

Chapter 3

MATHEMATICAL SCIENCE ADMINISTRATIVE STRUCTURES AND
INSTRUCTIONAL PRACTICES IN UNIVERSITIES AND FOUR-YEAR COLLEGES

This chapter describes recent changes in the administrative organization of mathematical science departments, faculty teaching loads, and dominant instructional formats in those departments at universities and four-year colleges. In particular, the data indicate ways that computer science, statistics, and applied mathematical science programs are administratively related to traditional mathematics departments. They also show effects of enrollment increases on teaching responsibilities and approaches of the faculty.

Highlights

- o Between 1975 and 1980 roughly 10% of universities and four-year colleges made some administrative restructuring of mathematical science departments. The most common change was merger of private college mathematics departments into larger, more diverse units.
- o In 28 of the larger public colleges, computer science departments were formed; private colleges more commonly expanded the scope and title of mathematics departments to include computer science.
- o From 1975 to 1980 the number of mathematical science course enrollments per FTE faculty member increased by 18%, returning to the level of 1965.
- o The expected credit-hour teaching loads of mathematics faculty and statistics faculty have changed little since 1975, but university computer science teaching loads have decreased markedly, with 24% of these departments expecting less than six hours per semester.
- o In a sample of lower level mathematics, statistics, and computer science courses, nearly three-fifths of all students are in classes smaller than 40. Lectures and large classes are far more common in universities than in colleges.
- o Regular faculty sabbatical leave programs are operating in a majority of mathematical science departments.

3.1 Administrative Structure of Mathematical Science Programs

During the 1970's course enrollments in statistics and computer science at four-year institutions increased by 62% and 269%, respectively. These areas now account for 24% of all mathematical science enrollments. Furthermore, each area has begun to acquire an academic identity quite distinct from the traditional mathematics departments. Not surprisingly, this emergence of independent disciplines has led to changes in the department administrative structure of mathematical science programs.

The 1980 CBMS survey questionnaire asked mathematical science department chairs to describe any such changes that might have occurred over the past five years. The specific questions were:

- 2(a) Is your department a part of a larger administrative unit in the mathematical sciences (e.g., a division or school of mathematical sciences)?
- 3(a) Between 1975 and 1980 was your department together with one or more other departments, consolidated into a larger administrative unit (e.g., a Division of Mathematical Sciences or Department of Electrical Engineering and Computer Science)?
- (b) Between 1975 and 1980 was your department divided with part of your faculty entering a new department (e.g., a new department of Statistics or Computer Science)?
- (c) Was your present department created since 1975?
- (d) Other major changes in administrative structure?

Although responses to questions 2(a) indicated great diversity in the interpretation of the phrase "larger unit in the mathematical sciences", there is very little evidence of movement toward such administrative structuring. The most common pattern is separate departments of mathematics, statistics, and computer science in universities and large colleges, with joint mathematics and computer science departments common in the smaller colleges. Also in the smaller colleges the various mathematical science departments are being combined with a wide range of other science departments into divisions of science -- some including biology, psychology, business, physics, chemistry, and physical education. As might be expected, the new departments created

in the mathematical sciences are primarily departments of computer science. From 1975-1980 this occurred most often in public four-year colleges. In smaller colleges computer science was most commonly accommodated by adding its programs and title to that of existing mathematics departments.

ADMINISTRATIVE RESTRUCTURING OF UNIVERSITY MATHEMATICAL
SCIENCE DEPARTMENTS, 1975-1980

Between 1975 and 1980 there were few new mathematical science departments formed in universities -- either by consolidation or division of traditional departments. The changes that did occur were formation of computer science departments. There are now 94* computer science and 42* statistics departments in the 160 universities.

Table 3.1

Type of Change	Instances*	
1. Consolidation of departments into larger administrative units	5 yes	155 no
2. Division of departments to form one or more new departments	12 yes	148 no
3. New departments created	7 yes	153 no
4. Other major changes	5 yes	155 no

*Estimated from the sample respondents.

