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21st ANNUAL
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AMS SURVEY

SECOND REPORT

A first report on 1977 Survey results appeared in these *Notices*, October 1977, pp. 336-361. It included a report of salary survey results and a first report of the survey of new 1976–1977 doctorates. This second report includes an update of the fall 1977 employment status of new doctorates, an analysis of faculty mobility, and a report on fall 1977 enrollments, class sizes, teaching loads, as well as a brief report on the two-year college survey.

The 21st Annual AMS Survey was made under the direction of the Society's Committee on Employment and Educational Policy (CEEP), whose members in 1977 were Lida K. Barrett, David Blackwell, Wendell H. Fleming (chairman), Hugo Rossi, Martha K. Smith, and Robert J. Thompson. A Data Subcommittee of CEEP consisting of Lida K. Barrett, Lincoln K. Durst, Wendell H. Fleming, and Donald J. Albers as a consultant for two-year colleges, designed the questionnaires with which the data were collected. The committee is grateful to members of the AMS staff, especially Marcia C. Almeida, for the diligence and efficiency with which the data were collected and compiled. Comments or suggestions regarding this program may be directed to the subcommittee.

Employment of Mathematical Sciences Doctorates, Fall 1977

by Wendell H. Fleming

This is one of a series of annual reports on trends in the job market for Ph.D.'s in the mathematical sciences. The report begins with an update of the fall 1977 employment status of new 1976–1977 doctorates. This is followed by a discussion of trends in the academic job market for mathematicians in four-year colleges and universities, based on 1977 AMS Survey data on faculty mobility.

The past year was a relatively good one for employment of new Ph.D.'s. However, the number of junior faculty members competing for permanent positions continues to exceed the number of such openings. A positive factor in the academic job market during 1977 was the continued pressure of enrollment increases in elementary mathematics courses (see the accompanying report on p. 104). The nonacademic job market for scientists, applied mathematicians, and engineers was relatively good in 1977. The number of mathematicians leaving junior faculty positions for jobs in business, industry, or government has increased substantially during the last two years. About 230 doctorate holding faculty members are estimated to have moved to nonacademic positions during 1977, and all but about 45 of these 230 individuals were reported as having their new jobs in the mathematical sciences, another scientific field, or engineering. This is in addition to about 200 new doctorates entering nonacademic employment. Fewer persons, both new doctorates and nonretained faculty members, were reported this year as not yet employed than in last year's survey. Fewer than 20 new doctorates and roughly 40 nonretained doctorate holding faculty members were in this cate-

For these reports, departments are divided into eight groups according to the highest degree offered in the mathematical sciences. The doctorate granting departments are in Groups I to VI below:

Group I and Group II include the leading departments of mathematics in the U.S.A. according to the findings of the American Council of Education in 1969* in which departments were ranked according to the quality of their graduate faculty. Group I is composed of the 27 departments ranked highest; Group II is made up of the other 38 leading departments listed in that report.

Group III contains all other U.S.A. departments of mathematics.

Group IV includes U.S.A. departments of statistics, biostatistics and biometrics.

Group V includes all other U.S.A. departments in the mathematical sciences.

Group VI consists of all departments in the mathematical sciences from Canadian universities.

Group M contains all departments in the U.S. and Canada in which a masters degree in one of the mathematical sciences is the highest degree offered.

Group B consists of departments in the U.S. and Canada offering only bachelors degrees in the mathematical sciences.

There are currently estimated to be about 5,300 full-time faculty members in Groups I, II, III departments, roughly 1,800 in Groups IV and V, with about 10,900 in Groups M and B. The Canadian doctorate granting departments in Group VI are estimated to have slightly fewer than 1,000 full-time faculty members.

*The findings were published in "A Rating of Graduate Programs" by Kenneth D. Roose and Charles J. Andersen, American Council of Education, Washington, D.C., 1969, 115 pp. The information on mathematics was reprinted by the Society and can be found on pages 338-340 of the February 1971 issue of these *Notices*.

gory as of fall 1977. A higher proportion of newly hired faculty members did not yet have the Ph.D. This is particularly true among those hired by departments which do not grant doctor's degrees (Groups M and B in the classification on the previous page). While the reasons for the phenomenon are not fully understood, there are indications that the pool of available Ph.D.'s does not in some respects fit the needs of Groups M and B departments. Many openings advertised by Groups M and B departments are for persons to teach courses in statistics, computer science, and other applied areas.

