1982. The First Report (page 1031) describes changes in numbers of new doctorates from different geographical regions since 1983.

Among U.S. citizens, the final tally shows 104 women and 342 men. The percentage of women (23%) among U.S. citizens is substantially higher than the percentage (19%) among non-U.S. citizens.

Employment data for new doctorates, broken down by field of their thesis research and by the survey Group of their degree-granting department, is updated in Tables 2A and 2B. The employment matrices report the status of the 1050 new doctorates included in the fall count; employment status is known for 994. Overall, the majority (59%) of new doctorates assumed academic positions in the U.S.; the percentage assuming academic positions, regardless of country, is 78%. Both of these percentages are down by one point from 1990–1991. The proportions assuming academic vs. nonacademic positions vary greatly with the field of thesis. For example, in probability, statistics, and applied mathematics 17% of the new doctorates assumed nonacademic positions, while only 9% of the doctoral recipients in all other fields took nonacademic jobs. The First Report shows additional differential patterns of employment depending on citizenship status of the new doctorate.

There were substantial changes in total employment in some sectors from last year. Total employment reported in Ph.D.-granting departments (229) decreased 20% from 1990–1991. Foreign academic employment (190) was 44% greater than last year (132). Employment in the nonacademic sector (120) decreased 29% from the unusually high figure of 168 in 1990–1991.

The updated matrix shows 67 new doctorates (6.7%) still seeking employment. This figure does not include non-U.S. citizens who are known to have returned to their country of origin and who may be still seeking employment outside the U.S. At the same time last year, 5% of the 1990–1991 new

Table 2A: Employment Status of 1991–1992 U.S. New Doctorates in the Mathematical Sciences, updated March 1993

TYPE OF EMPLOYER	FIELD OF THESIS										TOTAL
	Algebra/ Number Theory	Real or Complex Analysis	Geometry/ Topology	Logic	Probability/ Statistics	Applied Math	Discr. Math/ Combina-torics	Numerical Analysis	Linear or Nonlinear Optim.	Other	
Group I	16	11	23	3	13	28	5	8		1	108
Group II	6	4	9	1	7	4	2	3	2	2	40
Group III	6	2	5	2	6	12	6	6	1	4	50
Group IV	1				23						24
Group V						5			1	1	7
Masters	17	16	6	3	13	11	10	5		2	83
Bachelors	19	29	28	8	13	17	9	6	2	7	138
Two-year Colleges	3	1	4		2	1	3				14
Other Academic Departments	1	1		2	25	14	4	4	6	7	64
Research Institutes	9	4	6		27	10		3		2	61
Government			2		6	3		4			15
Business and Industry	5	6	5	1	44	15	7	6	8	8	105
Foreign, Academic	23	31	27	5	48	28	8	12	3	5	190
Foreign, Nonacademic	1	1		1	6	3		2	2		16
Not seeking employment	1	2	2	1	1	5			1		13
Still seeking employment	11	12	13	1	6	15	4	1	3	1	67
Unknown (U.S.)	3	6	1	1	7	2	2		1	1	24
Unknown (non-U.S.)*	4	3	3	2	9	4	1	3		2	31
Column Total	126	129	134	31	256	177	61	63	30	43	1050
Column Subtotals Male	105	108	105	28	189	142	48	51	25	26	827
Column Subtotals Female	21	21	29	3	67	35	13	12	5	17	223

*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".

Table 2B: Employment Status of 1991–1992 U.S. New Doctorates by type of granting department, updated March 1993

