Chapter V

TWO-YEAR COLLEGES

This chapter reports on a survey made of two-year colleges, relating to course enrollments, placement, and other curricular matters, and parallel to the survey of degree-granting institutions reported on in the preceding chapters. This survey of two-year institutions was conducted by CBMS in the late fall of 1970, at the same time as the four-year college survey, using a questionnaire (Appendix C) which was similar but modified to fit two-year college characteristics.

This survey is a direct successor to the first such study, conducted in the fall of 1966-67 and reported on in Volume I of the Report of the Survey Committee [E].

Significant evidence comes from this study that the number of course enrollments in the mathematical sciences in junior colleges has kept pace with the phenomenal growth in total student enrollment at these institutions, with each increasing by 68 percent over the four-year interval. This rapid growth reflects a widespread acceptance of two-year institutions as a basic component of the public education system and is in contrast to a 30 percent growth, over five years, in both total and mathematical enrollment in degree-granting institutions. These parallel changes indicate that the overall position of the mathematical sciences within the academic world has remained essentially fixed in spite of a major shift in institutional patterns.

Within mathematical science, however, there have been some shifts in emphasis. There has been an increase in the proportion of junior-college courses devoted to subjects normally considered to be pre-collegiate level, especially arithmetic. At the same time, there have been relatively greater increases in the teaching of computer programming, statistics, and finite mathematics in the two-year institutions, while calculus and other "sophomore" courses have not increased as rapidly as the student population has.

During this period the mathematical sciences faculty in two-year institutions has increased by 80 percent, with a slight trend toward a greater full-time component. This improvement in the quantity of the staff, relative to enrollment increases, has been accompanied by a measurable increase in its educational qualifications. An analysis of the faculty situation in junior colleges is given in Chapter VI.

Sample and Response

The methodology for determining a population of two-year institutions and for selecting a sample thereof was identical to that for degeee-granting institutions, and is described in detail in Chapter I. The U.S. Office of Education listing of 683 public (independent) two-year colleges and 267 private two-year institutions was supplemented by the addition of 94 public and 2 private two-year off-campus branches of four-year institutions. Also we deleted from the population, for sampling purposes, eight private institutions which specialize in art, bible, or dental technology and 33 private institutions with enrollment under 100, primarily under religious auspices; all of these institutions appear not to teach mathematical science. After deleting two other institutions which had been changed to degree-granting status, we ended with a population of 1,003 two-year institutions. These were sampled on the same weighted basis which is described in Chapter I. The sample ratios and response rates are shown in Table 5.1 and a list of responding institutions is given in Appendix D. These responding institutions, constituting 15 percent of all two-year colleges, actually cover 30 percent of two-year students and faculty under the weighted sampling procedure used.

Because two-year colleges have varying organizational structures, our questionnaires were addressed to the dean with the request that he forward it to the person directly in charge of the mathematics programs. From the 151 responses we determined that 70 institutions had a mathematics department, 55 included mathematics in a division of science and mathematics, 11 small institutions had no departmental structure, and 15 others provided for mathematics within such departments as engineering or general education. In every case, the responses indicated that there were no separate departments whose primary mission was instruction in computer science or statistics, although these subjects were occasionally assigned to other departments to teach.

Table 5.1

SAMPLING AND RESPONSE FOR MATHEMATICAL SCIENCE PROGRAMS IN TWO-YEAR COLLEGES

Group	Enrollment Range*	Number in Universe	Sampling Ratio	Number in Sample	Responses Received	Percent Response
A. Large Public Colleges	9,600-28,000	41	1:1	41	33	81
B. Medium Public Colleges	1,500-8,800	330	1:7.5	44	35	80
C. Small Public Colleges	under 1,500	405	1:7.5	54	36	67
D. Large Private Colleges	1,000-5,000	24	1:1	24	17	71
E. Small Private Colleges	under 1,000	203	1:4	51	30	59
Totals		1,003		214	151	71

* Enrollment includes both full-time and part-time students, fall 1970 (USOE data).

Table 5.2

ENROLLMENTS IN TWO-YEAR INSTITUTIONS, FALL 1970

(In thousands)

	Full Time	Part Time	Public Colleges	Private Colleges	Total
Total enrollment	1,165	1,058	2,102	121	2,223
Degree-credit	876	754	1,520	110	1,630
Nondegree-credit	289	304	582	11	593
First-time freshmen (Deg.Cr.)	414	240	601	53	654
First-time freshmen (Total)	562	355	857	60	917

Source: USOE, Projections of Educational Statistics to 1980-81. Includes 50 states and D. C. Does not include off-campus branches of degree-granting institutions, or Puerto Rico.

General Information on Two-year Colleges

As a point of reference we present in Table 5.2 the Fall 1970 enrollment for two-year institutions as they are categorized by USOE. For the CBMS adjusted population of 1,003 institutions listed in Table 1.1, a close estimate can be obtained by adding 90,000 to the public component in Table 5.2 to represent the added off-campus branches, the other adjustments being essentially self-balancing. On the basis of USOE data for individual colleges [Q], the distribution of the added 90,000 students is estimated to be two-thirds full-time, nine-tenths degree-credit, and two-fifths first-time freshmen. The USOE data in Table 5.2 are, however, reasonably suitable for time-series and other comparisons.

Table 5.2 shows that almost half--47 percent--of the two-year college students attend on a part-time basis; an examination of colleges by group indicates that part-time attendance is a common characteristic, but that it varies roughly according to institutional size, from 14 percent in small private colleges to 58 percent in the large public colleges (as shown in Table 5.7). The table above shows that about a quarter of all two-year college students are enrolled in "nondegree-credit" programs, principally

in public colleges. A question in the survey as to total student enrollments in college-transfer (degree-credit) programs and in occupational/terminal (nondegree-credit) programs revealed that most public institutions had substantial fractions taking each kind of program. Furthermore, with respect to the enrollment of these students in mathematical science courses, those respondents who did distinguish the types of students in their classes reported both types mixed together in most of their courses except for a few occupationally-oriented courses in technical or business mathematics. Even the latter courses seemed to carry credits for the enrollees, and apparently the fact that a student is officially enrolled in an occupational or terminal program does not preclude his obtaining credits in mathematical courses which may be transferable at the option of the receiving institution. Consequently, although we have noted in Table 5.2 the subcategorization of students as to credit basis, this division has little apparent relationship to the character of the institution or to coursework in mathematics.