FALL 1977 EMPLOYMENT STATUS OF 1976–1977 NEW DOCTORATES

Table 1 shows the fall 1977 employment status by type of employer and field of degree for 972 new mathematical science doctorates who received the degree between July 1, 1976 and June 30, 1977. This updates the corresponding table on p. 342 of the October 1977 *Notices*, using more recent information provided by departments and the recipients of the degrees. The first row "University" in Table 1 refers to those 1976–1977 new doctorates employed by departments in Groups I–V. The second row "College" refers to Groups M and B departments. The 972 new doctorates in Table 1 are 72 fewer than the 1,044 reported a year earlier (p. 99, February 1977 *Notices*). The number of 1976–1977 new doctorates employed by university departments was almost the same as for 1975–1976 new doctorates reported a year earlier. However, 36 fewer new doctorates were employed by college departments, and 22 more by government, business, industry, other academic departments, and research institutes. Only 17 were reported as not yet employed in fall 1977, compared to 30 in fall 1976. Two of these 17 are women.

FACULTY MOBILITY

This part of the AMS Survey is concerned with numbers of faculty members newly hired from various sources, as well as those leaving faculty positions and their subsequent employment status. The Survey also monitors trends in the proportions of tenured vs. nontenured faculty, and of doctorate-holding vs. nondoctorate-holding faculty. The numbers of departments in the various Groups I, II, ..., B responding to the 1977 Survey of faculty mobility are similar to previous years. The data obtained from those departments responding represent over half of all mathematical science faculty members. Over two-thirds of the faculty members in doctorate granting mathematics departments (Groups I–III) are included among responding departments.

TABLE 1

1977–1978 EMPLOYMENT STATUS OF NEW DOCTORATES IN THE MATHEMATICAL SCIENCES

Type of Employer	PURE MATHEMATICS: Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability	Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other	Total
University	43	59	50	6	16	45	37	1	25	2	12	296
College	35	36	27	4	5	19	11	2	19	4	10	172
Two-year college and high school	10	3	5	2			1		2	3	2	28
Other academic departments or research institutes	4	7	6	1	1	19	15	4	13		12	82
Government	5	6	1		1	26	6	4	9		4	62
Business and industry	5	11	6	1	2	19	52	6	25	1	8	136
Canada	14	12	2	4	5	9	8	3	7		6	70
Foreign	12	15	16	2	2	18	8	2	9	1	4	89
Not seeking employment	2	2	2			2			1			9
Not yet employed	4	3	2	1		2			2		3	17
Unknown	1	3	1		1	3			1		1	11
Total	135	157	118	21	33	162	138	22	113	11	62	972

Table 2 shows estimated faculty flow between 1976–1977 and 1977–1978 for U.S. departments. Further analyses for various groups of U.S. departments and a brief discussion of Canadian departments in Group VI are given separately below. The left-hand side of Table 2 shows the estimated numbers of new full-time faculty members hired from various sources between fall 1976 and fall 1977. The right-hand side of Table 2 shows the fall 1977 employment status of those full-time faculty members as of fall 1976 who permanently left their departments by fall 1977. Under "graduate school" on the left-hand side are included a number coming from departments outside the mathematical sciences, or from mathematics education. Similarly, the second row in Table 2 includes some moving to or from departments in other fields or other positions in academe (e.g., in a university computer or statistical laboratory). The number (+165) in parentheses represents a flow from nondoctorate to doctorate status of individuals who remained as full-time faculty members in the same department.

TABLE 2

FACULTY FLOW 1976–1977 to 1977–1978

Full-Time Mathematical Sciences Faculty in Four-Year Colleges and Universities in the U. S.

	Sources of New Faculty			Fall 1977 Employment Status, Faculty Leaving		
FROM	Doctorate Holding	Nondoctorate Holding		TO	Doctorate Holding	Nondoctorate Holding
Graduate school	460	250		Two-year college or high school	15	25
Another college or university position	500	55		Another college or university position	460	60
				Nonacademic employment	230	60
Nonacademic employment	40	30		Deaths and retirements	110	90
				Left U. S.	70	5
Outside U.S.	70	10		Graduate or professional school	10	40
Other sources[1]	70	90		Seeking employment	40	15
				Other[3]	80	40
Total	1,140	435		Total	1,015	335
Received doctorate and not moving[2]	(+165)	-		Received doctorate and not moving		(+165)
	1,305	435				500

Estimated size of full-time U.S. mathematical science faculty, Fall 1977
Doctorate holding 14,000 (+290 since Fall 1976)
Nondoctorate holding 4,030 (-65 since Fall 1976)

(1) Part-time to full-time in same department, from postdoctoral or two-year college position, etc.
(2) Mostly in Group M and B departments. Probably includes a fair number in mathematics education and other fields.
(3) No longer full-time in department, unknown employment status, etc.