TYPE OF EMPLOYER	TYPE OF DOCTORATE-GRANTING DEPARTMENT					ROW TOTAL	ROW SUBTOTALS	
	Group I Math	Group II Math	Group III Math	Group IV Statistics	Group V Applied Math/OR		Male	Female
Group I	86	3	4	9	6	108	85	23
Group II	13	16	3	4	4	40	33	7
Group III	19	8	15	3	5	50	44	6
Group IV	1	2	1	20		24	22	2
Group V	2				5	7	3	4
Masters	26	24	24	7	2	83	68	15
Bachelors	50	46	28	7	7	138	96	42
Two-year Colleges	1	5	7		1	14	7	7
Other Academic Departments	6	8	1	20	29	64	52	12
Research Institutes	31	5		20	5	61	51	10
Government	4	3	2	4	2	15	9	6
Business and Industry	29	14	11	30	21	105	80	25
Foreign, Academic	89	28	21	34	18	190	152	38
Foreign, Nonacademic	5	2	2	2	5	16	15	1
Not seeking employment	2	6	3		2	13	10	3
Still seeking employment	29	15	9	3	11	67	54	13
Unknown (U.S.)	16	3		1	4	24	21	3
Unknown (non-U.S.)*	12	3	5	9	2	31	25	6
Column Total	421	191	136	173	129	1050	827	223
Column Subtotals Male	348	153	97	127	102	827		
Column Subtotals Female	73	38	39	46	27	223		

*Non-U.S. citizens who returned to their country of citizenship and whose status is reported as "unknown" or "still seeking employment".

doctorates were reported as still seeking employment. Prior to 1990–1991, the unemployment rate reported in the spring analysis never exceeded 3% since the number was first reported in 1977. This year's rate is the highest ever reported in the Annual Survey.

The survey responses also reveal other indicators of the difficult employment market that are hidden in Tables 2A and 2B. The proportion of individuals in academic positions that are not tenure-eligible is high. Based on 360 individual responses from holders of academic employment, 51% report that there position is not tenure-eligible, up one point from last year. Sixty percent of the nontenure-eligible positions have contract durations of two years or less, up from 45% in 1990–1991. More of the academic jobs are short-term temporary positions. Of the 229 positions in U.S. Ph.D.-granting departments, 49 (21%) are held by individuals who received their degree from the same institution. Forty-three of the jobs tallied in Table 2A are part-time, and at least 25 of the 43 incumbents are still seeking full-time employment.

Individual respondents also provided information about jobs for which they applied. Among 364 new doctorates who reported applying for an academic position, the average number of applications made for academic positions was 65 and the average number of applications made for nonacademic positions was 5.3. Among 148 new doctorates who reported applying for nonacademic positions, the average number of applications for academic positions was 54 and the average number of applications for nonacademic positions was 13.8.

Finally, we note that the names of the 1991–1992 new doctorates and their thesis titles were published in the *Notices* (November 1992, and a supplemental list in April 1993).

III. Faculty Characteristics

Information about faculty and instructional programs was obtained from the Departmental Profile Survey sent to mathematical sciences departments at four-year colleges and universities in fall 1992. The First Report contained information collected earlier about faculty salaries.

Table 3A shows attrition due to deaths and retirements of faculty in mathematical sciences. Numbers of retirements tend to fluctuate substantially from year to year. Presumably these rates are sensitive to the effects of early retirement programs, and the attrition rates for a Group as a whole can show the effects of perturbations introduced by only a few institutions. The number of retirements in Group B, for example, increased by 55% in 1991–1992 following a substantial decrease the year before. The attrition rates increased in every survey Group. In Group I, for example, the rate reported for 1991–1992 is 39% greater than the rate reported for 1990–1991. In all mathematics departments, a total of 479 faculty retired or died between

Table 3A. Faculty Attrition*

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	I+II+III+M+B
Number of full-time faculty who retired or died (Group total)	55	30	63	148	28	3	170	161	479
% of full-time faculty in Group	2.8%	1.6%	2.5%	2.3%	2.5%	0.8%	3.0%	2.1%	2.4%
Number of usable responses**	35 (90%)	39 (91%)	70 (80%)	144 (85%)	51 (73%)	15 (60%)	154 (60%)	453 (46%)	751 (54%)

* Number and percentage of full-time faculty who were in the department in fall 1991 but were reported to have retired or died by fall 1992.
** The number of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to faculty size and recruitment data only. All counts are projected from the survey response to the respective Group as a whole.

