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26th Annual AMS Survey 1982
Second Report

Second Report

A first report of the 1982 Survey appeared in the November 1982 *Notices*, pages 630-653. It included a report of the survey of faculty salaries, a first report of the survey of new 1981-1982 doctorates, and a list of the names and thesis titles of the 1981-1982 doctorates included in the Survey. This second report includes an update of the fall 1982 employment status of new doctorates, an analysis of faculty mobility, and a report on fall 1982 enrollments and class sizes.

The 26th Annual AMS Survey was made under the direction of the Society's Committee on Employment and Educational Policy (CEEP), whose members in 1981 were Lida K. Barrett (chairman), Irwin Kra, Robert W. McKelvey, Donald C. Rung, Robert J. Thompson, and Barnet M. Weinstock. A Data Subcommittee of CEEP, consisting of Lida K. Barrett, Susan J. Devlin, Lincoln K. Durst, Wendell H. Fleming, Arthur P. Mattuck and Donald C. Rung (chairman), 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, Faculty Mobility, Nonacademic Employment and Enrollments, Fall 1982

by Donald C. Rung

This report is one in a series of annual reports on employment patterns, enrollment and class size in the mathematical sciences. It begins with an update of the fall 1982 employment status of new 1981-1982 doctorates, followed by an analysis of trends in the academic job market based upon the 1982 AMS Survey of faculty mobility. Finally it compares 1981 and 1982 fall enrollment and class size for various levels of courses in the mathematical sciences.

Estimates based on AMS Survey data suggest that 880 full-time positions in U.S. colleges and universities were filled by nondoctorates last fall and for 536 of these positions, the department would have preferred someone with a doctorate. About 87% of these positions were in Groups M and B schools. (See the box for descriptions of the groups.) While this number does not represent an annual demand for new doctorates it does indicate that at this time colleges cannot find enough mathematicians with doctorates to fill faculty positions. The 536 figure is an increase over the 350 reported last year. This increased demand for new doctorates is also seen in Table 2 which shows that the number of nondoctorate-holding faculty members hired (880) is substantial compared to the number of doctorate-holding faculty members hired (1,321). While the estimated total increase for this year in the size of the full-time faculty (703) is one of the largest in recent years, the increase for Groups I, II and III is only 87 (Table 3). Further the net increase in the nondoctorate faculty (241) is positive and increasing for the third consecutive year, after nine consecutive years of decline.

For the first time in ten years enrollments showed only a modest increase (4%) with many categories showing little or no increase. Class Size also is level with last year (Tables 6 and 7). Perhaps we can anticipate a period of

In this article departments in mathematical sciences in U.S. and Canadian universities and four-year colleges are classified as below. The first six groups consist of departments that have doctoral programs, of which Groups I-V are U.S. departments. (The numbers indicate how many departments were queried in the 1981 Survey.)

Group I contains the top 27 ACE ranked mathematics departments with scores in the 3.0-5.0 range.

Group II contains the other 38 ACE rated mathematics departments with scores in the 2.0-2.9 range.

Group III contains 87 mathematics departments not included in the ACE study.

Group IV includes 64 statistics, biostatistics and biometry departments.

Group V is made up of 137 other mathematical science departments (including 77 in computer science).

Group VI consists of 35 Canadian departments in the mathematical sciences.

Group M contains 369 departments with masters' programs (of which 24 are Canadian departments).

Group B is made up of 1,065 departments which offer at most bachelors' degrees (of which 34 are Canadian departments).

Notes: Group B includes about 100 departments with no degree programs. Both M and B include some departments in universities which have doctoral programs in other areas, in some cases in other areas of the mathematical sciences.

Response rates varied from one group to another, with the largest response rate from Groups I, II, and III. Of an estimated total in 1981 of 18,920 full-time U.S. mathematical sciences faculty members, 9,192 are members of departments which responded to the survey.

For an account of the ACE ratings referred to above see *A Rating of Graduate Programs* by Kenneth D. Roose and Charles J. Andersen, American Council on Education, Washington, D.C., 1970, 115 pp. The information on mathematics was reprinted by the Society and may be found on pages 338-340 of the February 1971 issue of the *Notices*.

stable enrollments—except for computer science courses. Part-time members of the faculty continue to play a significant role in undergraduate instruction. For example, departments in Groups M and B have over four part-time members of the faculty (excluding graduate assistants) for every ten full-time members.

The number of graduate students increased by 3% with departments in Groups I, II and III showing a 5% increase. The percentage of new doctorates taking nonacademic employment dropped slightly to 25% from the 1981 figure of 27%, the lowest figure since 1975 (Table 4). No doubt economic conditions account for this as well as the lowest net outflow in recent years of doctorate-holding faculty members (94) to nonacademic employment (Table 5).