The numbers in Table 2 are estimates obtained by extrapolating from AMS Survey data, not actual counts. These estimates are subject to various uncertainties. Moreover, minor adjustments have been made to balance the two sides of Table 2, and to take account of evidence on yearly changes in total numbers of faculty members obtained from other parts of the AMS Survey. Nevertheless, Table 2 is believed to give a fairly reliable overall picture of current faculty mobility.

Table 2 shows an estimated increase of 290 doctorate faculty members and a decrease of 65 nondoctorate faculty members between fall 1976 and fall 1977. This is an overall increase of 225. While these are only estimates, the data clearly indicate a modest increase in total numbers of mathematics faculty members during the last two years. However, the increase did not keep pace with rising elementary course enrollments (see p. 104, this issue, and p. 101, February 1977 *Notices*). The continued decline in mathematics graduate student enrollments (reported below) has made it difficult, or impossible, for many departments to recruit additional qualified teaching assistants. In such departments this creates a need for additional faculty members.

Almost all those shown on the left-hand side of Table 2 were hired without tenure. Only about 70 persons were newly hired with immediate tenure, and most of them moved from another tenured position elsewhere. On the other hand a considerable number were promoted to tenure within their own departments. Estimates of this number from different sources vary. A figure of 450 to 550 promotions to tenure between fall

1976 and fall 1977 seems reasonable. Slightly fewer than half of these are replacements for tenured faculty members leaving through death, retirement, or other reasons. The rest represent an increase in the total size of tenured faculty. It should be emphasized that these figures are only estimates. They refer to totals for all groups of departments; Groups I–III departments are discussed separately below. Moreover, current estimates are unreliable predictors of future tenure prospects, for reasons indicated at the end of this article.

In Table 2 the number 230 of doctorate faculty members leaving for nonacademic positions is up from the previous year, and is about twice the number reported two years ago. This apparently reflects greater discouragement with available academic job possibilities among junior faculty members. Moreover, 1977 was a rather good year generally for hiring by nonacademic organizations in scientific and engineering fields. The number 40 reported in Table 2 as still seeking employment is lower than a year earlier. In addition, four-fifths of the 230 taking nonacademic jobs were reported as having a position in the mathematical sciences, another scientific field, or engineering. It is encouraging that most (though by no means all) of those leaving academe appear to have found jobs using their talents as mathematicians in other ways.

The numbers of faculty members in Table 2 taking positions in two-year colleges and high schools is even smaller than in previous years. This does not seem to be a promising source of additional jobs for mathematicians leaving four-year college and university departments.

Doctorate-granting Mathematics Departments (Groups I, II, III). There are 156 departments in these three groups. They are research-oriented departments, in which a great deal of the research activity in traditional areas of mathematics takes place. These departments have about 4,960 full-time doctorate-holding faculty members, with roughly 3,640 tenured and 1,320 nontenured. They have, in addition, about 340 full-time faculty members without doctorates.

Table 3 shows estimated flow of doctorate-holding faculty for these 156 departments.

TABLE 3

FACULTY FLOW 1976–1977 to 1977–1978

Full-time, Doctorate-holding Faculty in 156 Doctorate Granting Mathematics Department in the U.S. (Groups I, II, III)

	Sources of New Faculty		Fall 1977 Employment Status, Faculty Leaving		
FROM	Nontenured	Tenured	TO	Nontenured	Tenured
Graduate school	200	0	Another Group I–III department	110	15
Another Group I–III department	110	20	Another college or university position (not Groups I–III)	85	5
Another college or university position (not Group I–III)	50	5	Nonacademic employment	55	10
Outside U. S.	25		Deaths and retirements	0	25
Other sources	25		Left U. S.	25	10
			Seeking employment	15	
			Other	20	
Total	410	25	Total	310	65
Received doctorate and not moving	(+20)	–			–
Received tenure and not moving	–	(+130)	Received tenure and not moving	(+130)	
	430	155		440	65