Table 3B. Faculty Recruitment

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	I+II+III+M+B
Number of open positions (Group total)*	153	103	145	401	71	23	257	535	1193
Number that were tenured/tenure-track	57	52	108	217	60	10	217	425	859
Number that were open to new doctorates	103	87	113	303	62	15	224	477	1004
Doctoral hires, male	119	62	101	282	41	18	138	287	707
Doctoral hires, female	26	19	19	64	11	2	50	112	226
Nondoctoral hires, male	0	0	0	0	0	0	12	43	55
Nondoctoral hires, female	0	1	0	1	0	0	15	40	56
Number of unfilled positions	7	21	25	53	19	3	36	47	136

* Number of positions under recruitment in 1991–1992 to be filled for 1992–1993.
Subtotals of rounded table values may exhibit rounding errors.

Table 3C. Faculty Size, Fall 1992, and Percentage Change in Size, Fall 1991 to Fall 1992

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	I+II+III+ M+B
Total number of full-time faculty (Group total)	1982	1841	2497	6320	1115	368	5627	7810	19757
% change in full-time faculty	–1.3%	–0.1%	0.3%	–0.3%	5.2%	–0.5%	–2.0%	–0.3%	–0.8%
Number of doctoral full-time faculty	1968	1750	2278	5996	1083	367	4396	5473	15865
% change in doctoral full-time faculty	–1.1%	–0.1%	0.4%	–0.2%	5.3%	0.6%	–1.5%	2.0%	0.2%
Number of tenured doctoral full-time faculty	1456	1378	1657	4491	692	260	3131	3647	11269
% change in tenured doctoral full-time faculty	–1.3%	1.1%	0.6%	0.1%	0.9%	0.0%	0.6%	2.3%	1.0%
Number of untenured, tenure-eligible doctoral full-time faculty	187	270	519	976	247	55	1143	1596	3715
% change in untenured, tenure-eligible doctoral full-time faculty	5.1%	–5.6%	0.4%	–0.5%	–2.4%	–5.2%	–2.6%	2.9%	0.3%
Number of untenured, nontenure-eligible doctoral full-time faculty	324	101	102	527	144	52	123	231	881
% change in untenured, nontenure-eligible doctoral full-time faculty	–3.3%	–2.9%	–3.8%	–3.3%	58.2%	10.6%	–30.9%	–6.9%	–9.3%
Number of part-time faculty	85	214	531	830	107	23	1795	3443	6068
% change in part-time faculty	9.0%	8.6%	–11.7%	–5.3%	2.9%	15.0%	2.8%	4.6%	2.6%

Table 3D. Women Faculty Size, Fall 1992, and Percentage Change in Size, Fall 1991 to Fall 1992

	GROUP								
	I	II	III	I+II+III	IV	V	M	B	I+II+III+ M+B
Total number of full-time women faculty (Group total)	135	185	329	650	152	27	1216	1933	3799
% change in full-time women faculty	–0.8%	5.7%	1.6%	2.4%	–1.8%	0.0%	0.2%	–1.1%	–0.2%
Number of doctoral full-time women faculty	128	131	195	454	136	27	629	1060	2143
% change in doctoral full-time women faculty	2.7%	7.2%	2.7%	3.9%	–3.9%	0.0%	2.2%	5.1%	3.9%
Number of tenured doctoral full-time women faculty	56	73	91	220	40	15	366	546	1132
% change in tenured doctoral full-time women faculty	–6.7%	9.0%	7.1%	3.8%	–7.0%	0.0%	4.3%	2.8%	3.5%
Number of untenured, tenure-eligible doctoral full-time women faculty	21	37	88	146	74	7	238	445	829
% change in untenured, tenure-eligible doctoral full-time women faculty	50.0%	0.0%	–1.1%	4.3%	–3.9%	0.0%	5.3%	9.9%	7.5%
Number of untenured, nontenure-eligible doctoral f-t women faculty	51	21	16	88	22	5	25	69	182
% change in untenured, nontenure-eligible doctoral f-t women faculty	2.0%	16.7%	6.7%	6.0%	0.0%	0.0%	–34.2%	–6.8%	–6.7%
Number of part-time women faculty	30	74	191	295	26	2	772	1428	2495
% change in part-time women faculty	–3.6%	4.7%	–14.1%	–9.2%	0.0%	200.0%	4.7%	6.3%	3.7%

October 1, 1991, and fall 1992 compared to a total of 366 mathematics faculty members who retired or died in the previous year, an increase of 31%.

