NOTICES
OF THE
AMERICAN MATHEMATICAL SOCIETY

1990 Annual AMS-MAA Survey

(Second Report)

Enrollments, Faculty Characteristics, and
Update on New Doctorates, Fall 1990
Donald E. McClure

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This is the second report of the 1990 Survey. A first report appeared in the November 1990 *Notices*, pages 1217–1250. It included a report on the 1989–1990 new doctorates, starting salaries, faculty salaries, and a list of names and thesis titles of the 1989–1990 doctorates. A supplementary list of 1989–1990 doctorates appears in this issue of *Notices*.

The 1990 Annual AMS-MAA Survey represents the thirty-fourth in an annual series begun in 1957 by the Society. The 1990 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, Charlotte Lin, Don O. Loftsgaarden, 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 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.

[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 *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 950 doctorates in the mathematical sciences awarded by U.S. institutions in the period July 1, 1989 through June 30, 1990. This is the largest number since 1975–1976 and is 24% higher than the 1984–1985 final count.

- The final count shows 410 U.S. citizens among the 947 doctoral recipients whose citizenship status is known. This is the second highest total number of U.S. citizens in the past six years, but the percentage (43%) is a historical low for the seventeen years in which citizenship status has been followed in the Annual Survey.

- A total of 537 non-U.S. citizens were awarded doctorates in 1989–1990. This is the largest number ever reported and represents an increase of 148% over the number of non-citizen new doctorates ten years earlier.

- The percentage of U.S. citizens among all graduate students, including master's degree candidates and special students, in U.S. doctorate-granting mathematics departments is 56%, substantially higher than the percentage they represent among new doctorates.

- In the final count there were 90 women (22%) among the 410 U.S. citizen new doctorates. Among non-U.S. citizens, women represent 15% of the new doctorates. These percentages are substantially lower than the ones for earlier stages of the mathematics education pipeline. Among all U.S. citizen graduate students in U.S. mathematical sciences departments, women constitute 36% of the total. At the undergraduate level, 43% of junior/senior mathematical sciences majors are women.

- Out of the 943 new doctorates (from U.S. or Canadian institutions) whose employment status is known, 60% are employed in academic positions in the U.S., 16% are employed in nonacademic positions in the U.S., and 20% are employed outside the U.S. Only 2% are reported as not yet employed, and the remainder are not seeking employment.

I. Introduction

The Annual AMS-MAA Survey collects information each year about departments, faculties and students in the mathematical sciences in the United States and Canada. This article reports results from two parts of the 1990 Annual AMS-MAA Survey. First, we update information about new doctorates reported earlier in the November 1990 issue of *Notices* (see pages 1217–1221). Second, we present summaries of results about characteristics of faculties and of instructional programs at the undergraduate and graduate levels.

The Second Report is patterned after previous years' reports in the interest of continuity and to make year-to-year comparisons possible. Some new types of information are reported, however, and the AMS-MAA Data Committee continues to welcome suggestions from the mathematics community concerning other types of information or reporting about the mathematics scene which members of the profession would find to be of interest.

In the 1990 Annual Survey, new information was requested from departments about faculty hiring and about different categories of faculty positions. Traditionally, the Annual Survey has done a detailed analysis of the employment status of new doctorates broken down by the field of their thesis. In the 1990 survey we added questions about the demand side of the employment market, in particular about the availability of openings in the academic job market. At the time that these questions were added to the survey, considerable attention was being given in the scientific press to projected shortages of trained scientists during the next decade. The new information collected in this area is intended to provide a baseline for comparison of changing demand in the future. It will also provide some basis for understanding recent perturbations of the academic job market.

New questions were also added to the survey in 1990 to enable a finer breakdown in the analysis of nontenured faculty ranks.

A more comprehensive and penetrating reporting of information about faculty populations and instructional programs in mathematics and the mathematical sciences will be contained in the forthcoming report on the 1990 Survey of Undergraduate Programs in the Mathematical Sciences and Computer Science, conducted by the Conference Board on Mathematical Sciences (CBMS).

II. Update on the 1989–1990 New Doctorates

Information about new doctorates awarded between July 1, 1989 and June 30, 1990 was collected from doctorate-granting departments in late spring 1990 and from a follow-up census of individual degree recipients. The First Report of the 1990 Annual Survey (November 1990 issue of *Notices*, pages 1217–1230) presents the survey results obtained about new doctorates up to the time of that report. Here we update the earlier figures on the basis of more complete returns.