Although 22 percent of the two-year institutions tabulated in Table 5.1 are under private control, the overwhelming fact is that most of these private institutions are relatively small; only five had a 1970 enrollment of over 2,000, and as a group the private colleges enrolled less than 6 percent of the two-year students. (This represents a distinct change over the last ten years; in 1960, 40 percent of junior colleges were private and they enrolled 14 percent of the students.) This preponderance of public junior college students within the total number obviously results in obscuring the private colleges' differences where they exist; thus we will take special notice of the private college situation where it is noticeably different from the public one.

Two-year college students are also unevenly distributed nationally. Over 31 percent of them attend junior colleges in California, and the seven states of California, New York, Illinois, Michigan, Texas, Florida, and Washington account for two-thirds of all the junior college students in the country, although the higher education enrollments in these states constitute only 44 percent of the U.S. total. The position of the public junior college in California is unique--junior college students constitute 55 percent of the higher education enrollment, and 80 percent of the first-time freshman total for the institutions in the state. About half of the 690,000 junior college students in California attend the 25 public colleges with enrollment over 10,000. The educational

impact of the junior college movement in California is perhaps unique, also--the widespread availability of junior college educational opportunities is evidently related to the fact that California enrolls 15 percent of the higher education students in the U.S., even though the state's population is only nine percent of the national total. Because the California junior colleges loom so prominently in the national picture, and so dominantly in the group of large public junior colleges, their characteristics with respect to mathematics enrollment and curriculum will be the subject of a special discussion later on.

As a matter of terminology, we shall refer to two-year colleges or junior colleges as generic terms, without any intended distinction between them, and include in this categorization all educational institutions which offer typically two years of post-secondary school instruction but which do not offer baccalaureate degrees. Some of these institutions offer an associate in arts degree, and most offer college-level credits for at least some of their courses, such credits being transferable to degree-granting institutions and often applicable there toward a baccalaureate degree. The general category of two-year college, as we use the term, includes many institutions called community colleges and some technical institutes, business colleges, art and music schools, and agricultural schools; quite a few use the name "college" without further qualification. The students at most of the public institutions and many of the private ones commute for the most part, and many attend in the evening and/or part-time. All of these factors should be considered when attempting to compare the mathematics programs in junior colleges with those in senior colleges.

The rapid growth of enrollments in two-year colleges over the last four years is shown in Table 5.3. The growth of 68 percent in total enrollment is approximated in each of the component enrollments shown in the table, and this 68 percent growth, which is equivalent to an annual (compound) rate of 14 percent, contrasts sharply with the 30 percent growth in total enrollment in degree-granting institutions over five years, equivalent to slightly over 5 percent annually. It is noteworthy, too, that the annual growth rate of 15 percent in degree-credit enrollment is more than double the rate of 7 percent which was predicted four years earlier (cf. [E], page 54). The USOE Projections [A] for 1980-81 indicate a continued growth for two-year institutions at a compound annual rate of more than 6 percent over the next ten years, in spite of

Table 5.3

ENROLLMENT GROWTH IN TWO-YEAR INSTITUTIONS, 1966 TO 1970
(In thousands)

	Total	Degree Credit	Nondegree Credit	Full Time	Part Time	First-Time Freshmen
Fall 1966 Enrollment	1,380	990	390	773	607	571
Fall 1970 Enrollment	2,313	1,706	607	1,225	1,088	957
Percent Increase 1966-1970	68%	72%	58%	59%	80%	68%
Annual Growth Rate	14%	15%	12%	12%	16%	14%

Source: USOE data as in Table 5.2, with adjustment to include Puerto Rico and off-campus two-year branches of degree-granting institutions.

a leveling-off of the birth rate. This projection may well prove to be quite conservative, for the growth in new freshmen at the junior colleges from Fall 1970 to Fall 1971 was estimated at over 13 percent by Parker (see page 12).

Course Enrollments in Two-year Colleges

In the fall term of 1970-71 there were 584,000 course enrollments in mathematical science courses in junior colleges, according to our survey. This represented a 68 percent gain over the number estimated from our previous junior college survey four years earlier, and this percentage gain is essentially identical to the gain in total enrollment of students. The gain in full-time equivalent student enrollment was, however, only 63 percent, because the growth in part-time students was greater than in full-time. Thus the mathematical science course enrollment averaged 0.37 course per FTE student for the fall term, a slight improvement over four years earlier. According to department chairmen's estimates the total mathematical course enrollment for the second semester or quarter of 1970-71 was expected to be 520,000 (89 percent of the fall enrollment), and the group of institutions which schedule a third quarter expected about 108,000 more enrollments then. All in all, therefore, the mathematical science course enrollment for the academic year was some 1,212,000, in courses lasting for one semester or quarter. The

Table 5.4

MATHEMATICAL SCIENCE COURSE ENROLLMENT IN TWO-YEAR COLLEGES
1966 AND 1970

	Fall 1966	Fall 1970	Increase 1966-1970
Course Enrollments in mathematical science	348,000	584,000	68%
Total student enrollment, full & part time	1,380,000	2,313,000	68%
Full-time equivalent student enrollment	975,000	1,588,000	63%
Mathematical science courses per FTE student	0.36	0.37	3%

Full-time equivalent (FTE) = full-time plus one-third of part-time.

total exposure of the average student to mathematical science is thus equivalent to 0.77 semesters annually, or between two and three credits.

