Chapter 3

MATHEMATICAL SCIENCE FACULTY IN UNIVERSITIES AND FOUR-YEAR COLLEGES

This chapter describes the number, educational qualifications, and selected personal characteristics of mathematical science faculty in universities and four-year colleges during Fall 1975. It also indicates instructional and research responsibilies of these faculty and patterns of movement into and out of academic positions between 1974 and 1975. The data are compared with enrollment and faculty information from previous CBMS surveys and other surveys of all higher education to help explain and predict patterns in mathematical science manpower utilization and needs.

Summary of Major Results

In Fall 1975 there were 16,863 full-time and 3,598 part-time faculty. This compares with 17,043 full-time and 2,830 part-time faculty in 1970, and it represents an abrupt halt to the roughly 1,000 per year growth in faculty throughout the 1960's. Furthermore, the patterns of faculty qualifications, institutional responsibilities and mobility have changed markedly since 1970.

-- The number of mathematical science enrollments per full-time-equivalent faculty member increased from 77 in 1970 to 83 in 1975, an 8% increase.

-- The decline in full-time mathematical science faculty was confined to university mathematics departments, whereas computer science experienced substantial gains and statistics more modest ones.

-- The fraction of mathematical science faculty holding doctoral degrees increased sharply between 1970 and 1975, particularly in four-year colleges where the fraction is now over 70%.

-- The median age of mathematical science faculty is approximately 39 years with fewer than 5% over 60. Overall, 72% of these faculty members hold tenure.

-- Women comprise only 10% of mathematical science faculties, and racial minorities about 7%, mostly Orientals.

-- There is a clear trend toward increased credit hour teaching loads, use of large-scale teaching methods, and higher research expectations of mathematical science faculty in all types of four-year institutions.

Many of the patterns cited above were also observed in two-year colleges. The major differences whereas the FTE faculty in two-year colleges increased by 26% (most in part-time positions), college mathematical science enrollments per FTE faculty increased from 104 in 1970 to 123 in 1975 (18%). Further details on the two-year college situation are given in Chapter 6. The overall trends in mathematical science faculty numbers, qualifications, personal characteristics, and responsibilities in four-year institutions are elaborated in subsequent sections of the present chapter.

General Trends in Higher Education Faculty

Changes in the numbers, qualifications, personal traits, and teaching loads of mathematical science faculty are clearly influenced by pressures on all of higher education. As data in Chapter 2 show, the number of students enrolled in four-year institutions grew much more slowly between 1970 and 1975 than during the 1960's -- approximately 11%. Furthermore, there has been substantial change in student academic preferences, noticeably away from physical sciences and mathematics. Combined with increasing constraints of funding for higher education, these pressures have led to reallocation of faculty resources that has hit hard at "slow or no-growth" areas.

Table 3.1 compares growth in higher education enrollment and faculty (all fields) from 1965 to 1975. There is a trend for enrollments to grow faster than faculty, a pattern that contrasts with the situation in mathematics for 1965-70 but not for 1970-75. While there is no regular comprehensive survey of higher education faculty educational qualifications, personal characteristics, and teaching responsibilities, the data of Tables 3.2 - 3.4 give a reasonably current profile of the overall situation. These data

Table 3.1

FULL-TIME-EQUIVALENT* ENROLLMENTS AND FACULTY FOR
ALL HIGHER EDUCATION
(In Thousands)

	1965	1970	1975
FTE Enrollment	4671	6721	8289
FTE Faculty	317	452	508**
Students/Faculty	14.7	14.9	16.3**

Source: NCES, Projections of Education Statistics to 1984-85 [E] and unpublished NCES data for 1975.
*Full-time plus one-third of part-time.
**Projected

Table 3.2

HIGHEST EARNED DEGREES OF FULL- AND PART-TIME FACULTY
IN ALL FIELDS OF UNIVERSITIES AND COLLEGES

Institutions/Degree Type	1966	1972
Universities		
Doctoral	54%	50%
Masters	28%	34%
Professional	11%	9%
Bachelors	7%	7%
Colleges		
Doctoral	38%	40%
Masters	52%	51%
Professional	2%	5%
Bachelors	7%	4%

Sources: NCES, Numbers and Characteristics of Employees in Higher Education, Fall 1966 [K] and Alan E. Bayer, Teaching Faculty in Academe, 1972-73 [L].