Table 3B reports information on the number of full-time faculty positions that departments attempted to fill during 1991–1992. Here, there is again a striking difference from the previous year in the level of recruitment. For at least the second year in a row there has been a significant decline in the number of positions that departments sought to fill. Only Group II shows a modest increase in the level of recruitment from 1990–1991, up from 89 to 103 positions. All other Groups experienced decreases in positions for which full-time faculty were sought. In Group I 15% fewer faculty were recruited in 1991–1992 than in 1990–1991; Group III sought 16% fewer faculty. Groups M and B showed declines of 19% and 4%, respectively. Group IV recruited 12% fewer new faculty.

Table 3B also provides information about hiring patterns for doctoral faculty. Among doctoral new hires, 18% of the new hires in Groups I, II, and III combined were women and 29% of the new hires in Groups M and B combined were women. Both of these percentages are higher than last year. As Table 2B shows, 20% of the new doctorates in mathematics were awarded to women in 1991–1992.

Tables 3C and 3D describe the makeup of faculties by sex, tenure status, and doctoral/nondoctoral degree in the different Groups. Significant variations from the corresponding data reported in last year's Second Report occur among numbers of untenured, nontenure-eligible faculty. Traditionally, among mathematics departments, Groups I and II employ larger numbers of faculty in this category relative to their total doctoral faculty size, and Groups III, M, and B employ smaller numbers. There were noticeable decreases in the numbers of nontenure-eligible faculty in every mathematics Group. These changes, along with the higher rates of attrition shown in Table 3A and the lower levels of faculty recruitment shown in Table 3B, indicate effects of economic conditions on the difficult employment market for doctoral mathematical scientists.

Table 3E contains information about the distribution of doctoral full-time women faculty within the survey Groups. In particular, the tabulated values, so-called "p-values", describe how many women faculty there are in the responding departments relative to the number expected in those departments, adjusted for department size. A detailed description of how the p-value for a department is defined is provided in the Technical Note at the end of this report.

The p-value for an individual department is a value in [0,1]. A value near 0 indicates that the number of doctoral women faculty is small relative to the department's size, while a value near 1 indicates that the number of doctoral women faculty is large. Heuristically, as described in the Technical Note, if there are no unusual patterns in the distribution of women faculty within a survey Group and if the department sizes gauged by the total number of doctoral faculty are relatively large, then the set of p-values for the Group should be approximately uniformly distributed between 0 and 1. Too many p-values near 0 indicates a larger number of departments than expected in that Group having relatively small numbers of women faculty.

Table 3E does show a nonuniform distribution of p-values in Group B. This is, however, in part a consequence of the small sizes of a large fraction of Group B departments and the resulting discrete nature of the distribution of p-values. Of the 436 responding departments in Group B, 45 have no tenured/tenure-eligible doctoral faculty and 100 have a total of 1 or 2 tenured/non-tenure eligible doctoral faculty.

Table 3E. Distribution of Tenured and Tenure-Eligible Doctoral Full-time Women Faculty, Fall 1992

	GROUP						
	I	II	III	IV	V	M	B
Number of departments returning usable responses	35	39	70	51	15	133	436
Number of doctoral* full-time faculty reported	1475	1495	1731	684	189	2229	2342
Number of doctoral* full-time women faculty reported	69	100	142	83	13	315	443
Proportion of women among doctoral* full-time faculty	4.7%	6.7%	8.2%	12.1%	6.9%	14.1%	18.9%
Number of departments reporting no doctoral* faculty	0	0	0	0	0	1	45
Number of departments reporting p-values** in range:							
[0.0, 0.2]	7	5	14	6	1	26	49
(0.2, 0.4]	10	11	14	18	7	31	109
(0.4, 0.6]	4	8	14	7	0	22	92
(0.6, 0.8]	8	8	14	10	4	25	67
(0.8, 1.0]	6	7	14	10	3	28	74

* Faculty counts in this table include only tenured and tenure-eligible faculty.
** See Technical Note for the description on the p-values whose distribution is tabulated.