Enrollments in individual courses are shown in Table 5.5 for both 1966 and 1970. What perhaps is most striking is that there is little radical change: the increases in individual courses tend to follow the student enrollment growth in general. Subjects with especially rapid growth include college arithmetic, elementary algebra, basic concepts, finite mathematics, statistics and probability, and computer programming. The subjects of analytic geometry and calculus have increased in proportion to the student body, but there has been a definite shift from a combined course to separate courses (which is contrary to the trend in senior colleges). There has been, relatively, a decline in the total enrollment in college algebra and trigonometry, but with a shift of emphasis from separate courses toward a combined one. Advanced courses such as differential equations, linear algebra, and other post-calculus mathematical subjects constitute a minimal portion of the mathematical offerings for both years. The rapid increases in statistics and in computing, as taught in the mathematics program, are less than we might really have expected. Together they constituted about 3 percent of the total enrollments in 1966, but in 1970 they accounted for 5 percent of the total and over 7 percent of the non-remedial subjects. (This does not take into account the enrollments in courses taught outside of the

Table 5.5

DETAILED ENROLLMENTS IN MATHEMATICAL SCIENCE COURSES
IN TWO-YEAR COLLEGES

(In thousands)

	Course	Fall 1966 Enrollment	Fall 1970 Enrollment	Typical Credits*
1.	Arithmetic	15	36	2-3
2.	High School Geometry	5	9	3-4
3.	Elementary Algebra (H.S.)	35	65	3-4
4.	Intermediate Algebra (H.S.)	37	60	3-4
5.	College Algebra	52	52	3
6.	Trigonometry	18	25	3
7.	College Algebra & Trigonometry	15	36	3-5
8.	Elementary Math. Analysis(algebra, etc.)	7	11	4
9.	Basic Concepts (structure, logic)	21	48	3-5
10.	General Math. (basic skills, operations)	17	21	3-5
11.	Finite Mathematics	3	12	3
12.	Mathematics of Finance	4	5	3
13.	Business Mathematics	17	28	3
14.	Math. for Elementary School Teachers	16	25	3-6
15.	Technical Mathematics (pre-calculus)	19	26	3-9
16.	Analytic Geometry	4	10	3-4
17.	Analytic Geometry & Calculus	32	41	5-13
18.	Calculus	8	17	4-9
19.	Technical Mathematics (calculus level)	1	3	3-4
20.	Differential Equations	2	1	3-4
21.	Elementary Statistics	4	11	3
22.	Probability (& Statistics)	1	5	3
23.	Programming of Digital Computers	3	10	3
24.	Other Computer-oriented Mathematics	2	3	3
25.	Linear Algebra	1	1	3
26.	Modern Algebra	L	L	3
27.	Slide Rule	3	9	1
28.	Mathematics for Liberal Arts	1	9	-
29.	Other pre-calculus mathematics	5	4	-
30.	Other advanced mathematics	L	1	-
	TOTALS	348	584	

* Credits may include several semesters for continuing courses under same title. Credits are in semester hours, estimated at the quartiles (unweighted).

Table 5.6

TOTAL ENROLLMENTS IN MATHEMATICAL SCIENCE COURSES IN TWO-YEAR COLLEGES, BY LEVEL
(In thousands)

Level	Fall 1966	Fall 1970	Increase 1966-1970
Preparatory (Courses 1-4, 10)	109	191	75%
Precalculus Mathematics (5-9, 11-15, 27-29)	181	290	60%
Calculus & Analytic Geometry (16-19)	45	71	58%
Upperclass Mathematics (20, 25-26, 30)	3	3	0%
Statistics (21-22)	5	16	220%
Computing (23-24)	5	13	160%
Total	348	584	68%

mathematical sciences program--especially computing, which is taught extensively in business and technical divisions or departments, which we will discuss subsequently.) In Table 5.6 the enrollments in the mathematical sciences departments are grouped according to the approximate mathematical levels of the courses; the relative growth rates between 1966 and 1970 are shown. When the individual courses of Table 5.5 are grouped in these more general classifications it can be seen that while the amount of course work in preparatory courses has increased more rapidly than the student population, this additional growth has not been inordinate in itself. However, the additional need for such preparatory work is very likely responsible for the relative reductions in calculus and upperclass mathematics since fewer students are able to complete the prerequisites in time to take these subjects during a two-year curriculum.

A comparison of the same levels of mathematical science offerings in the different types of two-year colleges is shown in Table 5.7. To put the magnitude of the offerings in each type of institution in focus we have estimated the total student enrollment and the percentage in full-time attendance; these

Table 5.7

ENROLLMENTS IN MATHEMATICAL SCIENCE COURSES IN TWO-YEAR COLLEGES
BY LEVEL AND INSTITUTIONAL TYPE, FALL 1970
(In thousands)

	Public Colleges			Private Colleges		Total
	Large	Medium	Small	Large	Small	
Preparatory	43	102	32	7	7	191
Pre-Calculus Mathematics	41	156	64	11	18	290
Calculus & Analytics	14	36	15	4	2	71
Upperclass Mathematics	1	2	*	*	*	3
Statistics	6	9	1	*	*	16
Computing	3	6	3	1	*	13
Total course enrollments in Mathematical Science	108	311	115	23	27	584
Total Student Body**	590	1,252	350	48	73	2,313
Percent Full-time Students**	42%	51%	66%	76%	86%	53%
Full-time Equivalent Students	363	847	271	41	66	1,588
Math Courses/FTE Student	0.30	0.37	0.42	0.56	0.41	0.37

*Less than 500. For institutional size, see Table 5.1. **Estimated

estimates are based on data for sample subsets of institutions. Calculation of the corresponding mathematical course enrollments per FTE student makes it immediately apparent that mathematical subjects attract a smaller fraction of the students in the large public colleges. This difference may be attributable in part to the wider variety of other subjects available at these institutions, but we find that a major part of the difference can be accounted for by dividing this group, with the course/student ratio for 25 California colleges being 0.27 while it is 0.34 for the 16 colleges in other states. (The California situation will be discussed later.) At the other extreme, mathematics seems to be taken by more students in the large private colleges; here the course/student ratio is strongly influenced by two technical institutes in which almost every student is enrolled in at least

Table 5.8

FRESHMAN-SOPHOMORE MATHEMATICAL SCIENCE ENROLLMENTS
IN TWO-YEAR AND FOUR-YEAR PUBLIC COLLEGES

Level	Public 2-yr. Colleges (000)	Public 2-yr. Colleges Percent	Public 4-yr. Colleges (000)	Public 4-yr. Colleges Percent
Preparatory/Remedial	177	33%	68	16%
Pre-Calculus Mathematics	261	49%	225	54%
Calculus & Analytics	65	12%	99	24%
Elementary Computing	16	3%	14	3%
Elementary Statistics	12	2%	11	3%
Total	531		417	

one mathematical science (with ratio 1.18!), and a liberal arts college which requires mathematics of all its freshmen.