Table 3.3

AGE DISTRIBUTION OF FACULTY IN UNIVERSITIES AND FOUR-YEAR COLLEGES IN 1973

	Universities		4 Year Colleges	
	Men	Women	Men	Women
30 or Less	4.9%	10.8%	7.1%	10.6%
31-35	15.0%	14.7%	17.3%	12.7%
36-40	15.7%	12.6%	16.7%	14.7%
41-50	30.0%	25.6%	29.4%	28.6%
51-60	22.1%	24.1%	18.5%	19.6%
over 60	9.2%	9.6%	7.0%	8.6%

Source: Alan E. Bayer, Teaching Faculty in Academe, 1972-73 [L].

Table 3.4

NUMBER OF HOURS PER WEEK OF SCHEDULED TEACHING IN UNIVERSITIES AND FOUR-YEAR COLLEGES, 1973*

Number of Hours	Universities	Four-Year Colleges
None or No Response	7.3%	6.1%
1-4	17.6%	9.1%
5-8	32.2%	17.6%
9-12	25.3%	39.6%
13-16	9.0%	17.5%
17 or more	8.6%	10.1%

Source: Alan E. Bayer, Teaching Faculty in Academe, 1972-73 [L].
*Percents are weighted averages of percents given for men and women.

provide a useful backdrop for interpretation of the status and recent changes in characteristics of mathematical science faculty.

Numbers of Mathematical Science Faculty

From 1970 to 1975 the number of full time mathematical science faculty in universities and colleges declined about 1%, to 16,863; the part-time faculty (not including graduate assistants) increased 27% from 2,830 to 3,598. The distribution of changes in faculty numbers is indicated in Table 3.5. Most striking is the drop in both full-time (-6.5%) and part-time (-11%) university faculty positions.

Table 3.5

FULL-TIME AND PART-TIME MATHEMATICAL SCIENCE FACULTY IN UNIVERSITIES AND FOUR-YEAR COLLEGES*

Type of Institution	1965-66	1970-71	1975-76
Universities			
Full Time	4,730	7,623	7,124
Part Time	698	1,009	900
Public Colleges			
Full Time	3,426	6,068	6,160
Part Time	360	876	1,339
Private Colleges			
Full Time	2,597	3,352	3,579
Part Time	693	945	1,359
Total			
Full Time	10,753	17,043	16,863
Part Time	1,751	2,830	3,598

*Not including graduate teaching assistants.

Counting each part-time faculty member as the equivalent of one third of a full time faculty member (as done in previous CBMS and NCES survey analyses), the number of mathematical science enrollments per FTE faculty has increased by 8%, reversing the decrease that took place between 1965 and 1970.

The changes in enrollment, faculty, and enrollments per FTE faculty have not affected all types of institutions or mathematical science departments the same. As mentioned above, university mathematical science departments had the only absolute decline in numbers of faculty. But within universities the apparent loss was concentrated in mathematics departments, not computer science and statistics departments. In university mathematics departments the data indicate that full-time-equivalent faculty declined by 802 or about 12%. The computer science and statisitcs FTE faculty increased by 31% and 3% respectively -- most in the category of full-time faculty members.

The surprising decline of faculty numbers in university mathematics departments is probably attributable in part to the formation on new departments of computer science and statistics with a resulting transfer of mathematics faculty members to the newly formed departments. However, the indicated decrease being larger than the increases in the numbers of computer science and statistics faculty, cannot all be explained by reorganization. Therefore we conclude that, as is supported by anecdotal evidence, there has been a genuine decline in the number of university mathematics professors, but probably not as large a decline as shown in Table 3.5.

In universities, and to less extent in public colleges, much of the mathematics instruction in pre-calculus courses is the responsibility of teaching assistants. Tables 3.7 and 3.8 show that since 1970-71 changes in the number and distribution of teaching assistants were similar to changes in senior faculty. University mathematics and statistics departments now use somewhat fewer TA's, but computer science has had a counterbalancing increase. Private colleges have begun to make substantial use of teaching assistants (including 34% undergraduates), though they still account for only 7% of FTE faculty in those institutions.

The data of Tables 3.5 - 3.8 indicate current status and recent changes in the numbers of mathematical science faculty at universities and four-year colleges. Patterns of mobility within the system and prospects for future growth or decline in these numbers are discussed with more detail in a later section of this chapter.

