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20TH ANNUAL
1976
AMS SURVEY

SECOND REPORT

A first report on 1976 Survey results appeared in these *Notices*, October 1976, pp. 313-341. It included a report of salary survey results and a first report of the survey of new 1975-1976 doctorates. This second report includes an update of the fall 1976 employment status of new doctorates, a report on fall 1976 enrollments, class sizes, teaching loads, and faculty mobility, a discussion of changing tenure patterns between 1972 and 1976, as well as a brief report on the two-year college survey.

The 20th Annual Survey was made under the direction of the Committee on Employment and Educational Policy (CEEP), whose members in 1976 were David Blackwell, Charles W. Curtis, Wendell H. Fleming (chairman), Martha K. Smith, and Daniel H. Wagner. The data were compiled by the AMS staff under the direction of Lincoln K. Durst, with advice from Richard D. Anderson representing the data subcommittee of CEEP.

Fall 1976 Part of the Survey of Four-Year Colleges and Universities

by R. D. Anderson and W. H. Fleming

The 1976 Survey results showed general trends similar to ones observed in annual surveys for the years immediately preceding it. The job market in 1976 was relatively good for new Ph.D.'s, but more difficult for more experienced Ph.D.'s who left faculty positions. Among those leaving, significantly more entered nonacademic employment. There has been a substantial increase in course enrollments during the two years 1974-1976, resulting in an increase in student load per faculty member. A striking change in tenure patterns has occurred during the four years 1972-1976. Most categories of departments are now heavily tenured, and there is the prospect of a severe "tenure crunch" in the near future.

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.

FALL 1976 EMPLOYMENT STATUS OF 1975-1976 NEW DOCTORATES

Table 1 shows the fall 1976 employment status by type of employer and field of degree of 1,044 new mathematical science doctorates who received the degree between July 1, 1975 and June 30, 1976. This updates the corresponding table, p. 318, October 1976 *Notices*, using more recent information provided by departments. Table 1 shows only 30 of 904 new doctorates as not yet employed, excluding 111 who moved to foreign countries (not U.S. or Canada), 13 not seeking employment, and 16 of unknown employment status. The 111 reported in Table 1 as foreign is considerably fewer than the number 263 of new 1975-1976 doctorates reported as having citizenship other than U.S. or Canada

*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 the *Notices*.

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(October 1966 *Notices*), p. 320). Many of those remaining will presumably return home after a period of some sort of postdoctoral study. Among those not yet employed, 4 were women, and the fall 1976 employment status of 1 woman is unknown. (About 11% of 1975–1976 mathematical science new doctorates were women; see October 1975 *Notices*), p. 320.)

Table 1 shows that the job market for new Ph.D.'s was relatively good in 1976. A helpful factor was the continued pressure of undergraduate mathematics enrollment increases, reported below, which led to a modest increase in the total number of mathematics faculty. In the first (October 1976) report, 97 new doctorates were shown as not yet employed and 38 as having unknown employment status. A comparison with the corresponding numbers above shows a significant amount of late hiring during summer and early fall 1976. About 7% to 8% of new doctorates have found employment since the first report, leaving about 3% still seeking employment.

TABLE 1

1976–1977 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	Totals
University	48	52	30	12	16	47	30	3	35		12	285
College	49	43	28	7	8	20	22	1	18	4	8	208
Two-year colleges and high schools	9	8	2	2			1	1	3	8	2	36
Other academic departments and research institutes	4	1	5	2	2	23	14	6	9	1	3	72
Government	7	3	4	1		23	10	7	15	1	3	74
Business and industry	4	16	5	2	4	17	39	17	6		3	112
Canada	14	10	8	1	5	11	20	3	8		7	87
Foreign	12	20	14	5	5	28	3	7	13		4	111
Not seeking employment	2	4	3			2	1				1	13
Not yet employed	9	6	5		1	2	2	1	4			30
Unknown	3		3	1	1	2	2	1	1	1		16
Totals	161	163	107	33	42	175	144	49	112	15	43	1,044

NUMBERS OF GRADUATE STUDENTS

Ph.D. granting mathematics departments in the U.S. (Groups I–III) experienced a 6% drop in the number of full-time graduate students, during the two-year period fall 1974 to fall 1976. There was a somewhat greater decline of 9% in the number of first-year full-time graduate students in these departments during the same two-year period. On the other hand, numbers of teaching assistants increased slightly, by about 2%. This decline in numbers of graduate students in departments in Groups I–III continues a downward trend reported in these *Notices*, February 1976, p. 109. It suggests that numbers of Ph.D.'s awarded by these departments will probably also continue to decline. On the other hand, the already keen competition among departments for qualified teaching assistants may be expected to become even more intense.