An interesting comparison can be made between public junior colleges and public four-year colleges (excluding universities) with respect to the level of courses in which students enroll. The percentages for each level in public junior colleges are contrasted in Table 5.8 with data for public four-year colleges as recorded in Tables 2.7 and 2.8. As might be expected, in the junior colleges a larger percentage--about double--of those who take mathematics are enrolled in preparatory work, and a smaller percentage get as far as the calculus. But these figures are deceptive; a comparison of enrollments in preparatory courses with figures for first-time freshmen [A] provides an interesting index, even though it is somewhat rough because there are other students in these preparatory courses. On this basis, the number of enrollments in preparatory courses is approximately 18 percent of the number of first-time freshmen for each group of institutions! A deductive corollary from these two comparisons is that the liklihood that a student might take some freshman or sophomore mathematics course while in college is roughly twice as large if he begins college in a four-year college, even though the liklihood of his taking remedial mathematics is about the same.

Courses in pre-calculus mathematics which were reported under the "other" category, and which are recorded as a group under item 29 in Table 5.5 include courses entitled mathematics for social science, for physical science, for agriculture, for health science, for law enforcement, for accounting, and for secondary school teaching (several instances); numerical methods, logic, introduction to matrices, modern geometry, and algebra combined with analytics. Advanced courses reported under "other" (item 30) include advanced calculus, vector analysis, history of mathematics, statics, theory of real functions, complex variables, engineering graphics, and several instances of descriptive geometry and of matrix analysis. It seems, though, that at least some of these are actually offered as extension courses rather than as part of a regular two-year curriculum.

Availability of Courses

Turning from the actual enrollments in various courses, we show in Table 5.9 the availability of courses in different types of institutions. As might be expected, almost every course is more widely available in large or medium-sized institutions than in small ones. In examining the ranges of subject matter covered by combinations of these specific courses, we find that 92 percent of all two-year institutions offer some type of course involving college algebra (courses 5, 6, 7, or 9), and 84 percent offer trigonometry (courses 6 or 7). Over 91 percent offer calculus and analytic geometry in some form (courses 16-19)--the only exceptions being some business schools and technical centers and some of the smallest colleges. Statistics is offered by 48 percent of the institutions, and by two-thirds of the larger ones. Preparatory mathematical courses (1, 2, 3, 4, or 10) are offered by over 90 percent of the large or medium institutions, by 80 percent of the small public institutions, and almost half of the small private colleges. The last column presents a percentage of all junior colleges which offer each course; the reader is cautioned that since small colleges outnumber the large ones, these percentages do not reflect the percentages of all students to whom these courses are available. In most cases the latter percentages are close to those for medium-sized public colleges.

Major changes from 1966 to 1970 in the availability of individual courses can be ascertained by comparing Table 5.9 with Table B5 of [E], although precise comparison is not feasible because of differences in categorization of institutions by type.

Table 5.9

AVAILABILITY OF MATHEMATICAL SCIENCE COURSES IN TWO-YEAR COLLEGES

Percent of two-year institutions offering each course sometime in 1970-71

	Course	Public Colleges Large	Public Colleges Medium	Public Colleges Small	Private Colleges Large	Private Colleges Small	All Colleges
1.	Arithmetic	64%	53%	33%	35%	13%	37%
2.	High School Geometry	70	35	19	29	3	24
3.	Elementary Algebra	94	76	42	24	7	48
4.	Intermediate Algebra	91	71	58	47	20	56
5.	College Algebra	58	59	58	53	30	53
6.	Trigonometry	85	76	58	53	27	64
7.	College Algebra/Trig.	48	38	42	53	43	41
8.	Elementary Analysis	27	24	17	24	43	25
9.	Basic Concepts	36	32	28	18	27	29
10.	General Math.	24	18	22	12	20	20
11.	Finite Mathematics	45	24	17	18	10	19
12.	Math. of Finance	24	18	11	6	10	13
13.	Business Math.	33	44	36	35	33	38
14.	Math/Elementary Teachers	73	65	53	29	10	48
15.	Technical Math.	52	53	50	12	3	41
16.	Analytic Geometry	18	26	17	12	7	18
17.	Analytics & Calculus	82	79	58	65	43	63
18.	Calculus	39	44	42	65	33	41
19.	Technical Culculus	27	26	22	12	0	19
20.	Differential Equations	70	62	31	41	13	49
21.	Elementary Statistics	61	59	33	35	23	41
22.	Probability/Statistics	27	15	17	6	13	16
23.	Computer Programming	55	44	19	35	7	27
24.	Other Computer Math.	33	29	14	12	0	18
25.	Linear Algebra	58	15	25	6	0	17
26.	Modern Algebra	12	3	6	0	0	4
27.	Slide Rule	48	38	22	24	0	24

One traditional course which has decreased significantly over this period is college algebra, which was formerly offered as a separate course by over three-quarters of all institutions with enrollment over 1,000; in 1970 it was offered at only 58 percent of such institutions, being replaced to at least some extent by a combined course in college algebra and trigonometry.

The other course which showed a major decrease was business mathematics, which was formerly taught in about 60 percent of all two-year colleges with enrollment over 2,000, but in 1970 was offered in only about 40 percent of such institutions.

During the same period there were major increases in the availability of half a dozen courses. Perhaps the most significant increase occured in the offering of mathematics for elementary school teachers, which was available in 1966 at only 30 percent of junior colleges, but is now offered at half of all institutions, and at 60 percent of the public colleges. Finite mathematics has increased in availability at both the largest public colleges and the small private ones. Technical mathematics involving calculus, formerly available at less than 10 percent of two-year colleges, is now offered at 25 percent of the public colleges, and a similar situation holds for a course in slide rule. The offering of elementary statistics has increased somewhat in the smaller colleges. Courses in computing, which in 1966 were taught in over half of the junior colleges with enrollment over 5,000, but seldom taught elsewhere, in 1970 were offered in well over half of the institutions with enrollment over 1,500. It should be noted that an increase in availability of a course is not always correlated with a more-than-normal increase in enrollment; of the above courses, only statistics, computing, slide rule, and finite mathematics grew in total enrollment much more rapidly than the student population, as shown in Table 5.5.