Table 3.6

MATHEMATICAL SCIENCE ENROLLMENTS PER FTE FACULTY*
IN UNIVERSITIES AND FOUR-YEAR COLLEGES

Type of Institution	1965-66	1970-71	1975-76
Universities	104	79	85
Public Colleges	101	78	87
Private Colleges	90	71	73
All Institutions	99	77	83

*Not including graduate teaching assistants.

Table 3.7

MATHEMATICAL SCIENCE FACULTY IN UNIVERSITIES*

Type of Department	1970-71	1975-76	% Change
Mathematics Departments			
Full Time	6,235	5,405	-13%
Part Time	615	699	+14%
Computer Science			
Full Time	688	987	+43%
Part Time	300	133	-56%
Statistics			
Full Time	700	732	+5%
Part Time	93	68	-27%
Total			
Full Time	7,623	7,124	-7%
Part Time	1,008	900	-11%

*Not including graduate teaching assistants.

Table 3.8

NUMBERS OF MATHEMATICAL SCIENCE TEACHING ASSISTANTS IN UNIVERSITIES AND FOUR-YEAR COLLEGES*

Type of Institution	1970-71	1975-76
Universities	7,055	6,612
Mathematics	5,999	5,087
Computer Science	309	835
Statistics	747	690
Public Colleges	1,804	1,805
Private Colleges	146	559
Totals	9,005	8,976

*A small number, about 6%, are undergraduates and the rest graduate students.

Qualifications of Faculty

As university and four-year college mathematical science faculties grew rapidly throughout the 1960's, the supply of highly trained potential faculty members grew even more rapidly. The yearly production of mathematical science doctorates increased from 596 in 1963-64 to 1,343 in 1968-69 and has held steady since then -- though now about 20% are in computer and information sciences.

The data presented in this section stress formal qualifications of faculty primarily because this is the only easily obtained measure of quality. The adequacy of this measure of quality in mathematical science departments will of course depend on the research, teaching, and service priorities of individual departments.

Tables 3.9 and 3.10 show overall trends in the formal qualifications of mathematical science faculty members. The most striking change since 1970 is the sharp increase in percent of public and private four-year college faculty who hold the doctoral degree, now 74% and 69% respectively. Since university faculties

Table 3.9

EDUCATIONAL QUALIFICATIONS OF FULL-TIME MATHEMATICAL SCIENCE FACULTY IN UNIVERSITIES AND FOUR-YEAR COLLEGES

Type of Institutions	1965	1970	1975
Universities			
Doctorate	3,584 (76%)	6,652 (87%)	6,492 (91%)
Masters	1,084 (23%)	901 (12%)	600 (9%)
Bachelors	62 (1%)	70 (1%)	32 (-)
Public Colleges			
Doctorate	1,237 (36%)	2,866 (47%)	4,536 (74%)
Masters	2,002 (59%)	3,114 (51%)	1,609 (26%)
Bachelors	186 (5%)	88 (2%)	15 (-)
Private Colleges			
Doctorate	890 (34%)	1,400 (42%)	2,471 (69%)
Masters	1,558 (60%)	1,890 (56%)	1,092 (31%)
Bachelors	149 (6%)	62 (2%)	16 (-)

Table 3.10

FIELD OF DOCTORATE FOR FULL-TIME MATHEMATICAL SCIENCE FACULTY IN 1975 FOR UNIVERSITIES AND FOUR-YEAR COLLEGES

Type of Institution	Mathematics	Statistics	Computer Science	Mathematics Education	Other
Universities (6492 doctorates)	69%	14%	8%	2%	7%
Public Colleges (4404 doctorates)	72%	8%	4%	15%	1%
Private Colleges (2471 doctorates)	83%	1%	1%	10%	5%

have apparently declined in numbers since 1970 and those institutions had already essentially totally doctorate faculties, many highly trained mathematical scientists have clearly been moving into four-year colleges, largely as replacements for those holding the master's degree. The exact pattern of this movement of faculty is not clear. Certainly some mathematical science doctorates fail to receive tenure in universities and move to college positions. Others who were in four-year colleges completed their doctoral study and stayed on, while a third group went directly from doctoral study to first appointment in four-year college. A different view of faculty mobility is given in a later section which reports data from another survey question.