Fall 1982 Employment Status of 1981-1982 New Doctorates

Table 1 contains the fall 1982 employment status by type of employer and field of degree for 860 new mathematical sciences doctorates who received the degree between July 1, 1981, and June 30, 1982. The names of these 860 people and the titles of their doctoral theses were published in the November 1982 *Notices*, pages 635-653. Table 1 updates the corresponding table on page

635 of the November 1982 *Notices*, using more recent information provided by departments and the recipients of the degrees. The total does not include a few more recipients of doctorates who were reported too late to gather employment information for these reports. (A supplementary list of recipients will appear in the April 1983 *Notices*.)

The first five rows in Table 1 refer to those 1981-1982 new doctorates employed by doctorate-granting departments in the U.S. The next two rows refer to those employed by U.S. mathematical sciences departments which grant masters and bachelors degrees only. There seem to be good job prospects for new doctorates in departments in Groups M and B. It should be noted that the survey of enrollments shows that 69% of all computer science enrollments and 48% of all statistics enrollments reported are in M and B departments! Mathematicians prepared to teach these courses will find no lack of opportunity to do so at those schools.

Faculty Mobility

This part of the Annual AMS Survey is concerned with the number of faculty members newly hired from various sources, as well as with the number of those individuals leaving

TABLE 1 - 1982-1983 EMPLOYMENT STATUS OF NEW DOCTORATES IN THE MATHEMATICAL SCIENCES

Type of Employer	PURE MATHEMATICS					Statistics	Computer Science	Operations Research	Applied Mathematics	Mathematics Education	Other	Total
	Algebra and Number Theory	Analysis and Functional Analysis	Geometry and Topology	Logic	Probability							
Group I	17	15	20	2	3	2	1		4		1	65
Group II	15	10	6		4	2	2	1	6			46
Group III	8	12	7		3	8	2	1	14		1	56
Group IV						33	1	1	1			35
Group V				1	1	1	26	5	1		2	37
Masters	11	25	9	3	3	11	4	2	9		2	79
Bachelors	20	12	7	3	1	5			6	2	3	59
Two-year College or High School	3	1	2			1				4	1	12
Other Academic Depts.		4	3		4	27	7	10	12	1	5	73
Research Institutes	3	7	5			7		2	9		2	35
Government	3		2			10		2	7			24
Business and Industry	3	10	5	3	3	38	46	13	19		6	146
Canada, Academic	3	2	3	2		6	3	3	3		6	31
Canada, Nonacademic	1					2						5
Foreign, Academic	8	10	4	2	1	26	10	9	5		3	78
Foreign, Nonacademic	4	8	3		1	9	3	3	5		1	37
Not seeking employ		1	2			3		1	1		2	10
Not yet employed	3	4				1		2	2		2	14
Unknown	3	3			1	6	1	1	1		2	18
Total	105	124	78	16	25	198	105	58	105	7	39	860

faculty positions and with information on their subsequent employment status. The Survey also monitors trends in the percentage of faculty members with tenure, and the percentage of faculty members with doctoral degrees. The number of departments in each of Groups I, II, ..., B responding to the 1982 Survey of faculty mobility is similar to that of previous years. The responding departments represent about half of all mathematical sciences faculty members. More than two-thirds of the faculty members in doctorate-granting mathematics departments (Groups I-III) are included among responding departments.

Table 2 shows estimated faculty flow between 1981-1982 and 1982-1983 for U.S. departments. Further analyses for Groups I-III are given in Table 3. The left side of Table 2 shows the estimated numbers of new full-time faculty members hired from various sources between fall 1981 and fall 1982. The right side of Table 2 shows the fall 1982 employment status of those full-time faculty members (as of fall 1981) who permanently left their departments by fall 1982. The row "graduate school" on the left side includes new faculty members 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 academia (e.g., in a university computer or statistical laboratory). The number (+88) in parentheses represents a flow from nondoctorate

to doctorate status of individuals who remained as full-time faculty members in the same department.

The numbers in Tables 2 and 3 were obtained by extrapolating from AMS Survey data and are not actual counts. The various totals of the responses from each group were adjusted according to the fraction of the total faculty within each group, as reported in the CBMS 1980 report. (A summary of this report is given in the February 1982 *Notices*, pages 139-143.) Nevertheless, Tables 2 and 3 are believed to give a fairly reliable overall picture of current faculty mobility.

Table 2 shows an estimated increase, between fall 1981 and fall 1982, of 462 in the size of the doctorate-holding faculty and an increase of 241 in the nondoctorate faculty, for an overall increase of 703, the largest in a decade. This increase almost kept pace with rising enrollments. Course enrollments rose by only 4% and class sizes were nearly stable (Tables 6 and 7).