Table 1: New Doctorates, Fall and Spring Counts

	85–86 Fall	85–86 Spring	86–87 Fall	86–87 Spring	87–88 Fall	87–88 Spring	88–89 Fall	88–89 Spring	89–90 Fall	89–90 Spring
U.S.	756	782	779	808	804	828	905	919	933	950
Canada	45	45	66	66	52	55	53	62	58	59
Total	801	827	845	874	856	883	958	981	991	1009

The spring count of new doctorates (Table 1) shows a total of 950 doctorates in mathematical sciences awarded by U.S. institutions and 59 awarded by Canadian institutions. The final count for U.S. institutions is a 3% increase from the previous year and is the highest number reported since 1975–1976.

Citizenship status is known for 947 of the new doctorates awarded by U.S. institutions. The total of 410 U.S. citizens is marginally lower than last year's spring count of 419, but still is the second highest figure since 1983–1984. The percentage of U.S. citizens (43%) is an all-time low.

The number of non-U.S. citizen new doctorates has risen steadily since 1978–1979. The final spring count shows 537 non-U.S. citizens, representing an increase of 148% from the count in 1979–1980. In the same ten-year period the number of U.S. citizen new doctorates has decreased by more than 30%.

Among the U.S. citizens, the final tally shows 90 women and 320 men. The percentage of women (22%) among the U.S. citizens is substantially higher than the percentage (15%) among non-U.S. citizens.

Employment data for new doctorates, broken down by the field of their thesis research, are updated in Tables 2A and 2B (see next page). The employment matrices report the status of the 991 new doctorates included in the fall count; employment status is known for 943. Overall, the majority (60%) of new doctorates assumed academic positions in the U.S. The percentage assuming academic positions, regardless of country, is 77%. The proportions assuming academic vs. nonacademic positions vary greatly with the field of the thesis. For example, in probability and statistics, which includes over 200 doctoral recipients from statistics graduate programs, 47% of those whose employment status is known took academic positions in the U.S.

The updated matrix shows 19 new doctorates (2%) 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 a year ago, 3% of the 1988–1989 new doctorates were reported as still seeking employment.

Finally, we note that the names of the 1989–1990 new doctorates and their thesis titles were published in *Notices* (November 1990 and a supplemental list in this issue).

Table 2A: Employment Status of 1989–1990 New Doctorates in the Mathematical Sciences

Type of Employer	Algebra or Number Theory	Real or Complex Analysis	Geometry or Topology	Logic	Probability or Statistics	Applied Mathematics	Discrete Math or Combinatorics	Numerical Analysis	Linear or Non-linear Optimization	Other	TOTAL
Group I	19	28	39	2	2	4	4	4		2	104
Group II	13	7	8		3	11	6	2		1	51
Group III	7	6	10	3	10	18	4	5	2	2	67
Group IV					31				1		32
Group V					4	9	2		1	2	18
Masters	12	12	11	3	22	12	6	1	2	3	84
Bachelors	23	12	12	6	17	21	10	2		4	107
Two-year Colleges	1	1	2		1	3		1		1	10
Other Academic Departments	7	5	4		37	19	2	3	5	8	90
Research Institutes	2	3	7		7	8	1	1	1	2	32
Government	1	2			9	4			1	2	19
Business and Industry	2	6	2	2	54	17	4	7	2	7	103
Canada, Academic	7	3	2	2	9	7	6	1	2	2	41
Canada, Nonacademic	1	1			5	2	1		1	1	12
Foreign, Academic	9	18	13	4	42	18	5	3	2	8	122
Foreign, Nonacademic	2		2		7	2			1	1	15
Not seeking employment	1	1	1		6	3	1	2	1	1	17
Not yet employed	2	3	3	1	4	4	1		1		19
Unknown (U.S.)		2	1		2	3	2		1	3	14
Unknown (non-U.S.)*	5	4		2	10	6	2	3	2		34
Total	114	114	117	25	282	171	57	35	26	50	991

*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 1989–1990 New Doctorates in the Mathematical Sciences
Females Only

Type of Employer	Algebra or Number Theory	Real or Complex Analysis	Geometry or Topology	Logic	Probability or Statistics	Applied Mathematics	Discrete Math or Combinatorics	Numerical Analysis	Linear or Non-linear Optimization	Other	TOTAL
Group I	1	2	7			1	1				12
Group II	3		2		2		1				8
Group III	1	1	2	.		5		2	1	1	13
Group IV					10						10
Group V					1		1			2	4
Masters		2	2	1	3	2	4			2	16
Bachelors	3	2	5	1	2	4				2	19
Two-year Colleges					1	1		1		1	4
Other Academic Departments	3				12	6				3	24
Research Institutes					2					1	3
Government					2						2
Business and Industry		1			11	5		2		1	20
Canada, Academic	2			1	3	1	1				8
Canada, Nonacademic		1			2						3
Foreign, Academic	4	2	1	1	5	2					15
Foreign, Nonacademic											
Not seeking employment			1		3	2	1	2		1	10
Not yet employed			1		2	1					4
Unknown (U.S.)						2				1	3
Unknown (non-U.S.)*		1			1	2		1			5
Total	17	12	21	4	62	34	9	8	1	15	183