Since the increase in doctoral level faculty members has been concentrated in colleges -- where the main responsibility is more often teaching and service than research -- it is interesting to study the areas of specialization of doctorate mathematical science faculty in various types of institutions. The results are probably not surprising. The public colleges, many of which have emerged from teacher education institutions, have the highest fraction of mathematics education doctorates, and all colleges have a low percent of statistics and computer science doctorates. The 1974-75 production of mathematical science doctorates has a profile different from that of all mathematical science faculty given by Table 3.10. A 1976 National Research Council report of doctorate recipients [N] indicates 1149 degrees in mathematical science, of which 174 (15%) were in probability and statistics and 167 (14.5%) were in computer science. These numbers do not include computer science degrees given by engineering departments nor statistics degrees given by biological or social science departments.

In both public and private colleges part-time faculty members have recently grown to account for a significant portion of mathematical science faculties. As Table 3.11 shows, the formal qualifications of these faculty are typically quite different from those of the full-time faculty.

In considering the implications of this data, it is important to remember that individuals included in the part-time category are in many cases joint appointees -- with part-time affilation in a mathematical science department. This probably helps explain the high percent of doctorates among statistics, computer

Table 3.11

EDUCATIONAL QUALIFICATIONS OF PART-TIME MATHEMATICAL SCIENCE FACULTY IN UNIVERSITIES AND FOUR-YEAR COLLEGES -- 1975

Type of Institution	Mathematics	Statistics	Computer Science	Mathematics Education	Other
Universities (doctorate %) 900 (65%)	476(52%)	175(89%)	129(67%)	26(31%)	94(99%)
Public Colleges (doctorate %) 1339 (17%)	937(18%)	58(10%)	89(3%)	231(19%)	24(33%)
Private Colleges (doctorate %) 1359 (43%)	1006(33%)	5(-)	50(10%)	45(71%)	253(83%)

science, and "other" classifications. It is also probably related to the recent overall growth of part-time faculty appointments and the decline of full-time mathematics faculty in universities.

Previous CBMS surveys have investigated the number of doctorates per institution, usually finding doctorates concentrated in the large universities. In the 1975-76 survey, among 173 responding four-year institutions only 8 had no mathematical science doctorates on their faculty, and these were small, special-focus schools.

Age, Tenure, Sex, and Racial Composition of Mathematical Science Faculty

The period of swift growth in the number and educational qualification of university and college faculties has led to significant change in the age distribution and tenure status of faculties. This in turn leads to changes in the job market for graduate students, sending delayed reactions throughout higher education enrollment and staffing. More recently, colleges and universities have been under strong pressure to increase the numbers of women and various racial minorities in their senior faculties.

Tables 3.12 - 3.17 describe the 1975-76 tenure, age, sex, and racial profiles of mathematical science faculties in universities and four-year colleges.

During the 1960's teaching faculties and production of mathematical science doctorates to fill faculty positions both grew rapidly. Thus it is not surprising that the median age of full time mathematical science faculty is only 39 years. Furthermore, fewer than 5% of these faculty are over 60 years old. Assuming a death and retirement rate of 1% per year, replacement will demand about 170 full-time mathematical science positions each year, compared to current production of well over 1,000 mathematical science doctorates.

Comparing information in Tables 3.12 and 3.3 confirms a finding of earlier CBMS surveys that mathematical science faculty tend to be much younger on the average than the total higher education faculty.

Table 3.12

AGE DISTRIBUTION OF FULL-TIME MATHEMATICAL SCIENCE FACULTY IN UNIVERSITIES AND FOUR-YEAR COLLEGES

Type of Institution	<30	30-34	35-39	40-44	45-49	50-54	55-59	≥60
Public Universities (5671 faculty)	12%	22%	22%	15%	11%	8%	5%	5%
Private Universities (1453 faculty)	9%	22%	22%	15%	14%	9%	6%	3%
Public Colleges (6160 faculty)	8%	24%	20%	18%	10%	9%	5%	6%
Private Colleges (3579 faculty)	4%	20%	26%	16%	10%	10%	7%	7%
All Institutions (16863 faculty)	10%	22%	22%	16%	11%	9%	5%	5%

Leveling enrollments and a preponderance of young faculty suggest long-term stability in mathematical science departments. This prospect is confirmed by the tenure data given in Table 3.13. The overall tenure rate of 72% in mathematical science departments is substantially higher than the 1973 national average of 57% for public higher education and 51% for private higher education overall (though in the intervening years these percents may have increased by as much as 10-15%). As with age, the tenure profiles of all four types of institutions are remarkably similar.