In other categories of mathematical science departments, increases in numbers of full-time graduate students during the two years 1974 to 1976 were reported as follows: Group IV, up 9%; Group V, up 4%; Group VI, up 15%; and Group M, up 4%.

FACULTY MOBILITY

In 1976, the AMS Survey was reorganized to collect data on faculty mobility, fall enrollments, teaching loads and class sizes during the fall semester. Thus, the data reflect actual fall 1976 information whereas in earlier years the data referred to the previous year's figures and

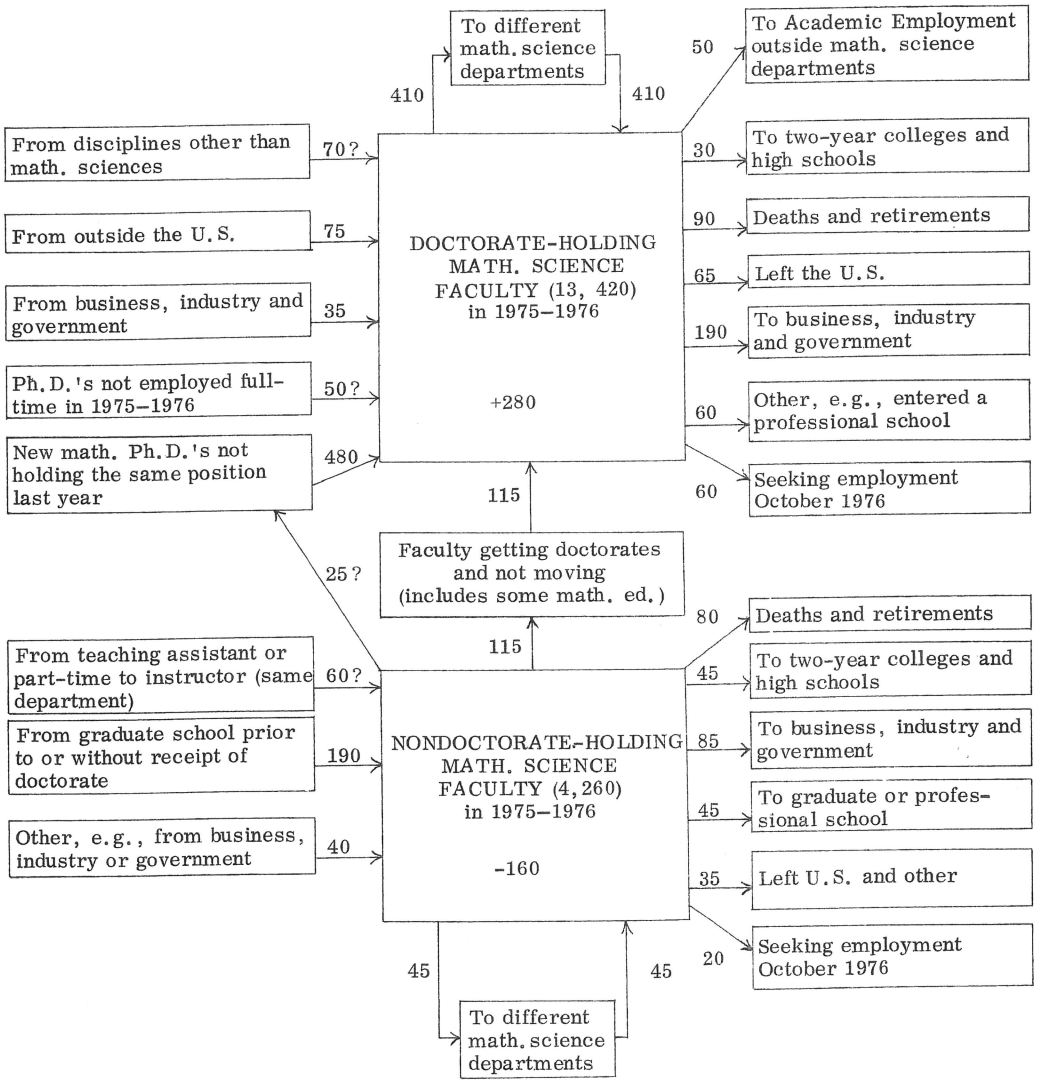
anticipated fall faculty status. The current faculty mobility data give actual status as of about October 1, 1976; for example, those reported as seeking employment in the fall of 1976 were still unemployed then. With data collected during the early summer, as was the case in earlier years, most late summer employment for the next academic year was not recorded.