The pattern of faculty mobility obtained by comparing the two sides of Table 2 continues the trend of last year. More full-time faculty members are being hired before receiving the doctorate. The figure of 880 shown in Table 2 corresponds to the estimate of 435 five years ago (February 1978 *Notices*, page 101). Most (91%) of the new nondoctorate faculty members were hired by departments in Groups M and B.

Attrition due to deaths and retirements continues at the yearly rate of about 1% of the total faculty. The number of faculty members who received tenure in their institutions is 403, up from last year's total of 392.

TABLE 2 - FACULTY FLOW 1981-1982 TO 1982-1983

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

FROM	Sources of New Faculty		TO	Fall 1982 Employment Status, Faculty Leaving	
	Doctorate-Holding	Nondoctorate		Doctorate-Holding	Nondoctorate
Graduate School	510	332	Two-year college or high school	12	50
Another college or university position	595	217	Another college or university position	482	112
Nonacademic employment	77	101	Nonacademic employment	173	84
Outside U.S.	77	0	Deaths and retirements	116	102
			Position outside U.S.	59	3
			Graduate or professional school	14	85
Other sources ⁽¹⁾	62	230	Seeking employment	12	19
Total	1321	880	Other ⁽³⁾	79	96
			Total	947	551
Received doctorate and not moving ⁽²⁾	(+88)		Received doctorate and not moving		(+88)
	1409				639

Estimated size of full-time U.S. mathematical sciences faculty, Fall 1982

Doctorate-holding	15,125 (+462 from Fall 1981)
Nondoctorate	4,488 (+241 from Fall 1981)
	19,613 (+703 from Fall 1981)

(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.
 (3) No longer full-time in department, unknown employment status, etc.

Doctorate-granting Departments of Mathematics (Groups I, II, III). Table 3 gives a somewhat different perspective of faculty mobility in and out of the 152 U.S. departments with doctoral programs. In Table 3 the sources of new tenured and nontenured doctorate-holding faculty members are shown, as well as the employment status of those leaving between academic years 1981-1982 and 1982-1983.

Groups M and B. The number of nondoctorate faculty members hired by Groups M and B departments has been steadily increasing, from about 350 newly hired for fall 1977 to 734 for fall 1982.

The M and B departments are very diverse, ranging from medium-to-large departments in public institutions to quite small departments in private colleges of varying degrees of selectivity. Besides mathematics instruction, mathematics departments in Groups M and B often have responsibilities in applied areas which in larger universities are taken by separate departments of statistics, operations research or computer science. As mentioned earlier, there are opportunities for young mathematicians with a strong commitment to teaching who fit the needs of Groups M or B departments.

Nonacademic Employment of Doctorates in the Mathematical Sciences

Table 4 is a summary of AMS Survey data on the employment of new doctorates during the last six years 1976-1977 to 1981-1982.

Table 4 shows a decline in hiring of new doctorates by business and industry. Many of

these jobs are in companies in high technology, computer-information processing, or communications areas. A significant number are with organizations which do consulting work in operations research, statistics or applied physics, or which provide computer software or data management services. The November 1980 issue of *Employment Information in the Mathematical Sciences* contains lists of the names and addresses of nonacademic employers of the individuals included in Table 1 on page 608 of the November 1980 *Notices*, with an indication of the thesis field of the employee.

**TABLE 4
NEW MATHEMATICAL SCIENCES DOCTORATES
TAKING NONACADEMIC POSITIONS IN U.S.**

	1976- 1977	1977- 1978	1978- 1979	1979- 1980	1980- 1981	1981- 1982
In Government	62	44	34	37	28	22
In Business/Industry	136	166	168	165	169	141
Total	198	210	202	202	197	163
Total new doctorates employed in U.S.	776	734	690	691	732	659
% in Govt./Bus./Ind.	26%	29%	29%	29%	27%	25%

**TABLE 5
ESTIMATED NET OUTFLOW OF
DOCTORATE-HOLDING FACULTY MEMBERS
TO NONACADEMIC EMPLOYMENT**

	1977	1978	1979	1980	1981	1982
Net Outflow	190	190	165	168	116	94

Table 5 shows the estimated annual net outflow of doctorate-holding faculty members to nonacademic positions since 1977. For instance,

TABLE 3 - FACULTY FLOW 1981-1982 TO 1982-1983

Full-time Doctorate-holding Faculty in 152 Doctorate-Granting Mathematics Departments in the U.S.