IV. Enrollment Profile and Undergraduate Majors

The Departmental Profile Survey collects information about enrollments and distribution of instructional effort in the mathematical sciences departments.

Table 4A (see next page) summarizes enrollment data for undergraduate and graduate courses. The decrease in Group I graduate enrollments from fall 1991 to fall 1992 and the substantial increases in Group IV and Group V graduate enrollments stand out. In interpreting the enrollment data, especially in comparing counts to other surveys, it is important to note that all counts reported here apply to the fall term only, not to a full academic year.

Table 4B provides a summary the distribution of undergraduate enrollments over different subjects within each survey Group. The proportion of enrollments at the level of calculus, precalculus, and remedial mathematics combined increased slightly in all groups of mathematics departments from fall 1991 to fall 1992, except for Group II which was essentially unchanged. In fall 1992 the proportion of enrollments in calculus, precalculus, and remedial mathematics combined was Group I, 64.2%; Group II, 59.6%; Group III, 64.7%; Group M, 50.6%; and Group B, 48.9%.

Table 4C shows one measure of the instructional load borne by faculty. The CBMS Surveys have reported substantial increases in student enrollments per full-time faculty member from 1970 to 1990. Table 4C shows results consistent with the 1990 CBMS Survey and describes the variation of this indicator of instructional load between Groups. In Groups IV and V the load is shifted more towards graduate enrollments than in the mathematics Groups.

Table 4D provides information about undergraduate majors. Except for Group IV, the numbers of majors were at or above the level of the previous year. The increase in numbers of mathematics majors continues an encouraging trend reported also in last year's Survey.

V. Graduate Student Profile

Tables 5A through 5C summarize population statistics for graduate students from the 1992 Departmental Profile Survey.

Numbers of first-year graduate students decreased in the doctorate-granting mathematics departments and increased

Table 4A. Undergraduate and Graduate Enrollments (thousands), Fall 1992, and Percentage Change in Enrollments, Fall 1991 to Fall 1992

	GROUP I	II	III	IV	V	M	B
Number of undergraduate course enrollments (thousands)	166	184	300	56	18	652	738
% change in undergraduate course enrollments	–3.5%	–1.7%	–0.8%	–0.1%	5.0%	–0.8%	2.7%
Number of graduate course enrollments (thousands)	9	9	12	22	6	20	1
% change in graduate course enrollments	–13.2%	–0.2%	–4.0%	10.6%	11.9%	–2.9%	9.2%
Number of usable responses	33 (85%)	39 (91%)	68 (77%)	51 (73%)	13 (52%)	128 (50%)	420 (43%)

* The number of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to Tables 4A through 4C on enrollments only. All counts are projected from the survey response to the respective Group as a whole.

Table 4B. Distribution of Undergraduate Enrollments, Fall 1992

COURSES	GROUP I	II	III	IV	V	M	B
Remedial mathematics*, %**	9	9	13		1	15	18
Precalculus, %	14	18	26	1	2	17	15
1st-year Calculus (mainstream), %	33	21	18		9	12	12
1st-year Calculus (non-mainstream), %	8	11	8	1		6	4
Statistics, %	2	3	6	93	23	9	8
Computer Science, %	1		2		8	7	12
Other department course for majors, %	17	19	14	1	28	12	11
Other undergraduate courses, %	16	18	14	3	29	21	20

* Arithmetic, high school algebra, geometry.