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

III. Faculty Characteristics

Information about faculty members and instructional programs was collected from mathematical sciences departments in the fall 1990 Departmental Profile Survey. The First Report contained information collected earlier about faculty salaries.

Table 3A shows attrition due to deaths and retirements of faculty in mathematical sciences. For Groups I, II and III combined, the rate is the same as last year. The attrition rates for faculty from Group B and Group VI are curiously higher than the others. The demographic profile of faculty in the Second Report of the 1989 Annual Survey (July/August 1990 issue of *Notices*, pages 659–662) showed that 15% of Group B faculty and 22% of Group VI faculty are age 55 or older compared to 19% for all groups combined.

Table 3B reports the new information on numbers of full-time faculty positions which departments attempted to fill with doctorates during 1989–1990. These data must be interpreted cautiously since the response rate is less than 100%. The response rate varies by group, and any attempt to project totals from the raw data may be affected by selection biases. Among doctoral new hires, women constitute 15% of the total in Groups I, II and III combined and 21% in Groups M and B combined.

Tables 3C and 3D (see next page) report percentages of women among different types of full-time faculty. This year's survey collected more detailed information about nontenured ranks in order to be able to analyze the subpopulation of full-time faculty members whose positions are not tenure-eligible. Such positions include, for example, postdoctoral fellows, research positions, and some instructorships and lectureships. In Groups I, II and III combined, the non tenure-eligible positions account for 7% of the doctoral faculty and 9.5% of all full-time faculty. In Groups M and B combined, the non tenure-eligible faculty members account for 4% of the doctoral faculty and 14% of all full-time faculty.

Table 3C reports the percentages of women by group and tenure status for faculty who have a doctorate. Table 3D reports the corresponding survey results for all full-time faculty. In the latter analysis, which includes the non-doctoral faculty, the percentage of women among non tenure-eligible faculty is substantially higher than the corresponding percentages either among doctoral faculty or among tenure-eligible ranks.

Tables 3E and 3F (see next page) report changes in sizes of nontenured and tenured faculty populations by group and by sex. Overall, the sizes of the tenured and nontenured populations increased, with the subpopulations of women showing substantially greater increases than the subpopulations of men.

Table 3A. Faculty Attrition*

| | GROUPS | | | | | | | | |
	I	II	III	I+II+III	IV	V	M	B	VI
% of full-time faculty	1.1	1.3	1.8	1.4	1.4	0.5	1.8	2.4	2.7

*Percentage of full-time faculty who were in the department in fall 1989 but were reported to have retired or died by fall 1990.

Table 3B. Faculty Recruitment

| | GROUPS | | | | | | | | |
	I	II	III	I+II+III	IV	V	M	B	VI
Number of open positions*	169	87	195	451	89	21	281	316	50
Doctoral hires, male	125	62	131	318	53	15	166	176	42
Doctoral hires, female	19	12	26	57	15	3	49	44	4
Nondoctoral hires, male	1	0	4	5	1	0	29	57	0
Nondoctoral hires, female	0	2	2	4	2	0	28	47	0
Number of unfilled positions	24	17	32	73	18	2	46	42	4
Response rate by group**	85%	86%	84%	85%	74%	33%	59%	49%	63%

* Number of positions under recruitment in 1989–1990 to be filled for 1990–1991.
**The proportion of usable returns varies for different sections of the Departmental Profile Survey. The response rates reported here apply to the recruitment data only.