Estimated size of the full-time faculty, Fall 1977, in Groups I–III

Doctorate, Nontenured	1,320 (-10 from Fall 1976)
Doctorate, Tenured	3,640 (+90 from Fall 1976)
Nondoctorate faculty	340 (-15 from Fall 1976)

Table 3 shows a very immobile body of tenured faculty. On the other hand, nearly one-third of the nontenured doctorate faculty members, fall 1977, are newly hired. About half of them are new 1976–1977 Ph.D.'s, and about one-fourth are persons rehired from another Group I–III department. The flow of about 85 to other college or university positions was partially offset by a reverse flow of 50 from such positions into Group I–III departments leaving a net flow of only 35. Among these 85 are those who moved to Groups M and B departments and some who took other academic positions. The chances of a nonretained faculty member finding a suitable position in a Groups M or B department are better for those who can teach introductory courses in such areas as statistics and computing (see p. 107).

It is estimated that roughly 130 faculty mem-

bers in Groups I–III were promoted to tenure between fall 1976 and fall 1977. This is somewhat less than one per department per year. Of these 130, half can be considered replacements for 50 tenured doctorate faculty members plus 15 nondoctorate faculty members leaving Groups I–III through death, retirement, or other reasons. The other half contributed to an increase in the total number of tenured doctorate faculty members. While the number with tenure increased, the percentage of doctorate faculty members with tenure increased only slightly (by about 0.7%). This contrasts with an increase in tenure percentages of some 2% to 3% per year between 1972 and 1976, and suggests that tenure percentages may stabilize at somewhere around 75% tenured.

Among nontenured doctorate-holding faculty members currently in Group I–III departments, nearly 60% received their doctoral degree during 1974–1977, and only 40% before 1974. Attrition of the nontenured faculty seems to occur continually, not merely several years after the Ph.D. when crucial tenure decisions are made. For instance, only slightly over half those leaving for nonacademic employment received the doctorate before 1974.

Other doctorate-granting departments (Groups IV, V, VI). The statistics and statistics-related departments in Group IV have had moderate growth in numbers of faculty, as well as in undergraduate enrollments. They are about two-thirds tenured; and prospects for promotion to tenure seem somewhat better than in Groups I–III. There are good employment possibilities for statisticians who do not remain in academe.

Because of a lower response rate among Group V departments, AMS Survey data give less reliable information about trends in computer science, operations research, and other applied departments in this group. These departments tend to be younger and less heavily tenured. Prospects for nonacademic employment are currently good in these fields.

The Canadian departments in Group VI have experienced little or no overall growth recently. They are heavily tenured, slightly more so than in the U.S. The pattern of faculty mobility is rather similar to that reported above for Groups I–III.

Groups M and B. These departments include about 60% of all mathematical science faculty members in U.S. colleges and universities. This year, nearly 40% of those newly hired by Groups M and B departments did not yet have doctoral degrees. Only 18% of those newly hired for fall 1977 are new doctorates coming directly from graduate school; the other 42% already had doctorates. The 40% hired without doctoral degrees represents a significant increase from recent years. (On the other hand, Table 2 indicates that a considerable number of them will continue work toward the doctorate.) Several factors may have contributed to the increase in the number of nondoctorate faculty members hired in groups M and B. The pool of new doctorates taking academic jobs was smaller this year. A higher proportion went to doctorate-granting departments, perhaps seeking to continue in a more research-oriented environment. Many of the openings in group M and B departments were for people who can teach courses in such applied specialties as statistics and computer science. (See the related item on p. 107.) About half the course enrollments in Groups M and B are at a level below calculus. Some departments may not seek to hire Ph.D.'s to teach this material.

In past years M and B departments tended to have a lower turnover rate of their junior faculty, and better chances of permanency than in many doctorate-granting departments. However, this year's survey data show a faculty mobility pattern for these departments similar to Groups I–III. Like other kinds of departments, those in groups M and B have a high percentage of faculty either tenured or in an essentially permanent status without formal tenure. It may be that an increasing number of openings in Groups M and B are temporary positions to meet enrollment increases in lower level courses.