ADMINISTRATIVE RESTRUCTURING OF PUBLIC COLLEGE MATHEMATICAL
SCIENCE DEPARTMENTS, 1975-1980

In roughly 10% of public four-year colleges, mathematical science departments have recently been combined with other physical, natural, and behavioral science departments into larger administrative units such as schools of science. Few mathematics departments have been sub-divided into new special focus departments. However, 28 of the estimated 71 public college computer science departments were created between 1975 and 1980, and many mathematics departments added computer science to their programs and titles.

Table 3.2

Type of Change	Instances*	
1. Consolidation of departments into larger administrative units	43 yes	364 no
2. Division of departments to form one or more new departments	11 yes	396 no
3. New departments created	28 yes	379 no
4. Other major changes	46 yes	361 no

*Estimated

ADMINISTRATIVE RESTRUCTURING OF PRIVATE COLLEGE MATHEMATICAL
SCIENCE DEPARTMENTS, 1975-1980

The most common administrative change for private college mathematical science departments was merger with other science departments into divisions or departments of science and mathematics. This consolidation occurred most often in smaller colleges. There were few newly created computer science departments, but expansion of a mathematics department to include computing was more common.

Table 3.3

Type of Change	Instances*	
1. Consolidation of departments into larger administrative unit	155 yes	675 no
2. Division of department to form one or more new departments	19 yes	811 no
3. New departments created	71 yes	759 no**
4. Other major changes	71 yes	759 no

* Estimated

**Most of these repeat entries in (1)

3.2 Teaching Loads and Instructional Formats

The data of chapters 1 and 2 show that between 1975 and 1980 mathematical science course enrollments increased by 33% while FTE faculty rose by only 13%. These differential growth rates produced an 18% increase in the number of enrollments per faculty member. The pressure of such increased teaching responsibilities, with limited new resources, could be expected to cause changes in the way mathematics instruction is delivered and in the working conditions of the faculty.

The 1980 CBMS questionnaire surveyed the patterns of instructional delivery by asking for detailed information about the teaching of five lower level courses: finite mathematics, calculus for physical scientists and engineers, calculus for biological and management sciences, computer programming I, and elementary statistics. The questionnaire also sought information on average teaching loads for faculty and utilization of teaching assistants. On these questions it was possible to make comparisons with findings of previous surveys.

MATHEMATICAL SCIENCE ENROLLMENTS PER FTE MATHEMATICAL
SCIENCE FACULTY MEMBER

From 1975 to 1980 enrollments per FTE faculty member in mathematical sciences increased by 18% to a ratio very close to that of 1965. The sharp increase occurred in every type of four-year institution, probably reflecting the growth in lower level, large section courses.

Figure 3.1*
(enrollment per FTE faculty members)

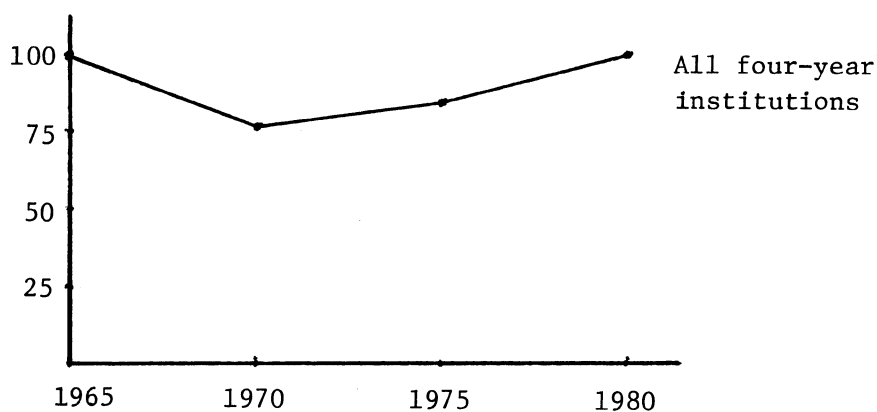


Table 3.4*

Type of Institution	1965	1970	1975	1980
Universities	104	79	85	96
Public Colleges	101	78	87	105
Private Colleges	90	71	73	90
All Institutions	99	77	83	98

*Not including graduate teaching assistants in the faculty count.
Data for 1960 not available.