(Groups I, II, III)

FROM	Sources of New Faculty		Fall 1982 Employment Status, Faculty Leaving TO		
	Nontenured	Tenured		Nontenured	Tenured
Graduate School	173		Doctorate-granting departments	134	21
Another college or university position	148	30	Other college or university position	37	6
Nonacademic employment	19	} 12 }	Nonacademic employment	31	18
Outside U.S.	31		Deaths and retirements	0	45
Other sources	6		Position outside U.S.	42	} 15 }
Total	377	42	Seeking employment	4	
Received doctorate and not moving	(+10)		Other	17	
Received tenure and not moving		(+119)	Total	265	105
	387	161	Received tenure and not moving	(+119)	
				384	105

Estimated size of full-time faculty, Fall 1982 Groups I-III

Doctorate, Nontenured	1,266 (+31 from Fall 1981)
Doctorate, Tenured	3,885 (+56 from Fall 1981)
Nondoctorate faculty	436 (+28 from Fall 1981)
Total full-time Faculty	5,587 (+87 from Fall 1981)

TABLE 6 – PERCENT CHANGE IN COURSE ENROLLMENTS

By Type of Course, Fall 1981 to Fall 1982

Type of Course	Groups								All Groups
	I	II	III	IV	V	VI	M	B	
Below calculus	-1%	-1%	-3%	*	*	*	1%	0%	0%
First year calculus	2%	1%	5%	*	*	3%	3%	5%	3%
Statistics	*	*	*	6%	*	6%	-1%	5%	2%
Computer Science	*	*	18%	*	5%	*	18%	30%	20%
Other undergraduate mathematics courses	4%	5%	8%	*	*	7%	10%	8%	7%
Graduate courses	-2%	7%	3%	0%	6%	28%	13%	26%	5%
All courses	2%	2%	3%	4%	6%	5%	5%	8%	4%

*Enrollments in this type of course amount to less than 5% of total undergraduate enrollments for this group of departments.

the number 94 for 1982 is the difference of 171 doctorates shown in Table 2 leaving academia and 77 hired in academia from nonacademic positions: the 1982 number is the lowest in at least ten years; no doubt reflecting the economic recession.

As mentioned above, the November 1980 issue of *Employment Information in the Mathematical Sciences* shows nonacademic employment of new doctorates for the period 1975 to 1980, by employer and field of degree. As might be expected 46% took positions in the Virginia to Massachusetts arc and 18% in California. In addition to the 1980 annual salary survey of new doctorates (November 1980 *Notices*, page 607), the AMS surveyed individual Ph.D. mathematicians in nonacademic jobs during 1980. This survey gave information about salaries. The results were

summarized in the November 1980 *Notices*, pages 610 to 614.

In summary, the 1982 AMS Survey showed an increase of 462 in the number of doctorate-holding faculty members in U.S. colleges and universities and a corresponding increase of 241 in nondoctorate faculty members. Most new doctorates (67%) found employment in academic positions, while 19% took positions in government or industry. There are virtually no unemployed Ph.D.'s in mathematics at any level and there seems to be a shortage of new doctorate faculty members especially at schools in Groups M and B.

Changes in Enrollments and Class Size

Unlike recent years, enrollments showed an increase smaller than normal (4%). Computer

TABLE 7 – AVERAGE CLASS SIZE IN FALL 1981 AND FALL 1982 (1981 figures appear in parentheses)

Type of Course	Groups							
	I	II	III	IV	V	VI	M	B
Below calculus	(35)	(42)	(46)	--	--	--	(40)	(31)
	36	40	46	--	--	--	39	31
First year calculus	(36)	(42)	(43)	--	--	(69)	(35)	(28)
	33	42	43	--	--	67	35	28
Statistics	--	--	--	(45)	--	(56)	(34)	(29)
	--	--	--	44	--	54	35	29
Computer Science	--	--	(37)	--	(46)	--	(33)	(27)
	--	--	38	--	47	--	33	27
Other undergraduate mathematics courses	(27)	(34)	(34)	--	--	(45)	(25)	(16)
	27	34	35	--	--	48	26	16
Graduate courses	(10)	(9)	(10)	(17)	(21)	(6)	(10)	(13)
	9	9	10	17	22	7	11	14
All courses	(30)	(37)	(38)	(33)	(37)	(45)	(33)	(27)
	30	37	38	32	38	46	33	27

A dash indicates that these courses represent less than 5% of total undergraduate enrollment for departments in this category.

science and mathematics courses showed the biggest increase. Table 6 gives the percentage increases for various courses. A pleasing statistic was the increase of 19% in junior-senior mathematics majors. This increase was not confined to Groups M and B. The increase for Groups I, II and III was still a nice 14%. This is the second year of such increases in mathematics majors.

Finally Table 7 compares class sizes for mathematical sciences departments for fall 1981 and fall 1982. Class sizes stabilized in most courses in mathematical sciences departments. This stable

enrollment may well herald several years of no growth in enrollment.

Graduate Student Enrollments. Doctorate-granting mathematics departments in the U.S. (Groups I, II, III) reported a 5% increase in the number of full-time graduate students from fall 1981 to fall 1982. Further, the number of entering full-time first-time graduate students in Groups I, II, III increased by 10%.

Departments in other Groups reported similar increases. Again, this was the second year of such increases.