NUMBERS OF GRADUATE STUDENTS

Doctorate granting mathematics departments in the U.S. (Groups I–III) experienced a 3% drop in the number of full-time graduate students, and a 6% drop in the number of first year full-time graduate students, between fall 1976 and fall 1977. This continues a downward trend observed for several years (see these *Notices*, February 1976, p. 109 and February 1977, p. 99). Since 1971 the number of full-time graduate students in Groups I–III has declined by one-fourth, and the number of first-year full-time graduate students by one-third. On the other hand, the number of teaching assistants in Groups I–III remained stable between 1971 and 1977. Competition for qualified teaching assistants is keen. Some departments have resorted to hiring graduate students from other departments as teaching assistants, while others have converted some teaching assistantships into junior faculty positions.

Among departments in Groups IV and V, full-time graduate student enrollments continued to rise. Increases of 3% in Group IV and 13% in Group V between fall 1976 and fall 1977 were reported. Canadian departments in Group VI reported a slight decrease, about equal to a slight increase reported a year earlier. A 4% decline in the number of full-time graduate students in Group M was reported.

FUTURE PROSPECTS

Studies of the anticipated demand for college teachers are quite pessimistic for the 1980s. For a thorough analysis of this kind, see Chapter 6 of A.M. Cartter, Ph.D.'s and the Academic Labor Market, McGraw-Hill, 1976. The basic difficulty is an anticipated decline in college enrollments, coupled with rather low attrition of the tenured faculty during this period. In the mathematical sciences we should expect the number of tenured openings during the early to mid 1980s at best to equal the number of replacements for tenured faculty members, some 250 to

300 per year. However, such projections are subject to considerable uncertainty, since the marginal effect on the job market of expansion or contraction is great. For instance, a 1% rise in the total size of U.S. mathematical science faculty creates 180 new positions, while a 1% decrease eliminates 180. The severity of the depression in higher education during the 1980s will be conditioned on public attitudes toward higher education, as expressed by percentages of college age persons enrolled and levels of funding. Another imponderable is the possible effect of a bill being considered by the U.S. Congress raising to 70 the mandatory retirement age. The Senate passed a version containing a provision (sponsored by Senator John Chafee of Rhode Island) which would exclude colleges and universities with tenure systems. The version passed by the House of Representatives did not contain this provision. As of the end of 1977, the matter had not been resolved in the Senate-House Conference Committee.

The nonacademic job market for scientists and engineers is responsive to economic conditions, and to patterns of funding for research and development by the U.S. Federal Government and large corporations. It was much better in 1977 than during the recession three to four years earlier. We may optimistically expect reasonably good opportunities for mathematics-related nonacademic jobs in the years ahead.

A further decline in numbers of mathematical science Ph.D.'s is expected in the immediate future. The decrease will probably not be sufficient to maintain a reasonable balance between supply and demand for Ph.D.'s in the 1980s, unless a greater proportion enter nonacademic work. Among recent mathematical science doctorates, the proportion in nonacademic work is in fact steadily increasing, if both new Ph.D.'s and those leaving faculty positions are counted. The proportion may soon exceed half those recent doctorates employed in the U.S. This clearly has implications for Ph.D. programs geared to training mathematicians for traditional academic careers in teaching and research.

Course Loads, Faculty Size, and Teaching Loads

by Lida K. Barrett

The data used as the basis of this report were collected from the Fall Enrollments, Departmental Size and Teaching Load questionnaire in the Fall of 1977. Returns were received from approximately 50 percent of the departments, with a higher response rate from Groups II and III and a lower rate from Group V. Projections to the total group of U.S. and Canadian universities and colleges were not made; the data in this report reflect only the situation in those departments reporting. Departments were asked to report the following information for both Fall 1976 and Fall 1977: the number of sections, and total enrollments in six categories (courses below calculus, first year calculus, statistics, computer science, other undergraduate courses, and graduate courses).

The data from the Fall Enrollments, Departmental Size and Teaching Load questionnaire reflect trends similar to those shown in recent years (February 1976 *Notices*, pp. 101-102; November 1975 *Notices*, pp. 360-361). The increase in the number of faculty members on a full-time equivalent basis was two percent, the overall enrollment increase was five percent, and the number of sections of courses increased four percent. This has the obvious effect that the average section size and the number of enrollments per full-time equivalent faculty member increased slightly from Fall 1976 to Fall 1977.