Table 3.13

TENURE STATUS OF MATHEMATICAL SCIENCE FACULTY IN UNIVERSITIES AND FOUR-YEAR COLLEGES

	Tenured Ph.D.	Tenured non-Ph.D.	Non-Tenured Ph.D.	Non-Tenured non-Ph.D.
Public Universities	69%	4%	25%	2%
Private Universities	57%	10%	28%	5%
Public Colleges	56%	18%	20%	6%
Private Colleges	45%	25%	24%	6%
All Institutions	62%	10%	24%	4%

Since computer science and statistics are the likely areas of future growth within the mathematical sciences, it is particularly timely to assess the age and tenure status of faculty in these areas. The data are given in Table 3.14. It is mildly surprising that these faculty members are only slightly younger than overall mathematical science faculty and the tenure ratio is only slightly lower than that for universities where most reside.

Because mathematical science departments, like all universit and four-year college departments, are facing pressure to maintain non-tenured faculty positions for continued faculty revitalization, the survey committee inquired about the number and age of mathematical science faculty granted tenure during 1974-75.

Table 3.14

AGE AND TENURE STATUS OF COMPUTER SCIENCE AND STATISTICS FACULTIES IN UNIVERSITIES AND FOUR-YEAR COLLEGES

Type of Department	<30	30-34	35-39	40-44	45-49	50-54	55-59	≥60
Computer Science								
Tenured	7%	9%	15%	14%	9%	8%	3%	-
Non-Tenured	11%	12%	6%	4%	1%	-	-	-
Statistics								
Tenured	-	10%	15%	16%	11%	9%	7%	3%
Non-Tenured	11%	16%	2%	-	-	-	-	-

The data in Table 3.15 reveal a consistent pattern of roughly 5% of mathematical science faculty gaining tenure in the past year. The average tenure age of 35 again suggests long term stability for mathematical science faculties.

Table 3.15

PERCENT AND AVERAGE AGE OF MATHEMATICAL SCIENCE FACULTY GRANTED TENURE DURING 1974-75 IN UNIVERSITIES AND FOUR-YEAR COLLEGES

Type of Department	% Granted Tenure	Average Age at Tenure
University		
Mathematics	4%	36
Computer Science	7%	34
Statistics	6%	35
Public Colleges	4%	36
Private Colleges	5%	35

One of the main goals of equal employment opportunity affirmative action programs in higher education has been to increase representation of women and racial minorities on faculties. Table 3.16 compares the percent of women in mathematical science faculty with the percent of women in all higher education.

Table 3.16

PERCENT OF WOMEN IN FULL-TIME MATHEMATICAL SCIENCE AND ALL FULL-TIME FACULTY FOR UNIVERSITIES AND FOUR-YEAR COLLEGES

Type of Institution	Mathematical Science (1975)	All Disciplines (1974)
Public Universities	7%	19%
Private Universities	7%	16%
Public Four-Year Colleges	13%	24%
Private Four-Year Colleges	10%	26%
All Institutions	10%	24%

The fact that women comprise a smaller fraction of faculties in mathematical science than in other disciplines is not at all surprising. It is difficult to determine whether the situation is changing, since comparable data were not collected in previous CBMS surveys. However, comparison of Tables 3.17 and 3.3 suggests trends.

In both universities and four-year colleges women are somewhat more concentrated in lower age groups. Furthermore, the age profile of women mathematical scientists on higher education faculties peaks much lower than that of women in other disciplines.