Admissions and Placement

In this era of "open admissions", 82 percent of two-year colleges still require some sort of admissions examination which includes mathematics. However, this is a noticeable reduction from four years earlier, when 93 percent of two-year colleges required an admissions examination. Details of admission requirements are given in Table 5.10. The downward trend in admissions examinations is especially evident in the public institutions with over 10,000 enrollment--only 61 percent of these require an examination. Those institutions which require an admissions examination frequently permit the prospective student a choice of examinations, but over half of the public institutions allow the use of the American College Testing (ACT) examinations, whereas the private institutions tend to follow

Table 5.10

PERCENTAGE OF TWO-YEAR COLLEGES
WHICH REQUIRE AN ADMISSIONS EXAMINATION WHICH INCLUDES MATHEMATICS

Type of Institution	Percent requiring admissions exams	Of those requiring examination, Percent which use various exams*					
		(a)	(b)	(c)	(d)	(e)	(f)
Large public colleges	61	5	0	53	5	37	16
Medium public colleges	80	25	0	61	11	11	18
Small public colleges	83	21	14	55	0	0	28
Large private colleges	73	73	18	18	0	0	9
Small private colleges	87	46	15	42	0	0	8
All institutions, 1970-71	82	28	9	53	4	5	20
All institutions, 1966-67	93	20	2	53	10	10	30
All institutions, weighted by total enrollment (1970)	76	21	3	56	7	15	18

* Type of examination:
(a) College Entrance Examination Board, Aptitude Examinations
(b) College Entrance Examination Board, Achievement Examinations
(c) American College Testing (ACT) examinations
(d) State secondary-school achievement examinations
(e) Educational Testing Services, School and College Ability Test (SCAT)
(f) Other; mostly locally prepared
Percentages add to over 100 because some institutions allow alternative examinations.

the private four-year institutions in relying upon the College Entrance Examination Board (CEEB) Aptitude Examinations. Public institutions in the states of New York and Florida usually permit use of the state-wide high-school examination results. No information is available as to how any of the colleges relate admission to the results of the examinations.

Once students are admitted, about half (45 percent) of the junior colleges administer placement examinations in mathematics, usually to determine the courses in which a student may enroll.

Table 5.11

PLACEMENT EXAMINATIONS IN TWO-YEAR COLLEGES

	1966-67	1970-71	
	All instns.	Large colleges	Small colleges
Percent of institutions which administer placement examinations in mathematics	52	49	42
Of institutions which administer placement examinations--			
A. Percent in which exam is taken by:			
1. All entering freshmen	64	37	64
2. Students taking mathematics in college for the first time	24	25	8
3. Students in special curricula (e.g., engineering, etc.)	16	11	12
4. Other (for admission to specific courses, or if so advised)	14	26	12
B. Percent for which placement examination tests for a knowledge of:			
1. Arithmetic	59	62	72
2. Algebra	83	93	88
3. Geometry	31	44	40
4. Trigonometry	46	65	56
5. Other	13	5	4
C. Percent in which objectives are:			
1. To determine which students have the necessary mathematical knowledge to undertake regular college courses	54	34	37
2. To determine mathematical aptitude	34	30	21
3. To section by ability level	15	25	16
4. To determine which course the student may enroll in	70	66	84
5. Other	4	10	4
D. Percent using standardized or nationally distributed examinations	52	66	52

Some details of the trends in placement examinations are given in Table 5.11. It is noteworthy that of those colleges that do not give placement examinations, almost four-fifths have an

admissions-examination requirement in mathematics the results of which may be available for placement advising. Even so, the trend since 1966 has been to remove requirements and barriers for students in the larger institutions: whereas 73 percent of the colleges with enrollment over 2,000 gave placement examinations then, only 49 percent of the large and medium institutions did so in 1970.

The placement examinations which are given apparently cover a wider range of mathematical subjects than formerly. In 1970, 90 percent of the tests included algebra, 68 percent included arithmetic, and 42 percent included geometry questions, whereas these subjects were tested in 1966 to the extent of 83, 59, and 31 percent, respectively. The subject of trigonometry is also included in 60 percent of the 1970 tests, as compared with 46 percent in 1966. There is, apparently, little difference between large and small colleges in the content of there examinations; perhaps this reflects the fact that a majority of departments rely upon standardized or nationally distributed examinations for this testing. Over two-thirds of the colleges which administer placement tests give them to all freshmen or to all freshmen taking mathematics; the remainder require them only in certain curricula or for entrance to college-level courses such as college algebra or calculus.

The purpose of admissions and placement examinations is, of course, to ascertain whether students are ready for college mathematics and which courses they are qualified to enter. The actual enrollment of freshmen in the various courses reflects, in some sense, the results of this testing as well as of the faculty advising which (sometimes) follows. We show in Table 5.12 the mathematics enrollments of students who were classified as freshmen in the fall of 1970, as best they could be estimated from the partial responses to this question--apparently a number of chairmen did not have records as to which of their students were classified as freshmen. In this table we have grouped together as "college algebra and equivalent" the courses numbered 5-9, 11-15, and 27-29 of Table 5.5, and courses in statistics and computing have not been included in any of the categories.

In an effort to see whether the initial preparation of junior college students has changed between 1966 and 1970 we have compared in Table 5.13 the fall enrollments for those years. As it happens, the data for the two years are not precisely

Table 5.12

PERCENTAGE DISTRIBUTION OF FRESHMAN ENROLLMENTS IN MATHEMATICS IN TWO-YEAR COLLEGES, FALL 1970

Course Level	Public Colleges			Private Colleges		All
	Large	Medium	Small	Large	Small	Insts.
Arithmetic & General Math	10%	11%	13%	8%	19%	12%
High School Algebra & Geometry	40%	27%	18%	28%	9%	26%
College Algebra & equivalent	41%	55%	61%	52%	67%	54%
Analytics & Calculus	9%	7%	8%	12%	5%	8%

comparable; in 1966 we obtained data for entering freshman, whereas the 1970 data is for all students classified as freshmen. The latter group might be expected to be somewhat more advanced in course assignments; while the table shows a larger percentage of freshmen in 1970 who are taking what is usually considered college-level mathematics, the percentage who have progressed as far as analytical geometry and calculus has diminished in spite of this expectation that the 1970 group would be more advanced at the time of recording the data.