Percentage increases in enrollments varied from 2.6 percent in Group I departments to 7.2 percent in Bachelors-granting departments. The enrollment increase was greatest at the lower level courses, but increases were also present in courses above calculus, contrary to the trends observed in 1973–1974. Graduate enrollments continue to drop slightly. The average class size, obtained by dividing the reported enrollment by the number of sections, varied from 33.3 in Group III to 25.2 in Group B with increases of 0.5 to 1.1 enrollments per section from 1976 to 1977. If the total number of enrollments is divided by the sum of the number of full-time faculty members and the number of full-time equivalents for part-time faculty members (but not including the full-time equivalents for graduate teaching assistants), then the number of student enrollments per full-time faculty member (not including graduate teaching assistants as teachers) varies from 1976 to 1977 as shown in Table 1.

TABLE 1

	Fall 1976	Fall 1977
Group I	103.	106.
Group II	89.3	90.3
Group III	116.1	116.5
Group M	101.7	104.6
Group B	83.5	87.5

These data reflect quite clearly a rising student load and, though the increases are small, they indicate a distinct trend upward.

Meaningful data on teaching loads are difficult to assemble due to variations in class size and in modes of instruction. This year's questionnaire sought to examine for the first time the percentage of enrollments in various modes of instruction. Departments were asked to supply the percentage (to the nearest 5 percent) of enrollments for a number of different modes of instruction (small classes with no more than 40 students, large classes with more than 40 students, large lecture format with recitation sections, self-paced, other). The response rate for this portion of the questionnaire was:

	Number of Departments Reporting
Group I	12 of 27
Group II	30 of 38
Group III	53 of 91
Group M	154 of 361
Group B	385 of 1,052

The following table summarizes certain of this information: figures are given for 1977; there was little change from 1976. Table 2 indicates

TABLE 2

For Classes Calculus and Above	Percentage of Enrollments in Classes of 40 or Fewer Students	Departments With ALL Classes of 40 or Fewer	Departments With NO Classes of 40 or Fewer
	Median (quartiles)		
Group I	65 percent (30- 80)	0 of 12	1 of 12
Group II	52.5 percent (30- 90)	6 of 30	1 of 30
Group III	85 percent (40-100)	13 of 53	1 of 53
Group M	100 percent (75-100)	83 of 154	5 of 154
Group B	100 percent (100-100)	297 of 385	10 of 385

the distribution of percentages of enrollments (calculus and above) taught in small classes. The left hand column in Table 2 shows the median percentages among departments reporting. The figures in parentheses are quartiles. For instance, the median percentage reported by Group II departments was 52.5%. Three-fourths of Group II departments reported that at least 30% of their enrollments (calculus and above) are taught in small classes, while one-fourth reported 90% or more of their enrollments in small classes. The right-hand columns show extremes, namely, numbers of departments with either all small classes or no small classes.

Table 2 shows that the small class structure is the norm for departments that do not have doctoral programs. Moreover, it shows that in every group the median percentage of students in classes of 40 or fewer students is greater than 50 percent. The median percentage of students in classes larger than 40 in departments granting doctorates in mathematics was 10 percent for Groups I–III and only one-fourth of these departments reported more than 25% of their enrollments taught in this instructional mode. It is interesting to note that although one department in Group II and one in Group III had 50 percent of their students in large classes, the folklore that students at large universities are in large classes does not apply to most of the departments reporting in this study. Only 40 departments in Groups I, II, III, among the 95 reporting, use the large lecture-recitation mode of instruction in courses calculus and above. Of these 40 departments, nearly half use this mode for 25% or fewer of their enrollments.

For courses below calculus, the distribution of percentages taught in the various modes is similar to that reported above, in the case of Groups I–III departments. However, among Groups M and B departments, percentages of below calculus enrollments taught in small classes are somewhat lower than those shown in Table 2. For Group M, the median percentage for courses below calculus was 70%, with quartiles (25%–100%). For Group B the median was 95% with quartiles (50–100%). The next most common mode in Groups M and B was large classes (more than 40 students). Large lectures with recitation sections were seldom reported by these departments.

The incidence of self-paced instruction for courses calculus and above was reported as follows:

	Number of Departments Using Self-paced Instruction	Range of Percentage of Enrollments in Self-paced mode (calculus and above)
Group I	1 of 12	5 percent
Group II	4 of 30	5 to 35 percent
Group III	4 of 53	5 to 30 percent
Group M	10 of 154	5 to 55 percent
Group B	11 of 395	5 to 65 percent

AMS Two-Year College Survey

by W. H. Fleming

This year's AMS Survey of two-year colleges showed essentially no growth in numbers of faculty members and only a modest growth in course enrollments. This continues a trend observed in the 1976 Survey. These data indicate that we are no longer in the period of two-year college expansion observed for a number of years up to 1975. See these *Notices*, February 1977, pp. 103, 106. (On the other hand, preliminary estimates of total two-year college enrollments, in all fields, for fall 1977 indicate a 7% rise from fall 1976.)