EXPECTED CREDIT-HOUR TEACHING LOADS IN MATHEMATICS DEPARTMENTS

Since 1975 there appears to have been little net change in the expected credit-hour teaching loads at universities and public colleges and a modest increase in private colleges. About half the universities give reduced loads to faculty who are either active researchers, lecturers in large courses, or administrators. In public colleges reduced loads are commonly given for researchers, administrators, advisors, or large class lecturers (in that order of frequency), and in private colleges nearly all reductions of the normal teaching load are for administrators. A few schools give different loads for different professorial ranks -- usually less for full professors.

Table 3.5
(% of mathematics departments with indicated teaching load)

Type of Institution	Credit-Hour Load						
	<6	6	7-8	9	10-12	12	>12
1. Universities							
1970	8%	40%	32%	8%	5%	7%	-
1975	-	26%	39%	21%	5%	10%	-
1980	10%	23%	29%	26%	4%	9%	-
2. Public Colleges							
1970	-	3%	5%	14%	25%	35%	18%
1975	-	1%	5%	1%	14%	57%	21%
1980	-	3%	6%	4%	7%	59%	22%
3. Private Colleges							
1970	-	-	-	7%	17%	60%	16%
1975	-	4%	2%	6%	18%	56%	14%
1980	2%	3%	5%	7%	17%	45%	22%

EXPECTED CREDIT-HOUR TEACHING LOADS IN STATISTICS
AND COMPUTER SCIENCE

Since 1975 expected teaching loads in university statistics departments have tended to concentrate more in the 6-8 semester hour range. University computer science credit-hour loads have declined markedly with 24% of all departments expecting less than 6 hours. However, the emerging public college computer science departments have expected teaching loads very similar to their mathematics department counterparts.

Table 3.6
(% of departments with indicated teaching load)

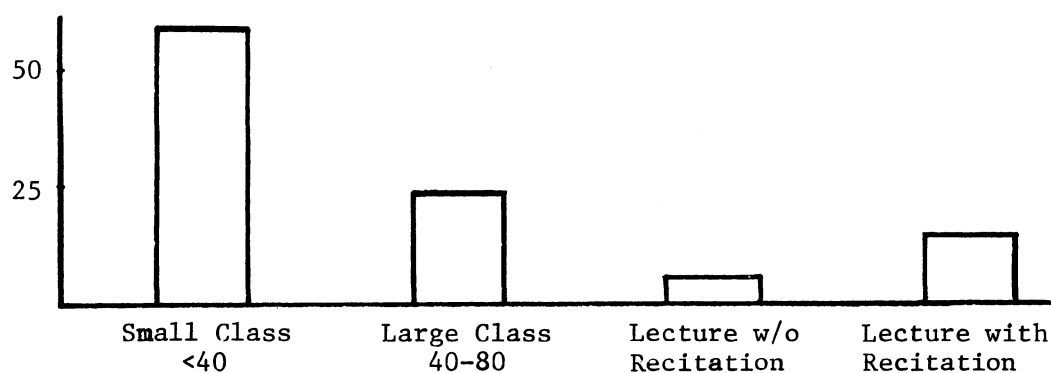
Type of Department	<6	6	7-8	9	10-11	12	>12
1. University Statistics							
1970	44%	28%	12%	8%	8%	-	-
1975	17%	45%	11%	17%	5%	5%	-
1980	9%	41%	34%	16%	-	-	-
2. University Computer Science							
1970	17%	46%	27%	-	7%	3%	-
1975	14%	34%	19%	14%	14%	5%	-
1980	24%	44%	8%	16%	4%	4%	-
3. Public College Computer Science, 1980							
	-	7%	-	23%	-	54%	15%

INSTRUCTIONAL FORMATS IN SELECTED MATHEMATICAL SCIENCE COURSES, 1980

Nearly three-fifths of all students in finite mathematics, calculus, computer programming, and elementary statistics are taught in small classes. These small classes are most common in finite mathematics and statistics. Large lectures with recitation sections are more common in calculus and computer programming than in the other two courses.