The racial distribution of U. S. mathematical science faculties has traditionally been heavily Caucasian. Orientals, Hispanics, and Blacks have made up a very small fraction of mathematical science faculties. Among the faculty members described by institutions responding to the 1975 CBMS survey, nearly 93% were Caucasian, 5% Oriental, 1% Hispanic, and 1% Black. Since

Table 3.17

DISTRIBUTION OF FULL-TIME MATHEMATICAL SCIENCE FACULTY IN UNIVERSITIES AND FOUR-YEAR COLLEGES BY AGE AND SEX

	<30	30-34	35-39	40-44	45-49	50-54	55-59	≥60
Universities								
Men [6661]	11%	22%	23%	15%	11%	8%	5%	5%
Women [463]	24%	19%	9%	12%	13%	9%	6%	8%
Four Year Colleges								
Men [8554]	7%	24%	22%	18%	10%	8%	5%	6%
Women [1185]	11%	16%	14%	14%	11%	18%	7%	8%

the sample numbers in each minority classification are very small, it is dangerous to use these figures to estimate national totals of Oriental, Hispanic, or Black mathematical science faculty, but it seems safe to say that there are probably fewer than 250 in each of the last two categories.

The current under-representation of minorities on mathematical science faculties is certainly a direct consequence of the student racial distribution in graduate preparation programs. For instance, in 1974-75 only 9 U. S. citizen Blacks earned doctorates in the mathematical sciences and only 16 Blacks overall. In that same year only 5 U. S. citizen Hispanics earned mathematical science doctorates and only 35 Hispanics overall [M].

Faculty Utilization

During the rapid growth of mathematical science undergraduate major programs, graduate programs, and faculty research activity throughout the 1960's there were tendencies to reduce faculty teaching loads, increase use of large scale teaching methods, and increase expectations of faculty research productivity, With mathematics major enrollment now declining and faculty size stabilizing it is interesting to inspect recent changes in the utilization and productivity expectations of mathematical science faculty.

Data presented in Table 3.6 shows that the ratio of mathematical science enrollments to FTE faculty increased by nearly 8% between 1970 and 1975. Tables 3.18 - 3.23 provide information suggesting ways that this increased student load has been handled.

Based on Table 3.18 it appears that since 1970 university and public college credit hour teaching loads have increased noticeably. No departments reported normal teaching loads of less than 6 hours per week, and the average load increased from 7.2 hours to 11.9 hours in public colleges. The private college teaching load remained relatively stable between 1970 and 1975.

Table 3.18

EXPECTED TEACHING LOAD OF FULL-TIME FACULTY IN MATHEMATICS DEPARTMENTS IN UNIVERSITIES AND FOUR-YEAR COLLEGES*

Teaching Loads	Universities 1970	Universities 1975	Public Colleges 1970	Public Colleges 1975	Private Colleges 1970	Private Colleges 1975
Less than 6 hours	8%	-	-	-	-	-
6 hours	40%	26%	3%	1%	-	4%
7-8 hours	32%	39%	5%	5%	-	2%
9 hours	8%	21%	14%	1%	7%	6%
10-11 hours	5%	5%	25%	14%	17%	18%
12 hours	7%	10%	35%	57%	60%	56%
More than 12 hours	-	-	18%	21%	16%	14%

*Data are percent of all mathematics departments having the given teaching load, not numbers of faculty.

Though the data in Table 3.18 are percents of all mathematics departments reporting various average teaching loads, there was only a slight trend for faculty in larger or research-oriented institutions to have smaller teaching responsibilities. Furthermore, teaching loads were generally the same for all tenure track faculty ranks, the main exceptions being reduced loads for administrators. The teaching loads in computer science and statistics

departments were, as in 1970, generally lower than in mathematics departments -- probably reflecting the predominant research and service functions of such departments and the fact that most are located in research oriented universities which have lowest teaching loads overall. Though it appears that computer science and statistics teaching loads have increased since 1970, the percents are based on small numbers of departments in the universe and responding, so a shift of one or two departments produces large percent changes.

Table 3.19

TEACHING LOADS OF FULL-TIME FACULTY IN COMPUTER SCIENCE AND STATISTICS DEPARTMENTS

Teaching Loads	Computer Science 1970	Computer Science 1975	Statistics 1970	Statistics 1975
Less than 6 hours	17%	14%	44%	17%
6 hours	46%	34%	28%	45%
7-8 hours	27%	19%	12%	11%
9 hours	-	14%	8%	17%
10-11 hours	7%	14%	8%	5%
12 hours	3%	5%	-	5%
More than 12 hours	-	-	-	-

The effective teaching load of full-time faculty members is also affected by class size, style of instruction employed, and use of teaching assistants. The survey questionnaire asked respondents to report course enrollments and number of teaching sections. From this data we have calculated average class size for several of the most common undergraduate courses. Though data for comparison with previous years are unavailable, individual departments might find interesting comparisons with their own class size numbers.