Table 1 shows numbers of full-time mathematics faculty members by sex, tenure status (doctorate-holding or nondoctorate), in those departments providing usable responses to the Survey questionnaire (286 out of a total of 1,019 mathematics departments in two-year colleges.)

TABLE 1

SIZE OF FACULTY	1976–1977 FACULTY Total	1976–1977 FACULTY With Tenure	1976–1977 WOMEN Total	1976–1977 WOMEN With Tenure	1977–1978 FACULTY Total	1977–1978 FACULTY With Tenure	1977–1978 WOMEN Total	1977–1978 WOMEN With Tenure
Nondoctorate	1,466	957	318	166	1,456	946	322	167
Doctorate	183	92	31	14	197	98	30	16
Total	1,649	1,049	349	180	1,653	1,044	352	183

Table 1 indicates that among those institutions reporting, 12% of the full-time mathematics faculty members at two-year colleges hold doctorates. While this percentage is small, it has been gradually rising. Among faculty members newly hired for fall 1977, 22% were reported as having doctor's degrees. Slightly over half the newly hired doctorates came from the mathematical sciences, and the rest from mathematics education or other fields. Table 1 shows slightly fewer than two-thirds of the faculty members as tenured. However, this underestimates the number whose employment status should be considered fairly permanent. Only 70% of departments responding reported that their institution has a tenure system.

In addition to full-time faculty members, 1,437 part-time faculty members, including 424 women, were reported. Most of these part-time faculty members hold other full-time positions elsewhere as teachers in high schools or other two-year colleges, or in other full-time work.

The questionnaires asked for information on salaries including a minimum, median, and maximum salary figure both for staff members with doctorates and for those without doctorates. Annual salaries of full-time faculty members for the academic year of 9–10 months were sought. In Table 2 the data in the parentheses give the range of the middle fifty percent of salaries reported. The figures outside the parentheses represent the minimum and maximum salary listed by any reporting institution.

An increase of 3.8% in two-year college mathematics course enrollments between fall 1976 and fall 1977 was reported. There was an increase of 3.1% in the number of sections taught. Since the number of faculty members remained essentially constant, there was some increase in faculty load.

Two-year college faculty mobility. It is estimated that about 325 full-time two-year college mathematics faculty members were newly hired for fall 1977, replacing about an equal number leaving. This is an estimate for all two-year college mathematics departments, obtained by extrapolating from Survey data. (In contrast, Tables 1 and 2 report data for those departments responding, without extrapolation.) There are altogether about 6,000 full-time two-year college mathematics faculty members in the U.S. Among those newly hired for fall 1977, the Survey data indicate that about 20% came directly from graduate school, 40% from another academic position, 25% from part-time to full-time status at the same institution, and the other 15% from nonacademic employment or other sources. Among those leaving, roughly 35% retired or died, 30% took a nonacademic position, 25% took another academic position, 5% returned to graduate school, and 5% moved from full-time to part-time status at the same institution or are seeking employment. These percentages are based on counts of rather small numbers of individuals, and should be taken only as general indicators of current mobility of the two-year college faculty.

TABLE 2

SALARIES (in hundreds of dollars)	1976–1977 Minimum	1976–1977 Median	1976–1977 Maximum	1977–1978 Minimum	1977–1978 Median	1977–1978 Maximum
Nondoctorate	78(112–155)	(129–185)	(142–219)350	82(120–161)	(137–194)	(154–229)360
Doctorate	96(125–191)	(136–210)	(142–226)350	101(135–194)	(150–210)	(155–237)360

Supply vs. Demand for Faculty Members in Applied Fields Among Departments not Granting Doctorates*

by Wendell H. Fleming

There has recently been considerable demand for applied mathematicians in such specialties as computing, statistics, and numerical analysis. This is evidenced, for instance, by the fact that a substantial proportion of listings in Employment Information for Mathematicians (EIM) are for positions to be filled by persons in applied fields.** These listings for applied mathematicians include a considerable number for faculty positions in departments which offer, at most, the master's degree. In this article we report some evidence as to how well last year's pool of job applicants filled the needs of departments in this category.