Table 5.13

DISTRIBUTION OF FRESHMAN ENROLLMENTS IN MATHEMATICS IN TWO-YEAR COLLEGES, 1966 AND 1970

	Entering Freshmen Fall 1966		All Freshmen Fall 1970	
	(000)	Percent	(000)	Percent
Arithmetic & General Mathematics	35	12%	51	12%
High School Algebra & Geometry	84	30%	112	26%
College Algebra & equivalent level	124	44%	234	54%
Analytics & Calculus	39	14%	34	8%

Remedial and Prerequisite Courses

The survey respondents were asked whether "prerequisite" instruction in mathematics is offered, with or without credit, to correct the deficiencies of students who are beginning to take college mathematics for the first time. Every institution with enrollment over 1,500 answered affirmatively! Among the smaller junior colleges (all with enrollments under 800), 80 percent of the public institutions and 40 percent of the private ones also answered affirmatively, and several of those who responded negatively to this question listed course offerings (with credit) in arithmetic and high school algebra. Two others reported that they had given up prerequisite offerings during the last five years, one because such courses were given at a neighboring institution, the other because corresponding programmed materials were now avaliable to students on a voluntary basis. On the other hand, over a quarter of the colleges which offer prerequisite work have introduced some or all of it during the last five years. Most of the respondents in this category indicated that specific courses (especially arithmetic and elementary algebra) had been introduced because of student deficiencies which were apparent from placement or admissions examinations. Several very large institutions located in large cities noted that new courses had been added specifically because of new "open" admissions policies with respect to educationally disadvantaged students.

There is no information from our 1970 survey to indicate what distinction, if any, might be made between "prerequisite" and "remedial" course work. Even though the content may not differ much from courses taken, or not taken, in the elementary and secondary schools, credit of some sort is usually given for such courses as college arithmetic, geometry, and elementary or intermediate algebra. We have classified this type of course as "preparatory" in most of the tables above. These tables, especially 5.9, and 5.12, show the extent to which such courses are offered and taken in junior colleges. It will be observed from Table 5.9 that, the larger the institution, the more likely it is to offer preparatory courses. At the same time, the fraction of freshmen enrolled in mathematics who are taking one (or more) of these preparatory courses is shown in Table 5.12 also to be larger in the larger institutions. If we examine the credit status of these preparatory courses, we find, as shown in Table 5.14, that those smaller institutions which do

Table 5.14

CREDITS OFFERED FOR REMEDIAL COURSES IN TWO-YEAR COLLEGES

Course	Percent Offering Course		If course offered, percent offering: No Credit		Remedial Credit		Regular Credit	
College size:	Large	Small	Large	Small	Large	Small	Large	Small
Arithmetic	53	28	16	0	46	39	38	61
High School Geometry	38	14	11	19	47	19	42	62
Elementary Algebra	74	30	14	0	44	48	42	52
Intermediate Algebra	71	46	16	14	24	19	60	67

offer these courses are more likely to give regular credit for them. Most institutions actually offer either regular credit or credit which is designated as remedial--perhaps implying that it may be used for prerequisite purposes and/or is counted as part of the student's credit load, but is probably not available for later transfer credit. It will be seen from Table 5.13 that the fraction of freshmen mathematics students who take preparatory courses has probably not changed materially between 1966 and 1970.

Mathematical Science Courses Taught Outside of Mathematics Program

The information presented so far in this chapter has been limited to those courses in the mathematical science which are taught in the department or division which has the primary responsibility for mathematical instruction. The respondents to the questionnaire were also asked to estimate the enrollments in mathematical science courses which were given by other divisions or departments. These estimates are probably not as reliable as other data presented because the respondents did not have direct responsibility for these offerings; the errors are likely to come from understatement. The estimates of course enrollments for the entire academic year are given in Table 5.15; these

Table 5.15

ESTIMATED ENROLLMENTS IN MATHEMATICAL SCIENCE COURSES
TAUGHT OUTSIDE OF MATHEMATICS PROGRAM IN
TWO-YEAR COLLEGES, ALL TERMS, ACADEMIC YEAR 1970-71

(Enrollment in thousands)

Courses	Enrollment in courses given by division specializing in:					
	Natural Science	Occupational Programs	Business	Social Science	Other	Total
Arithmetic		8	5	1		14
Business Mathematics		3	33	L		36
Statistics		L	4	1	L	5
Probability			1	L		1
Pre-calculus College Math.	4	1	1	L		6
Calculus or Diff. Equations	L	L	L	L	L	L
Computer Science & Programming	2	10	7		2	21
Other courses	L	6	L	L	3	9
Totals	6	28	51	2	5	92

L = some, but less than 500.

figures should be halved to get information comparable to the regular enrollments reported earlier in Table 5.5. It may be noted that the principal course taught outside the mathematics program was business mathematics, with computer programming and arithmetic both strongly represented; all of these courses were taught primarily in the business or occupational programs. Statistics, which was widely taught in other departments in four-year colleges, was not so treated in two-year colleges except for some course efforts by business departments.

Computers and Computing

The availability of computers for educational and research purposes in junior colleges has increased materially over the last four years. While the increased importance of computing may be indirectly evident in some of the data already presented, we will recapitulate such information in this section together with a summary of the responses to special questions on computing. By 1970, approximately 80 percent of the mathematics departments in junior colleges with over 1,500 enrollment had access to a computer or to computer terminal facilities, and 30 percent of the mathematics staffs in the smaller junior colleges had similar access, whereas in 1966, just 63 percent of the larger colleges and 15 percent of the smaller ones had access to computing facilities. We calculate from these figures that in 1970 some three-quarters (74 percent) of junior college students were attending institutions in which computing facilities were available, at least to some extent.

A specific course in "Programming of Digital Computers" (course number 23) was offered by the mathematical sciences faculty in 44 percent of the larger junior colleges, and in 15 percent of the smaller junior colleges, as recorded earlier in Table 5.9. This represents a spectacular increase in four years: in 1966, only 21 percent of the larger institutions, and 5 percent of the smaller one offered such a course. "Other computer-oriented mathematics" courses (number 24) were reported as part of the mathematical sciences offerings by 28 percent of the larger colleges and 10 percent of the smaller ones; taken together with Computer Programming, one or both of these courses were offered by the mathematical sciences departments in 59 percent of the larger colleges and 23 percent of the smaller ones. The total enrollments in these courses are estimated at 10,000 for course 23 and 3,000 for course 24, for the fall semester of 1970.