The 1965 CBMS survey noted substantial increase from 1960 in the use of large lecture systems of instruction. By 1970 some

Table 3.20

AVERAGE CLASS SIZE IN SELECTED MATHEMATICAL SCIENCE COURSES
IN UNIVERSITIES AND FOUR-YEAR COLLEGES

Course Title	Public University	Private University	Public College	Private College
8. College Algebra and Trigometry	43.3	35.3	34.1	29.1
14. Math. for Elem. Sch. Teachers	30.5	30.5	28.8	28.1
17, 18. Calculus	38.2	37.5	27.7	26.0
23. Advanced Calculus	23.6	15.5	16.8	12.8
24. Elementary Statistics	36.7	38.8	28.7	25.8
51. Introduction to Computing	29.8	43.4	30.7	29.0

Table 3.21

PREVALENCE OF INSTRUCTIONAL METHODS OTHER THAN SMALL SECTIONS
IN UNIVERSITY AND FOUR-YEAR COLLEGE MATHEMATICAL SCIENCE DEPARTMENTS

Method of Instruction	University Mathematics		Computer Science		Statistics		Public Colleges		Private Colleges	
	1970	1975	1970	1975	1970	1975	1970	1975	1970	1975
Large Lectures	56%	56%	77%	50%	40%	68%	17%	38%	12%	22%
Organized Independent Study	24%	12%	51%	22%	18%	21%	22%	19%	51%	20%
Television	6%	10%	2%	11%	9%	-	10%	3%	4%	-
Audio-Tutorial	NA	4%	NA	-	NA	-	NA	9%	NA	9%
Programmed	9%	6%	3%	-	2%	-	7%	7%	10%	9%
Computer Assisted	5%	6%	11%	11%	11%	5%	2%	3%	2%	5%
Computer Managed	NA	-	NA	-	NA	-	NA	3%	NA	-
Self-Paced	NA	22%	NA	17%	NA	21%	NA	31%	NA	28%

NA Not on the 1970 survey questionnaire.

form of large lecture classes was used in 56 percent of university mathematics department, 77 percent of computer science departments, 40 percent of statistics departments, 17 percent of public college and 12 percent of private college mathematics department. Table 3.21 shows the current prevalence of large lecture instruction and other alternatives to the traditional small section lecture-recitation methods.

Since survey respondents were asked only to check any of the teaching techniques "used to a substantial degree" by their departments, the data of Table 3.21 indicate only roughly the relative frequency of various procedures -- not the number of students involved. The most striking indicated changes are the emergence of "self-paced" and "audio-tutorial" instruction in all types of mathematical science departments (perhaps explaining the sharp drop in "organized independent study") and the increase in the use of large group instructional methods at both public and private four-year colleges.

Changes in format of mathematical instruction generally involve changes in the use of graduate and undergraduate teaching

Table 3.22

LOWER DIVISION MATHEMATICS TEACHING BY TEACHING ASSISTANTS IN UNIVERSITIES AND FOUR-YEAR COLLEGES

Percent of Teaching Done by TA's	Percent of Departments in Given Range			
	University			Public College
	1965	1970	1975	1975*
0% - 19%	22%	21%	21%	64%
20% - 39%	24%	28%	30%	24%
40% - 59%	30%	37%	32%	9%
60% - 79%	14%	7%	13%	3%
80% - 100%	10%	7%	4%	-

*Comparable data for 1965, 1970 not available.

assistants. Since teaching assistants commonly have major instructional responsibility only in lower division courses, the survey questionnaire asked respondents what percent of this teaching is handled by TA's. The 1975 findings are compared with 1965 and 1970 data in Table 3.22. Changes since 1965 in the fraction of university lower division teaching borne by TA's were slight. However, it appears that public colleges are beginning to make substantial use of TA's. The responses from computer science and statistics departments were really too few and scattered to make reliable estimates of TA roles there. The credit hour teaching loads for TA's in various types of mathematical science departments are given in Table 3.23. The 1975 pattern is very similar to that of 1970.

Along with regular teaching, advising, and administrative responsibilities, mathematical science faculty members are increasingly expected to do research. Table 3.24 shows the pattern of such expectations. Even admitting that these data represent department chairmen's expectations it seems clear that pressure for regular research and publication has increased since 1970 -- particularly in colleges.