The total numbers of departments reporting in the various categories is marginally higher than in earlier years making the data somewhat more reliable. On the Mobility Survey, returns from doctorate granting mathematical sciences departments were received from 128 of the 156 mathematics departments, from 39 of the 65 statistics and biostatistics departments, from 25 of the 103 computer science and applied mathematics departments, and in masters and bachelors granting departments from 196 of 344 of the former and from 442 of 1017 of the latter. The returns include Canadian departments in the M and B categories.

The flow diagram below represents best estimates of the full-time U.S. mathematical sciences faculty in fall 1976 with sources of arriving faculty and destinations of departing faculty indicated. The data come primarily from the faculty mobility forms and are extrapolated to the total faculty. The numbers with question marks indicate guesses for which no direct specifically detailed information is available.

FACULTY FLOW DIAGRAM 1975–1976 to 1976–1977

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



The data in the flow diagram are quite similar to the data from last year (*Notices*, November 1975, p. 358). However, a difference is that there was an increase of about 120 in total full-time faculty as compared to virtually no increase a year ago. Also, since the data were collected in the fall, the number seeking employment as of October (instead of as of July) is down from 170 to 60 among doctorates and from 80 to 20 among nondoctorates. The number leaving academic employment for business, industry, and government was up from 100 to 190 among doctorates and from 70 to 85 among nondoctorates. This is a significant increase. It indicates increasing difficulty placing in another teaching position faculty who must change jobs, together with dissatisfaction by some with the kinds of academic jobs available. In addition, 1976 may have been a more favorable year for finding nonacademic employment. Not shown in the diagram but recorded in the data is that only about 45 of the 190 doctorates who left academia took positions outside science, engineering or mathematics. Of these 45, 15 left doctorate granting departments and of the 45, about 10 left tenured positions.

Another point to note in comparing this year's faculty flow diagram to last year's is that there were sizably more faculty members changing academic departments. Among both doctorates and nondoctorates, the number changing academic positions was up about 50%. Presumably this fact reflects the large number of temporary positions.

There also was a sizable recorded increase in the new employment of nondoctorates in faculty positions. This fact probably reflects budget restrictions, last-minute hiring and the reported nonavailability of doctorates for some positions in August.

Much of the data, particularly that on the right side of the flow diagram, is quite accurate. However, some data (such as yearly changes in doctorate-holding faculty and in total faculty) collected from different forms is generally but not explicitly consistent and estimates have to be made. Furthermore, in the flow charts the system has to balance and thus, minor further modifications have been made.

COURSE LOADS, FACULTY SIZE, AND TEACHING LOADS

An encouraging development over the past two years, fall 1974 to fall 1976, has been an increase in enrollments in mathematics courses. The total two-year percentage increase for U.S. departments is summarized in Table 2. For Canadian departments in Group VI there was a similar two-year increase of 16%.