The March 1977 issue of EIM listed about 125 openings in nondoctorate-granting departments, for which persons in applied specialties were sought (or strongly preferred). In May 1977 each of these departments was asked to report on its progress in filling these positions; over 80% of them responded, and the status of 106 of these openings was learned. As of June 1977, 72 of the 106 had been filled, but 34 had not yet been filled. Among the remaining 34, the departments were still seeking to fill 25 for fall 1977. Of the 72 persons hired, 47 were reported as primarily in the applied specialty requested (e.g. statistics, computing). The remaining 25 were reported as primarily in another field; however, nearly all of these 25 have had some experience in the specialty requested. In addition, many of those departments still trying to fill the opening listed in EIM indicated a willingness to consider persons in other areas of mathematics with some credentials in the desired applied specialty.

Among the 72 persons hired, 57 hold doctorates and 15 only master's degrees. The fields of highest degree were reported as follows: "pure mathematics" 28, computer science 20, statistics 8, operations research 5, other applied mathematics 7, unknown or other fields 7 (these numbers add to 75, not 72, since 2 joint mathematics-computer science degrees and one joint applied mathematics-computer science degree were reported).

These data indicate that, from the viewpoint of departments without doctoral programs, there was some competition last year for people suited to their needs in certain applied fields. From the viewpoint of job seekers trained in other fields (e.g., pure mathematicians), those who have acquired a second skill in one of the applied fields currently in demand have broader employment possibilities.

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**The great majority of listings in EIM mention at least one specialty in pure or applied mathematics. In the most recent issues about thirty percent of the specialties mentioned are either computing or numerical analysis, about twenty-five percent are probability or statistics, twenty percent are in other areas of applied mathematics, and less than ten percent are in other areas of pure mathematics. This contrasts sharply with the distribution among areas of specialization for new recipients of doctoral degrees in the mathematical sciences as reported in recent years. For the years 1971-1972 through 1975-1976, see p. 108; for 1976-1977, refer to the column totals in Table 1 on p. 100.

Doctorates in Mathematics and Related Areas July 1971–June 1976

The following table was prepared on behalf of the Committee on Employment and Educational Policy. It presents data from the last five annual Summary Reports, "Doctorate Recipients from United States Universities", issued by the National Research Council.

The classification is by the recipients themselves from forms prepared at the time of their graduation. It is believed to be essentially complete, giving data in somewhat different form than that collected by the AMS from department chairmen. The 1976 report for doctorates earned from July 1, 1975, to June 30, 1976, was issued recently.

According to the NRC data, 1971–1972 was the peak year for production of mathematics doctorates (data from 1967–1971 is summarized in these *Notices*, October 1974, p. 254). The downward trend shown below is quite consistent with AMS Survey data on new doctorates, collected independently. AMS data for 1976–1977 indicate a further drop since 1975–1976 in the number of new doctorates (see Table 1 of page 100 of this issue) which is based on the list of new doctorates published in the October 1977 *Notices*, pp. 344–361. Supplementary lists appear in the January 1978 issue, p. 56 and in this issue, p. 138. Note the substantial drop in the number of pure mathematics degrees since 1971–1972. The fluctuations in certain categories, such as computing theory and practice and operations research may be due to variations in classification.

	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976
Mathematics	1,281	1,222	1,196	1,149	1,003
A. Algebra	167	141	124	126	115
B. Analysis	241	244	213	180	141
C. Geometry	35	32	38	26	23
D. Logic	39	33	21	38	34
E. Number Theory	36	31	23	27	26
F. Probability, Mathematical Statistics	151	156	150	174	165
G. Topology	130	111	112	94	72
H. Computing Theory and Practice	163	221	194	167	147
I. Operations Research		3	24	55	36
J. Applied Mathematics	119	119	138	101	104
K. Mathematics, General	112	90	111	115	97
L. Mathematics, Other	88	41	48	46	43
Total Pure (A, B, C, D, E, G, K)	760	682	642	606	508
Total Other (F, H, I, J, L)	521	540	554	543	495
Education					
Mathematics Education	152	134	110	108	96
Engineering					
Engineering Mechanics	209	176	161	162	113
Operations Research	62	104	125	90	82
Life Sciences					
Biometrics and Biostatistics	30	34	35	37	46
Social Sciences					
Econometrics	32	31	20	27	30
Statistics	85	62	36	43	35