** Percents are "column percents" describing relative enrollments within the respective Survey Groups of the different types of undergraduate courses.

Table 4C. Undergraduate and Graduate Enrollments per Full-time Faculty Member, Fall 1992

	GROUP I	II	III	IV	V	M	B
Undergraduate course enrollments per full-time faculty member	84	100	120	50	48	116	94
Graduate course enrollments per full-time faculty member	5	5	5	20	17	4	0
Total course enrollments per full-time faculty member	89	104	125	70	65	119	95

Table 4D. Undergraduate Junior/Senior Majors (hundreds) and Undergraduate Women Junior/Senior Majors (hundreds), Fall 1992, and Percentage Change in Majors, Fall 1991 to Fall 1992

	GROUP I	II	III	IV	V	M	B	I+II+III+ M+B
Number of junior/senior majors (hundreds)	54	47	75	11	5	252	300	728
% change in junior/senior majors	4.9%	–0.5%	4.8%	–4.9%	23.0%	2.1%	0.1%	1.5%
Number of women junior/senior majors (hundreds)	20	19	33	4	2	114	133	319
% change in women junior/senior majors	9.0%	0.0%	3.2%	–4.1%	37.9%	2.1%	–0.3%	1.6%
Number of usable responses*	34 (87%)	37 (86%)	63 (72%)	44 (63%)	12 (48%)	120 (47%)	360 (37%)	614 (44%)

* The number of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to undergraduate major data only. All counts are projected from the survey response to the respective Group as a whole.

substantially in Groups IV, V, and M. The 26% increase in first-year students in Group M is especially large and follows a moderate decrease in the number of first-year students reported in last year's survey.

Table 5B gives the numbers of women graduate students by Group. In mathematics departments (Groups I, II, III, and M), 35.5% of the first-year students are women. Among U.S. citizen first-year mathematics graduate students, 36.5% are women. There is considerable variation between Groups in the latter percentage. In Group I 26.7% of U.S. citizen first-year students are women; Group II, 35.4%; Group III, 38.2%; and Group M, 44.1%. These percentages illustrate the narrowing pipeline for women students in mathematics. Table 4D that 43.8% of undergraduate junior/senior majors in mathematics departments are women. In statistics departments (Group IV), 47.1% of the U.S. citizen first-year graduate students are women.

Table 5C records the numbers of U.S. citizen graduate students by Group. The pattern of changes in numbers of first-year students is similar to the one shown in Table 5A. There are very substantial increases in numbers of U.S. citizen first-year students in Groups IV, V, and M and decreases in numbers in the doctorate-granting mathematics departments.

In all doctorate-granting departments, the percentage of U.S. citizens in the full population of graduate students (55.6%) is higher than their percentage among new doctorates (43%).

Table 5A. Full-time Graduate Students, Fall 1992, and Percentage Change in Graduate Students, Fall 1991 to Fall 1992

	GROUP					
	I	II	III	IV	V	M
Total number of full-time graduate students	3758	2657	3706	3006	1002	3516
% change in full-time graduate students	–2.2%	–0.4%	5.3%	6.2%	6.1%	8.3%
Number of first-year graduate students	930	652	1123	1005	373	1522
% change in first-year graduate students	–1.1%	–4.8%	–4.5%	7.0%	8.3%	25.7%
Number of usable responses*	34 (87%)	39 (91%)	68 (77%)	51 (73%)	14 (56%)	123 (48%)

* The number of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to Tables 5A through 5C on graduate student enrollments. All counts are projected from the survey response to the respective Group as a whole.