TABLE 2

Groups	Course Enrollment Increase 1974 to 1976
I, II, III	11%
IV	18%
V	16%
M	11%
B	13%

Of the increase about 60% occurred from 1974 to 1975 and the remainder from 1975 to 1976. The latter increase in mathematics is particularly gratifying since recently published figures show that the total enrollments in four-year colleges and universities presumably declined slightly from fall 1975 to fall 1976. Indeed, the percentage increase from 1974 to 1975 exceeded the comparable overall student increase in four-year colleges and universities which was about 5%.

The recent trends show that more students are taking more mathematics. Some, but not all of the increase is attributable to the recent increases in the number of engineering students. Greater student interest in such other practically oriented fields as business and medicine, which require at least basic college level mathematics, is another factor.

A more detailed analysis shows that generally the recent increases have been occurring in almost all categories of courses and departments--except for graduate courses in core mathematics where declines of from 2% to 5% a year are continuing.

Specifically the data show that the major declines from 1970-1975 in upper division mathematics enrollments reported by the CBMS Survey (these *Notices*, page 105, Table 1) have apparently been arrested. For example, in Ph.D. granting departments, upper division undergraduate enrollments outside statistics and computer science have shown an increase of more than 10% from 1974 to 1976, whereas CBMS Survey data indicated a 32% decline from 1970 to 1975.

While as shown in Table 2 student course enrollments have been increasing at a substantial rate, the number of sections taught has been increasing at only about half that rate. We are getting more students per section. Furthermore, other data on the same survey sheets show that the number of full-time faculty members apparently decreased by 0.3% from 1974 to 1975, and increased by about 1.5% from 1975 to 1976 overall in Groups I, II, III, M and B. There was also an overall 2% increase in TA's from 1974 to 1976 and a sizable 20% increase in the number of part-time faculty in that period (but the total numbers of part-time faculty are relatively small, from about 10% of full-time faculty in Groups I, II and III to 25% to 30% in Groups M and B).

Obviously, therefore, there has been some deterioration in teaching load phenomena over the past two years. Allowing for the effects of changes in numbers of TA's and in part-time faculty, it is estimated that over the past two years the average full-time faculty member's student load has increased by 9%, and course load has increased by 3% rather uniformly over the classes of doctorate, masters and bachelors level departments. It should be noted that an increase in student load produces pressure for more faculty and therefore for more jobs. Also with demographically established expectations of a numerically stable total student body over the next three years, we should not anticipate a marked further deterioration in student load per faculty member. When the numbers of students drop in the 1980s, there is almost certain to be a marked improvement in student load per faculty member.

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CHANGES IN TENURE PATTERNS

By referring to the figures for total faculty and for tenured faculty as published in the October *Notices* over the past four years we get the following percentages of tenured among all doctorate-holding faculty (including instructors).

TABLE 3

Category of Department	Percent of Doctorate Faculty with Tenure Fall 1972	Fall 1976	Four-Year Change
I	72.5	75.8	+ 3.3%
II	58.2	71.5	+13.3%
III	57.5	74.9	+17.4%
M	55.5	73.7	+18.2%
B	46.3	60.8	+14.5%

The reporting departments for the two years shown in Table 3 are not identical but the differences shown in the right-hand column are generally similar to the cumulative annual changes shown where each year the same departments report the annual changes.

Table 3 is striking. In the four-year period 1972-1976, during which the size of the total faculty has been almost constant and in which we have been marking time while adjusting to a changed job market, we have seen a change from a faculty with considerable tenure flexibility to one in which the national faculty is quite heavily tenured. Except in category B, the 1976 percentage is very nearly that maintained by the top-rated (Group I) departments during this period. Some institutions do not formally grant tenure; and some individuals included on the right side of Table 5 below are faculty members at such institutions. Since absence of formal tenure is somewhat more common at four-year colleges than at universities granting the Ph.D., one should not infer from Table 3 that there is more flexibility in Group B departments. Moreover, except for instructors, the nondoctorate faculty is substantially more fully tenured than is the doctorate faculty (the nondoctorate faculty being somewhat older, and having had many nontenured people replaced by doctorates over the years).

Other U.S. doctorate granting mathematical science departments are somewhat less heavily tenured than those shown in Table 3. For statistics-related departments (Group IV) 66% of doctorate holding faculty are tenured. For Group V, which includes younger computer science, operations research, and other departments, the corresponding figure is 56%. On the other hand, Canadian departments in Group VI are even more heavily tenured (77%) than U.S. departments.