Table 3.23

TEACHING LOADS OF TEACHING ASSISTANTS IN UNIVERSITIES AND FOUR-YEAR COLLEGES

Credit Hour Load	University Mathematics 1970	University Mathematics 1975	Computer Science 1970	Computer Science 1975	Statistics 1970	Statistics 1975	Public College 1975
Less than 4 hours	23%	11%	65%	50%	62%	50%	3%
4 - 5 hours	35%	41%	4%	10%	8%	10%	34%
6 hours	35%	37%	31%	30%	30%	20%	38%
More than 6 hours	7%	11%	-	10%	-	20%	24%

Table 3.24

FACULTY RESEARCH AND PUBLICATION EXPECTED BY UNIVERSITY AND FOUR-YEAR COLLEGE MATHEMATICS DEPARTMENTS

Expectation	Universities 1970	Universities 1975	Public Colleges 1970	Public Colleges 1975	Private Colleges 1970	Private Colleges 1975
Publication at a stated rate	41%	56%	13%	32%	4%	14%
Maintain research activity but no specified rate of publication	53%	40%	25%	32%	24%	34%
No expectation of research or publication	6%	4%	62%	36%	72%	52%
Average rate expected per year, when stated	1.0	1.1	0.4	0.8	0.6	0.5

Faculty Mobility

Throughout the era of growth in mathematical science faculty during the 1960's, each year brought many additions to each department -- some fresh from graduate programs and others changing their institutional affiliations. But the 1970's have been a period of limited growth, increasing tenure, and thus stability of mathematical science faculty. To help in understanding the new dynamics of the academic marketplace, the survey committee asked each responding department to report the source of all faculty members employed for the first time in 1975 and the destination of those who left during that year.

The responses indicate that during 1975 about 1,230 mathematical scientists were appointed to university or four-year college positions and 1,045 left such positions, a net increase of roughly 185. Allowing for the likelihood that department chairmen are better able to describe the source of their new faculty than the destination of those who left, this still suggests a recent increase in mathematical science faculties -- either contradicting data presented earlier in this chapter or indicating a recent improvement in the mathematical science hiring situation.

About one half of the reported mobility involved movement from one academic position to another. Apart from this kind of internal mobility, Table 3.25 shows the details of additions to and subtractions from mathematical science faculties, in comparison with those for 1970.

Table 3.25

CHANGES IN UNIVERSITY AND FOUR-YEAR COLLEGE FULL-TIME MATHEMATICAL SCIENCE FACULTY

Source/Destination	Doctorates 1970	Doctorates 1975	Non-Doctorates 1970	Non-Doctorates 1975
Additions to Faculty				
From Graduate School	843	426	512	130
From Post-Doctoral Study	87	68	-	-
From Non-Academic Positions	52	46	44	3
From Other Sources	11	-	14	-
	+993	+540	+570	+133
Subtractions from Faculty				
Deaths and Retirements	103	128	89	58
To Non-Academic Positions	55	176	82	32
To Graduate School	49	7	230	21
To Other Positions	54	86	28	15
	-261	-397	-429	-126
Net Changes	+632	+143	+141	+ 7

The raw data on which national estimates in Table 3.25 are based were, in many categories, very sparse. So it is dangerous to place great faith in the absolute numbers of faculty additions and subtractions. However, confidence in several broad patterns and trends seems justified.

First, compared with 1970, overall faculty growth has greatly slowed. Additions to faculties still come almost totally from graduate schools; deaths and retirements equalled slightly more than 1% of the total of mathematical science faculty members; there was a noticable increase in the number of mathematical scientists leaving academic positions; but very few left for further graduate study, and there was very little faculty movement between four-year and two-year institutions.

The pattern of university and four-year college faculty mobility is illustrated graphically in Figure 3.1. That flow chart also indicates the roughly 255 faculty members who earned doctorates and remained in four-year positions held prior to completion of that degree. Recall that in many categories national estimates are based on sparse raw data, so it is dangerous to place much faith in absolute numbers -- only the orders of magnitude.

Figure 3.1

FLOW CHART OF FACULTY MOBILITY 1974-75 TO 1975-76
IN UNIVERSITIES AND FOUR-YEAR COLLEGES