Table 5B. Women Full-time Graduate Students, Fall 1992, and Percentage Change in Women Graduate Students, Fall 1991 to Fall 1992

	GROUP					
	I	II	III	IV	V	M
Total number of full-time women graduate students	889	777	1229	1223	329	1435
% change in full-time women graduate students	5.6%	–0.8%	6.0%	13.9%	7.6%	7.6%
Number of first-year women graduate students	241	232	400	447	136	628
% change in first-year women graduate students	–5.4%	–13.2%	–4.6%	10.5%	8.6%	23.2%

Table 5C. U.S. Citizen Full-time Graduate Students, Fall 1992, and Percentage Change in U.S. Citizen Graduate Students, Fall 1991 to Fall 1992

	GROUP					
	I	II	III	IV	V	M
Total number of full-time U.S. citizen graduate students	1970	1513	2276	1556	538	2295
% change in full-time U.S. citizen graduate students	–5.6%	1.2%	6.2%	13.3%	6.4%	12.2%
Number of first-year U.S. citizen graduate students	520	464	739	612	221	1115
% change in first-year U.S. citizen graduate students	–4.0%	–2.3%	–2.1%	19.9%	11.7%	36.9%

Technical Note

Table 3E describes the distribution of so-called "p-values" for the departments responding to the Departmental Profile Survey. The p-values are designed to describe the size of the doctoral full-time women faculty relative to the size of the doctoral full-time faculty for any individual department. They provide a more sensitive indicator than do simple percentages when the number of women in a department is small. Many departments have no women faculty and the percentage *per se* does not then distinguish between a small department with no women faculty and a large department with no women faculty. The p-value does distinguish between these two cases.

Our definition of the p-value is motivated by a probability model. Within a particular survey Group, let θ denote the proportion of doctoral full-time women faculty among all doctoral full-time faculty. For example, $\theta = 0.082$ for Group III (Table 3E). If the characteristics of the faculty within a single department show no systematic differences from the characteristics of all faculty in the survey Group of that department, i.e., if that department looks like a random sample from the faculty in the Group as a whole, then the number of doctoral full-time women faculty in the department should have (approximately) a binomial distribution with parameters θ and N, where N is the number of doctoral full-time faculty in the department. The binomial cumulative distribution function is

$$B(x; N, \theta) = \sum_{k \le x} \binom{n}{k} \theta^k (1-\theta)^{N-k}$$

If there are W women among the doctoral full-time faculty and if one is willing to assume that the department is a random sample from the faculty of the Group, then the probability that there are W or fewer women in a department of the given size is $B(W; N, \theta)$.

The definition of the p-value is motivated by this model. Because of the discrete form of the binomial distribution function, it is important to make a "continuity correction" in defining the p-value so that the value is not positively biased by the inherent right-continuity of the cumulative distribution function. For each department, we define

$$\text{p-value} = [B(W; N,\theta) + B(W^-; N,\theta)]/2,$$

where $B(W^-; N,\theta)$ is the limit from the left of $B(\cdot)$ at W.

If N is not too small, then $B(\cdot; N,\theta)$ is well-approximated by a continuous distribution function. The claim in Section III about the approximate uniform distribution of the p-values within a survey Group then follows from the general result that $F(X)$ is uniformly distributed when X is a random variable with continuous distribution function F.

Bibliography

Albers, D. J., Loftsgaarden, D. O., Rung, D. C., and Watkins, A. E. *Statistical Abstract of Undergraduate Programs in the Mathematical Sciences and Computer Science in the U.S., 1990–1991 CBMS Survey*, MAA Notes No. 23, 1992.

American Association of University Professors. *The Annual Report on the Economic Status of the Profession* 1992–1993, Academe: Bulletin of the AAUP, March/April 1993, Washington, DC.

Bowen, W. G. and Rudenstine, N. L. *In Pursuit of the Ph.D.*, Princeton, NJ: Princeton University Press, 1992.

Commission on Professionals in Science and Technology. Occasional Papers, prepared by Betty M. Vetter. *Supply and Demand for Engineers in the 1990s* (90–1), April 1990. *Who is in the Pipeline? Science, Math, and Engineering Education* (90–2), July 1990. *Recruiting Doctoral Scientists and Engineers for the Twenty-first Century* (90–3), October 1990. *Women in Science and Engineering, An Illustrated Progress Report* (90-4), December 1990. *Recruiting and Retaining a Diverse, Quality Technical Workforce* (91-1), April 1991. *By the Year 2000: Myths and Facts* (91-2), July 1991. *Cultural Diversity in Higher Education* (91-3), October 1991. *Supply and Demand in Science and Engineering* (91-4), January 1992. *American Minorities in Science and Engineering* (92-1), April 1992. *Foreign Citizens Among U.S. Scientists and Engineers* (92-2), July 1992. *What's Holding Up the Glass Ceiling? Barriers in the Workforce* (92-3), October 1992. *Setting the Record Straight: Shortages in Perspective* (92-4), January 1993. CPST, Washington, DC.