The reader is reminded that of a total U.S. mathematical science faculty of 17,000–18,000, about 5,000 are in Groups I, II, III; 2,000 in Groups IV and V; 5,500 in Group M, and 5,000 in Group B.

It is certain that the rapid tenuring of faculty observable over the past few years cannot continue. Table 3 shows an overall rate of increase of between 3% and 4% per year in tenure percentages among doctorate holding faculty. At that rate tenure percentages would climb quite soon past 80%. While this may occur in some categories of departments, Table 3 suggests that tenure percentages have already stabilized below the 80% level in Group I. Moreover, some university systems have limited the percentage of tenured faculty to the 60% to 70% range.

By increasing the percentage of tenured faculty, many more promotions to tenure have been possible during 1972-1976 than merely replacements for tenured faculty members who retire or die. The Faculty Flow Diagram shows only 170 vacancies created by deaths and retirements (among both doctorate and nondoctorate faculty). This represents 1% per year of all mathematical science faculty, a figure which will not increase significantly before the mid-1980s.

Once tenure percentages stabilize in the years immediately ahead, relatively more people will be forced to move after several years in a department, with fewer promotions to tenure. Indeed, more and more of the available teaching positions are likely to be strictly temporary and at a beginning level.

PROSPECTS OF PERMANENCY FOR NONTENURED FACULTY

The survey attempts to supplement the hard data reported above with estimates of the prospects of permanency for nontenured doctorates generally and for newly employed doctorates specifically. The following two tables summarize the results obtained.

TABLE 4

Category of Department	Percentage of all newly employed nontenured doctorate faculty judged as having "fair to better" prospects of permanency.
I	19%
II	45%
III	63%
IV	70%
V	88%
M	69%
B	73%

Table 4 represents department chairmen's current perceptions of whether newly hired faculty have "fair to better" (as contrasted to "poor to no") prospects of permanency. These data contain inherent uncertainties, both from the somewhat ambiguous nature of the question asked, and from the possibility of changed future conditions when actual tenure decisions are made. Nonetheless, Table 4 indicates a general intention (except in the top-rated departments) to keep permanently new faculty who perform well. This is consistent with other faculty mobility data, which show a much greater turnover rate of nontenured faculty among higher rated departments than among departments which do not have Ph.D. programs.

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TABLE 5

Category of Department	Percentage of all nontenured doctorate faculty individually judged as likely to be retained indefinitely
I	21%
II	21%
III	39%
IV	35%
V	43%
M	52%
B	53%

Table 5 shows estimated percentages of all nontenured faculty expected to be retained indefinitely. Among those included in Table 5 are some at institutions which do not formally grant tenure. The numbers in Tables 4 and 5 are not comparable to each other. Table 5 refers to current assessment of individuals' current chances of permanence, while the responses reported in Table 4 apparently refer in some instances to positions which individuals hold. Moreover, "fair to better" in Table 4 is a weaker statement than "likely" in Table 5.

Tables 4 and 5 indicate that, except in higher ranked departments, many (or most) new and existing nontenured faculty are expected to be retained indefinitely. Considering the high percentages of faculty already tenured, we may expect a highly immobile and statistically very inflexible faculty a few years from now. The implications for long-term academic employment prospects of new Ph.D.'s of the next ten years are serious indeed.

AMS Two-Year College Survey

by W. H. Fleming

In 1976 the two-year college questionnaire of the Annual AMS Survey was distributed in the fall, rather than early in the summer (as in previous years). The questionnaire was expanded with the cooperation of Professor Donald J. Albers of Menlo College, Menlo Park, California. In addition to the customary salary and tenure information, the revised questionnaire included questions on enrollments and faculty mobility. The 1976 questionnaire requested information for both the years 1975-1976 and 1976-1977. The sample of the departments responding in this survey is thus the same for both years and is different from the sample used in the 1975 AMS Survey. The information reported this year is based on usable returns from 307 departments out of a total of 966 mathematics departments in two-year colleges.