The area of computing and computer programming is, however, only partly under the aegis of the mathematical sciences faculty. While the latter taught some 13,000 students in the fall of 1970, there were some 21,000 others who studied this subject sometime during the academic year under the auspices of other faculties in 32 percent of the institutions. As shown in Table 5.15, about 10,000 of these students enrolled in computing courses in occupational programs, and another 7,000 in business programs;

the remainder were mainly in courses conducted under auspices of engineering or physical science faculty members. A re-examination of reporting institutions as to whether computing courses are offered, irrespective of which department of division offers them, reveals that some 71 percent of the larger institutions and 39 percent of the smaller ones offer this subject somewhere. (For the smaller institutions, the apparent discrepancy between this report of 39 percent offering computing courses and the earlier report indicating that only 30 percent of the smaller institutions had computing facilities available to the mathematical sciences faculty may in some instances reflect the non-availability to the mathematics faculty of facilities located in the occupational or business areas!)

Specific certificate programs in computer programming are offered by 7 percent of the public junior colleges, and 22 percent of these public institutions offer an associate degree with this major. Those institutions (perhaps about 200) which offer one or both of these programs reported that they awarded an average of 5 such certificates or degrees per program in 1970. Such concentrated programs offering either certificates or degrees appear, however, to be available only in public institutions (perhaps because of the high cost factors); out of the 67 private junior colleges reporting in our survey, only one college (a business college) reported such a program.

Certificate programs in data processing are offered by 13 percent of the public junior colleges, and associate degrees with this subject designation are offered by 29 percent of these colleges. Again, this major is principally available only in the public institutions, although three of the largest private junior colleges do offer an associate degree in data processing. In this field, the 300 or so institutions offering programs averaged 12 awards of either certificates or degrees in 1970.

The data compilations of the U. S. Office of Education in its annual series Associate Degrees and other Formal Awards below the Baccalaureate (OE-54045) cannot be compared readily with the data reported in our survey, but they appear to be reasonably consistent. Associate degrees in arts or science were awarded in 1969-70 to some 206,000 graduates of two-year programs--about 85 percent of these were awarded in two-year institutions--but no subdivision of these by majors is reported. In a classification of "awards in organized occupational curricula" (with some

overlap of associate degree awards) USOE for 1969-70 recorded 1,627 awards in scientific data processing by 96 institutions and 4,860 awards in business data processing by 318 institutions, most of which are two-year institutions. The numbers of these awards in scientific and business data processing have trebled and doubled, respectively, over a two-year period--a phenomenal growth. No separate classification of computer programming is provided in these reports to USOE; this field is probably subsumed for the most part in the data processing classifications.

The rapid increase in offerings in data processing, computer programming, and other computing subjects, especially in publicly-supported institutions which charge little or no tuition, may well indicate that these offerings are beginning to meet an educational need which up until very recently was only being accommodated by proprietary schools charging relatively high tuition fees. The availability of these low-cost programs is thus opening up these technical specialties to the economically disadvantaged.

Mathematical sciences departments reported the use of a computer as an adjunct to the teaching of a number of courses other than those in computer science; some 18 percent of the institutions which have access to a computer reported such a usage. About two-fifths of these courses using a computer adjunct were in calculus or differential equations, and about one-fifth were in statistics; the remainder covered a wide range of courses, including arithmetic, algebra, finite mathematics, elementary analysis, technical mathematics, and network analysis.

With respect to use of computers by the faculty, the survey found, as indicated above, that 80 percent of the larger junior colleges and 30 percent of the smaller ones have computing facilities which are available to the faculty. We estimate that 28 percent of the faculty at the institutions which have facilities actually use them in connection with their teaching. In terms of all institutions, this means that about 14 percent of the national junior college faculty make some use of computers in their teaching of mathematics. Table 5.16 shows the percentages of mathematics departments in which the faculty makes minimal, moderate, or high use of computers in teaching, in a classification analagous to that used on page 58 and in Table 4.3 for four-year institutions. A comparison of these two tables reveals that while the teaching use of computers is generally somewhat less in junior

Table 5.16

PERCENTAGES OF MATHEMATICS DEPARTMENTS IN TWO-YEAR COLLEGES REPORTING MINIMAL, MODERATE, AND HIGH USE OF COMPUTERS IN TEACHING

	Minimal Use: Up to 10% of Faculty		Moderate Use: 10% to 25% of Faculty	High Use: At Least 25% of Faculty
	No access:	Access:		
Public Junior Colleges	43%	23%	7%	27%
Private Junior Colleges	80%	9%	3%	8%
Large Junior Colleges	20%	29%	13%	38%
Small Junior Colleges	70%	16%	2%	12%
All Junior Colleges	50%	21%	6%	23%

colleges, the percentage of public junior colleges (and especially the larger ones) which make extensive ("high") use of computers is substantially greater than for public four-year colleges. This may of course indicate that for those junior colleges which emphasize computer usage in their teaching the subjects involved form a larger fraction of a more limited curriculum.

The questionnaire also sought information as to the faculty use of computers for research purposes. This usage turned out to be fairly minimal: while 80 percent of the larger colleges have facilities, only 25 percent of the total group reported any research use at all, and for small institutions, 30 percent of which have facilities, only 8 percent use these facilities for research. For both large and small colleges only about 4 percent of the individual faculty members use the computer for research, as compared with some 11 percent of the faculty at public four-year colleges.

Instruction Techniques

The traditional lecture-recitation system continues as the primary method of instruction in the majority of mathematics classes in junior colleges. In fact, it appears as the only method of instruction used in 50 percent of the smaller institutions and in 24 percent of the larger (and medium-sized)

Table 5.17

TECHNIQUES OF INSTRUCTION IN JUNIOR COLLEGES

Percent of junior colleges in which mathematics faculty make use of non-traditional methods of instruction.

Technique	1966-67 Enrollment over 2000	1966-67 Enrollment under 2000	1970-71 Colleges Large	1970-71 Colleges Small
Large lecture classes with small quiz sections	15%	5%	8%	5%
Large lecture classes with help sessions	10	10	11	16
Organized program of independent study	11	10	29	20
Television courses: broadcast or closed-circuit	9	2	3	2
Film courses	1	0	2	2
Courses by programmed instruction	52	16	49	24
Computer-assisted instruction (CAI)	7	1	10	1
Other special techniques	8	11	15	18

institutions. Other techniques of instruction are being used, at least in some classes, but the pattern of innovative techniques of instruction is pretty much the same in 1970-71 as it was in 1966-67, as shown in Table 5.17. There continues to be a rather widespread reliance upon programmed instruction, with half of the larger institutions making some use of programmed methods, apparently primarily in arithmetic, elementary algebra, and other review or remedial subjects. Organized independent study has significantly increased, with 29 percent of the larger institutions and 20 percent of the smaller ones reporting programs of this type.