Figure 3.2

(% of students taught by each format)



Lectures, with or without recitation sections, enroll nearly one-third of students in the selected courses at universities. In both public and private colleges a small class format is much more common.

Table 3.7

(% of students taught by each format)

Institution Type	Small Class	Large Class	Lecture w/o Recitation	Lecture with Recitation	Other
Universities	36%	31%	10%	21%	1%
Public Colleges	67%	21%	2%	9%	-
Private Colleges	79%	13%	1%	7%	-

UTILIZATION OF TEACHING ASSISTANTS IN MATHEMATICS,
STATISTICS, AND COMPUTER SCIENCE, 1980

Data in Chapter 2 show that from 1975-1980 the number of mathematical science teaching assistants increased by 18%, mostly in computer science and private college mathematics departments. Further, the fraction of TA's who are not graduate students (e.g., undergraduate TA's) more than tripled to over one in five. The major roles of TA's are teaching their own classes, conducting recitation sections, tutoring, and paper grading, but the use of TA's varies widely from department to department.

Table 3.8
(% of TA's in each principal role)

Type of Department	Role				
	Teaching Their Own Class	Conducting Quiz Section	Paper Grading	Tutoring	Other
1. University					
Mathematics (n=5491)	50%	29%	11%	8%	1%
Statistics (n=546)	8%	42%	28%	22%	-
Computer Science (n=1813)	18%	21%	36%	26%	-
2. Public College					
Mathematics (n=1535)	29%	15%	15%	27%	15%
Computer Science (n=90)	26%	-	57%	17%	-
3. Private College Mathematics (n=1154)					
	7%	19%	24%	50%	-
All Departments (n=10,629)	33%	25%	19%	20%	3%

SABBATICAL LEAVE POLICIES

The great majority of universities and four-year colleges have regular sabbatical leave plans. The grant of such leave depends, in most institutions, on well-defined research plans.

Table 3.9
(% of departments in each category)

Type of Department	Leave Conditions			No Sabbatical
	Automatic	With Research Plan	Other	
1. University				
Mathematics (n=160)	8%	61%	16%	15%
Statistics (n=45)	28%	56%	16%	-
Computer Science (n=94)	12%	74%	4%	10%
2. Public College				
Mathematics (n=407)	5%	52%	19%	24%
Computer Science (n=71)	7%	55%	14%	24%
3. Private College (n=830)				
	11%	51%	14%	24%

3.3 Summary and Interpretations

The major course enrollment and faculty trends from 1975 to 1980 have led to pressures for change in the administration and delivery of instruction in mathematical sciences. The continuing growth of computer science as a major sector of the field has led to formation of independent computer science departments in most universities and in many large public colleges. In private colleges many mathematics departments have expanded their titles and programs to include computer science. However, it appears that pressures for administrative economy are leading to broader consolidations that include mathematical science programs in units that also have responsibility for a variety of physical and social sciences.

The rapid growth in mathematical sciences course enrollments out-paced growth in faculties, resulting in increased ratios of students to faculty. The increase from 1975 to 1980 was 18% overall, but the 1980 level is nearly identical to that of 1965. The normal credit-hour teaching loads for mathematical science faculty have decreased in university computer science departments, increased in private college mathematics departments, and changed little in other types of departments. The students in those courses are now increasingly likely to be in lower level courses, but, except for university departments, the teaching is still predominantly in small classes (<40). As a strategy for coping with the increased, lower-level enrollments, departments are making greater use of teaching assistants, but many of these TA's are not mathematics graduate students.

The trends in these data are hardly encouraging, suggesting that gains of the 1965-1975 period are being lost to pressures of enrollment, limited resources, and a diminishing pool of graduate student teaching assistance.