The first table indicates that 11% of full-time mathematics faculty at two-year colleges hold doctorates, among those institutions reporting. This percentage has been gradually rising, as shown by CBMS Survey data (these *Notices*), p. 109). Among faculty newly hired for fall 1976, 28% were reported as having doctorate degrees. Among full-time faculty, about 20% are women and about 68% are tenured.

SIZE OF FACULTY	1975–1976				1976–1977			
	FACULTY		WOMEN		FACULTY		WOMEN	
	Total	With Tenure	Total	With Tenure	Total	With Tenure	Total	With Tenure
Nondoctorate	1433	1000	281	172	1453	1014	293	167
Doctorate	154	92	28	10	179	92	34	12

Rather rapid increases in two-year college mathematics enrollments were observed by CBMS in previous years, with accompanying increases in student load per faculty member. These trends seem to have abated in 1976. An increase of 2.4% in two-year college mathematics course enrollments between fall 1975 and fall 1976 was reported. Numbers of faculty increased by nearly the same percentage.

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 the following table 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.

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SALARIES (in hundreds of dollars)	1975–1976			1976–1977		
	Minimum	Median	Maximum	Minimum	Median	Maximum
Nondoctorate	48(110-150)	(122-175)	(135-204)325	48(110-156)	(130-181)	(140-212)325
Doctorate	85(132-202)	(138-216)	(145-222)335	90(131-192)	(141-218)	(147-229)335

Two-year college faculty mobility. It is estimated that about 300 full-time two-year college mathematics faculty were newly hired for fall 1976. Faculty mobility data indicate that roughly 65 of them were formerly employed in a four-year college or university, 55 in another two-year college (full or part-time), and 85 in a secondary school. Approximately 60 came directly from graduate school and 35 from other sources. In addition, roughly 70 individuals changed from part-time to full-time status at the same institution.

It is estimated that about 220 individuals left a full-time mathematics faculty position at a two-year college in fall 1976. Among them, some 30 were hired by a four-year college or university, and an additional 30 by another two-year college. About 50 retired or died, and perhaps 10 were seeking employment. The remaining 100 included those who found other kinds of employment or returned to graduate school, or whose status is unknown.

CBMS Survey results (Table 4, p. 108) show about 5,900 full-time two-year college mathematics faculty in 1975, and about 3,400 part-time. Just as observed in the preceding report on four-year colleges and universities, faculty attrition due to deaths and retirements amounted to less than 1% of full-time two-year college faculty in 1976.

The articles on pages 98-104 of this issue of these *Notices* report on the 1976 Annual AMS Survey. Articles on pages 105-109 by John Jewett and Donald Albers summarize results of the 1975 CBMS Survey.

In general, as in the past, the AMS and CBMS surveys are in substantial agreement, although the methodology of the surveys is different. Questionnaires for the Annual AMS Survey are sent to all departments in the mathematical sciences listed in the Mathematical Sciences Administrative Directory, with data from the returns (from roughly fifty percent of all departments) used explicitly or extrapolated to the total population as appropriate. The more detailed CBMS Survey, conducted every five years, uses sampling techniques with follow-up requests to nonresponding departments. Some apparent minor discrepancies in the two surveys are statistical, while others result from nuances of wording or of classification. For example, the tenure percentage of the total faculty is markedly different from the tenure percentage of all faculty members above the instructor level.

Perhaps the most serious discrepancy in the two current surveys is in the total mathematical sciences full-time faculty for fall 1975, listed as 17,700 in the AMS Survey's faculty flow diagram and as 16,863 in the CBMS Survey. Since the 17,700 AMS figure is based both on consistent large (but nonrandom) returns every year, and on careful monitoring of annual changes since 1970, the author tends to believe the 17,700 figure is a good estimate. However, it should be pointed out that "number of total faculty" is not really a well-defined concept, since in some departments there are some faculty members who are only partly or marginally in the mathematical sciences (e.g., in some computer science and statistics areas and in mathematically-oriented engineering departments, as well as in some smaller college departments which combine mathematics with physics or other disciplines).

R. D. Anderson