Table 3C. Percentage of Women among Doctoral Full-time Faculty, Fall 1990

	I	II	III	I+II+III	GROUPS IV	V	M	B	VI
% of all doctoral faculty	6.0	6.5	8.8	7.1	13.3	7.9	13.8	17.2	6.3
% of tenured doctoral faculty	4.5	5.1	5.7	5.1	6.3	7.7	10.4	13.3	3.7
% of untenured, tenure-eligible doctoral faculty	10.2	11.4	17.0	14.0	29.5	6.7	20.9	24.3	19.1
% of non tenure-eligible doctoral faculty	11.6	14.6	13.0	12.3	24.4	13.3	27.7	26.2	13.8

Table 3D. Percentage of Women among All Full-time Faculty, Fall 1990

	I	II	III	I+II+III	GROUPS IV	V	M	B	VI
% of all full-time faculty	6.6	9.3	13.3	9.8	14.1	7.7	21.6	24.6	6.4
% of non tenure-eligible faculty	15.5	50.0	48.0	33.7	27.1	11.8	55.7	44.7	14.0

Table 3E. Faculty Size
Percentage Change in Doctoral Nontenured Faculty, Fall 1989 to Fall 1990

	I	II	III	I+II+III	GROUPS IV	V	M	B	VI
Male	2.6	8.6	2.2	3.9	1.1	5.8	0.4	6.2	7.8
Female	33.3	−15.0	17.4	12.0	25.4	0.0	9.2	9.6	−12.5
Total	5.3	5.1	4.4	4.9	6.9	5.3	2.1	7.0	3.5

Table 3F. Faculty Size
Percentage Change in Doctoral Tenured Faculty, Fall 1989 to Fall 1990

	I	II	III	I+II+III	GROUPS IV	V	M	B	VI
Male	−0.1	0.8	0.9	0.5	3.2	4.8	0.1	2.2	7.5
Female	5.0	13.2	3.0	6.7	3.0	37.5	6.0	6.7	17.6
Total	0.1	1.4	1.0	0.8	3.2	6.8	0.7	2.8	7.8

IV. Undergraduate Enrollment
Profile and Majors

Data on undergraduate enrollments and majors are summarized in Tables 4A through 4E. The year-to-year percentage changes given in Tables 4A and 4D are based on responses obtained on the 1990 Departmental Profile Survey form alone and are not affected by differential response rates from one year to the next.

Survey results about class sizes were last reported three years ago, for the 1987 Annual Survey. There are no striking changes from 1987 to the present results shown in Table 4C.

Every five years, the CBMS Survey has collected and analyzed more detailed information about enrollment patterns, curricular trends, and other information pertaining to mathematics instructional programs. We alert readers to a report which is now in preparation for the 1990 CBMS Survey.

Table 4A. Percentage Change in Undergraduate Enrollments, Fall 1989 to Fall 1990

| | GROUPS | | | | | | | |
	I	II	III	IV	V	M	B	VI
% change	−0.1	−3.9	0.1	1.7	−1.5	0.3	1.3	1.8
Response rate by group*	90%	84%	79%	66%	28%	55%	46%	70%

*The proportion of usable returns varies for different sections of the Departmental Profile Survey.
The response rates reported here apply to Tables 4A through 4C on undergraduate enrollments.

Table 4B. Distribution of Undergraduate Enrollments, Fall 1990

| | GROUPS | | | | | | | |
COURSES	I	II	III	I+II+III	M	B	M+B	VI
Remedial mathematics*, %	10.0	6.4	12.2	10.0	16.2	17.2	16.7	1.8
Remedial math + pre-calculus, %	24.8	26.8	38.6	31.4	32.6	32.3	32.5	3.4
Remedial math + pre-calculus + calculus, %	57.9	59.0	60.7	59.4	47.1	46.9	47.0	34.0

*Arithmetic, high school algebra, geometry.

Table 4C. Average Class Size, Fall 1990

| | GROUPS | | | | | | | |
COURSES	I	II	III	IV	V	M	B	VI
Remedial mathematics*	32	34	41		19	35	28	62
Traditional pre-calculus	32	39	43			37	29	99
First-year calculus	35	44	38			31	25	69
Undergraduate statistics	37	44	36	44	50	33	27	42
Undergraduate computer science	30	25	19	35	42	23	18	33
Other undergraduate mathematics, majors	29	31	26			22	16	36
Other undergraduate mathematics, nonmajors	36	34	39			34	27	51
Graduate courses	10	10	8	15	17	11	12	4
All courses	30	34	33	32	27	29	23	42

*Arithmetic, high school algebra, geometry.

Table 4D. Percentage Change in Junior/Senior Majors, Fall 1989 to Fall 1990

| | GROUPS | | | | | | | |
	I	II	III	IV	V	M	B	VI
% change	5.6	−5.9	−3.9	10.5	−7.7	2.3	3.9	4.1

Table 4E. Percentage of Women among Junior/Senior Majors, Fall 1990

	I	**II**	**III**	**GROUPS** **IV**	**V**	**M**	**B**	**VI**
% of departmental majors	37.9	40.8	42.3	42.1	30.3	45.5	44.1	30.4

V. Graduate Student Profile

Survey results about characteristics of graduate students are summarized in Tables 5A through 5C.