———. *Salaries of Scientists, Engineers, and Technicians: A Summary of Salary Surveys*, 12th Ed., Washington, DC, 1992.

———. *Professional Women and Minorities*—1992. Washington, DC, 1992.

———. *Preparing for the 21st Century: Human Resources in Science and Technology*. Proceedings of a Symposium, March 26–27, 1992, Washington, DC, July 1992.

Jackson, A. *Top Producers of Women Mathematics Doctorates, Notices of the AMS*, September 1991.

Madison, B. and Hart., T. A. *A Challenge of Numbers: People in the Mathematical Sciences*. National Academy Press, Washington, DC, 1990.

McClure, D. E. *Academic Hiring Survey, 1991–1992, Notices of the AMS*, April 1992.

National Research Council. *Summary Report* 1991, *Doctorate Recipients from U. S. Universities*, National Academy Press, Washington, DC, 1993.

———. *Moving Beyond Myths: Revitalizing Undergraduate Mathematics*, National Academy Press, Washington, DC, 1991.

———. *Everybody Counts: A Report to the Nation on the Future of Mathematics Education*, National Academy Press, Washington, DC, 1989.

———. *Renewing U.S. Mathematics: A Plan for the 1990s*. National Academy Press, Washington, DC, 1990.

National Science Board. *Science and Engineering Indicators*—1991. U.S. Government Printing Office, Washington, DC, 1991 (NSB 91-1).

National Science Foundation. *Science and Technology Data Book*, NSF 92-331, National Science Foundation, Washington, DC, 1992 .

———. *Science and Engineering Degrees*: 1966–89, NSF 91–314, Washington, DC, 1991.

———. *Science and Engineering Doctorate Awards*: 1991, NSF 92–309, Selected Data Tables, Washington, DC, 1992.

———. *Science and Engineering Doctorates:* 1960–1991, NSF 93–301, Detailed Statistical Tables, Washington, DC, 1993.

———. *Academic Science and Engineering: Graduate Enrollment and Support*, 1989, NSF 90–324, Detailed Statistical Tables, Washingon, DC, 1991.

———. *Selected Data on Graduate Students and Postdoctorates in Science and Engineering*, Fall 1991 (NSF 92-335). Selected Pamphlet No.11: Institutional Listings (NSF 90–324–11), Selected Pamphlet No. 12: Postdoctorates and Other Nonfaculty Research Staff (NSF 90–324–12), Washington, DC, 1990.

———. *Survey of Mathematics and Statistics Departments at Higher Education Institutions*. Higher Education Surveys Report, Survey Number 5, December 1990.

———. *Foreign Participation in U.S. Academic Science and Engineering*: 1991, NSF 93-302, Washington, DC, 1993.

Acknowledgment

The Annual AMS-MAA Survey attempts to provide an accurate appraisal and analysis of various aspects of the academic mathematical scene for the use and benefit of the mathematics community. Every year, college and university departments in the United States are invited to respond. The Annual Survey relies heavily for the quality of its information on the conscientious efforts of the dedicated staff members of these departments. On behalf of the AMS-MAA Data Committee and the Annual Survey staff, I thank the many secretarial and administrative staff members in the mathematical sciences departments for their cooperation and assistance in responding to the survey questionnaires. Elizabeth Foulkes has made essential contributions to the coordination of the Annual Survey, management of the work of the Data Committee, full computerization of the data analysis, and preparation of the reports. The Data Committee expresses special thanks to her.