In comparison with last year's Second Report on the 1989 Annual Survey, we note that Groups I and IV, which report substantial increases in the number of first-year graduate students in fall 1990, are the same groups reporting substantial decreases in fall 1989 (Table 5A). At the same time, the groups (II and III) that reported substantial increases in fall 1989 are the same ones showing moderate declines in numbers of first-year students in fall 1990.

Except for Group I, the percentage of women among U.S. citizen graduate students is substantially higher than the overall percentage of women among U.S. citizen new doctorates (Table 5B).

A similar dichotomy stands out in the summary of citizenship status for full-time graduate students (Table 5C). The percentage of U.S. citizens among full-time graduate students is substantially higher in Groups I, II, III and IV than their percentage among new doctorates.

Table 5A. Percentage Change in Number of Graduate Students, Fall 1989 to Fall 1990

	I	**II**	**III**	**GROUPS** **IV**	**V**	**M**	**VI**
First-year students	8.1	−0.8	−5.4	14.5	−13.7	4.3	−10.8
All years	4.9	5.4	4.0	1.5	−3.3	15.8	4.8
Response rate by group*	87%	72%	67%	59%	28%	47%	60%

* The proportion of usable forms varies for different sections of the Departmental Profile Survey.
   The response rates reported here apply to Tables 5A through 5C on graduate student enrollments.

Table 5B. Percentage of U.S. Citizen Women among U.S. Citizen Graduate Students, Fall 1990

	I	**II**	**III**	**GROUPS** **IV**	**V**	**M**
% of first-year students	26.9	35.3	40.1	41.5	36.1	48.6
% of all years	23.0	34.0	37.3	40.4	26.2	45.4

Table 5C. Percentage of U.S. Citizen Graduate Students, Fall 1990

	I	**II**	**III**	**GROUPS** **IV**	**V**	**M**
% of first-year students	55.4	63.4	62.0	51.2	48.4	74.7
% of all years	52.4	56.4	57.9	46.5	44.3	73.9

Acknowledgment

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Doctoral Degrees Conferred 1989–1990

Supplementary List

The following list supplements the list of thesis titles published in the November 1990 issue of *Notices.* Each entry contains the name of the recipient and the thesis title. The number in parentheses following the name of the university is the number of degrees granted by the department.

CALIFORNIA

University of Southern California (5)

MATHEMATICS

Bauer, Maximilian, *Example of pseudo-Anosov homeomorphisms.*

Jaekel, Tauno, *Stochastic flow with a singular vortex.*

Morris, Pricilla Jean, *On a class of homogeneous stochastic flows.*

Neubauer, Michael G., *On solvable monodromy groups of fixed genus.*

Spieler, Gisela, *Parameter estimation by system theoretic methods.*

COLORADO

University of Denver (1)

MATHEMATICS AND
COMPUTER SCIENCE

Marrannes-Marbeau, Jocelyne Helene, *Analysis of a discrete quantum probability model.*

KANSAS

Kansas State University (1)

STATISTICS

Crabb, Jeffrey, *A SAS program to correct the analysis of unbalanced two-way split-plot designs.*

MINNESOTA

University of Minnesota, Minneapolis (4)

STATISTICS

Adams, John, *Evaluating regression strategies.*

Bian, Guorui, *Bayesian statistical analysis with independent bivariate priors for the normal location and scale parameters.*

Kang, Chang Wook, *Generalization of the diagnostic methods of recursive residuals.*

Wong, Weng Kee, *Heteroscedastic optimal design.*

MONTANA

Montana State University (2)

MATHEMATICAL SCIENCES

Doyle, Randall Ross, *Extensions to the development of the sine-Galerkin method for parabolic problems.*

Lewis, David Lamar, *A fully Galerkin method for parabolic problems.*

NEW YORK

Polytechnic University (4)

MATHEMATICS

Bershatsky, Eugene, *The development of confidence bounds for a sales forecast.*

Chau, Jack-Kang, *Normal lattices and measures.*

Hertzlinger, Joseph, *Normality and similar properties in lattices.*

Schutz, Robert W., *On regular lattice measures.*

CANADA

University of Calgary (1)

MATHEMATICS AND STATISTICS

Ye, Qiang, *Symmetric matrix pencils.*

Errata

The thesis title for Mark R. Purtill (Mathematics, Massachusetts Institute of Technology) was incorrect in the November 1990 *Notices*. The correct title is "André permutations, lexicographic shellability, and the cd-index of a convex polytope."

The name of David Halpern (Mathematics, University of Arizona) was spelled incorrectly in the November 1990 *Notices*.