The increased amount of instruction in review and remedial mathematics has been accompanied by an increase in various methods of auxiliary assistance to students. In addition to the substantial use of programmed instruction, other kinds of auxiliary efforts are reported by a number of institutions. Among these, computer-assisted instruction, audio-tutorial programs, videotape replay systems, tape cassettes, tutorial sessions, and mathematics or computing laboratories were reported by the larger institutions, while the smaller institutions mentioned

individualized attention, peer-group instruction, special help sessions for slow students, and team teaching, as well as learning laboratories. However, the use of filmed courses or broadcast or closed-circuit television for instruction in the mathematical sciences was not reported except at a handful of institutions.

Large lecture classes supplemented by quiz sections are in vogue at only 8 percent of the large institutions as compared with 15 percent four years earlier. On the other hand, in the smaller institutions there has been a trend toward the use of large lecture sections supplemented by help sessions. Approximately one-fifth of the small, public institutions are using this approach to reach the student as an individual.

Coordination of Transfer Programs with Four-year Institutions

The articulation of junior college transfer programs with the curricular offerings and requirements of the four-year institutions to which the junior college students may transfer is of obvious importance in mathematics because of the sequential nature of the subject matter. One method of possible correlation of programs is through state action; our survey results indicate that the course offerings and/or curricula in mathematics were subject to state control or approval for 70 percent of the public institutions but only 32 percent of the private colleges. Of course, it does not necessarily follow from the existence of state accreditation requirements or even state boards of administrative control that there is careful coordination--or some degree of uniformity--in the content and packaging of offerings in a specific subject area. Thus the survey sought information as to the nature of specific articulation of the mathematical sciences offerings in those junior colleges which offer college-transfer programs with the mathematics programs of four-year institutions. As shown in Table 5.18, the most prevalent method of coordination was through direct and regular consultations between the staff members of the junior colleges and those of the senior institutions. Official state-wide coordination, at the level of the mathematics staffs, was in effect for about a quarter of the junior colleges, both public and private, and a number of other means were employed to achieve coordination. Altogether, some form of articulation was in effect for virtually all of the public junior colleges, but only for about three-quarters of the private

Table 5.18

COORDINATION OF TRANSFER PROGRAMS OF JUNIOR COLLEGES WITH THOSE OF FOUR-YEAR INSTITUTIONS

	Public Junior Colleges	Private Junior Colleges
Course offerings or curricula subject to state approval	70%	32%
Coordination of junior college offerings in mathematics with those of four-year institutions, through:		
a. an official state-wide coordination program	28%	23%
b. regular consultations of mathematics staffs	81%	63%
c. other coordination activities (see text)	39%	20%
One or more of the above means of coordination:	98%	72%

Note: Business and technical schools whose programs are principally terminal rather than for transfer credit are excluded from this tabulation.

junior colleges. Perhaps the remainder of the private colleges feel that adequate coordination is achieved unilaterally by their use of traditional courses or standard textbooks.

The most frequently mentioned "other" means of coordination were a number of cooperative projects for regional groupings of two-year colleges in conjunction with a nearby university, conducted under grants from the National Science Foundation in its College Science Improvement Program. Several respondents noted collaborative discussions arising in, or resulting from, regional Section meetings of the Mathematical Association or meetings sponsored by the Association's Committee on the Undergraduate Program in Mathematics. In some cases in which the junior college is part of a state education system, coordination is automatically induced because of uniformities of the system. Other examples cited included coordination which resulted from teacher interchange, from attendance of junior college faculty members at university colloquia and mathematics clubs, and from sharing either facilities or faculty members.

California Junior Colleges

The extensive California junior college system consists of 90 public junior colleges with a total 1970-71 enrollment of some 689,000 full- and part-time students. These colleges are administered not as a state-wide system but on a county or local basis. As we noted on page 71, these colleges enroll some 31 percent of all junior college students in the country. They are typically large, averaging 7,600 students, and the group includes 25 which have over 10,000 students. However, only 42 percent of the students are full-time, as compared with 58 percent full-time in junior colleges in all other states.

We have examined the responses from the California colleges in our sample to see in what respects their mathematics programs deviate from those of junior colleges in other states. One important difference, as we observed earlier, appears in the ratio of mathematics course enrollments to the full-time equivalent student body; this ratio was exceptionally low in the 25 large California junior colleges--only 0.27 as compared with 0.37 for the entire country. To get a better fix on this, we have separated the mathematical courses according to levels (cf. Table 5.7), and calculated the course/student ratio for each level, as shown in Table 5.19. This table shows that slightly more preparatory-remedial work is taken by California students--but this may only reflect the fact that a larger percentage of California high school graduates continue on to higher education, so that the comparatively less able are in junior college in higher proportions. The principal difference, however, is in the pre-calculus category of courses, of which California students take less than other students. Why? Part of the cause may be related to the remedial situation: those who must take remedial mathematics in the fall semester cannot register for regular college courses until the spring. The figures in Table 5.19 do not indicate, however, that this is a major factor. Another possibly related factor lies in the analytic geometry-calculus sequence; although California students take about the same amount of these subjects as students in other states, over 70 percent of the California registration is in a combined course (#17) carrying 12 to 16 credits, whereas about half of the students in other states take separate courses (#16 and #18). The combined course, which is presumably designed to be parallel to that offered in the senior institutions in California, may encompass a number of topics in pre-calculus mathematics, but we do not have evidence of this and

Table 5.19

MATHEMATICS COURSES PER STUDENT IN CALIFORNIA JUNIOR COLLEGES

Course Level	Courses per full-time-equivalent student in: 25 Large Public Colleges in California	65 Other Public Colleges in California	All Colleges not in California
Preparatory/Remedial	0.13	0.14	0.12
Pre-Calculus Mathematics	0.08	0.09	0.22
Analytics & Calculus	0.04	0.05	0.04
Upperclass Mathematics, Statistics, and Computing	0.02	0.02	0.02
Total courses/FTE student	0.27	0.30	0.40

in any case the California registration in the calculus sequence is not inordinately high. One might conclude that either the California students are more apt to enroll in curricula which do not require mathematics beyond the remedial, or that California high schools prepare their better students in such a way that they do not need this traditional freshman mathematics. Unfortunately, we have no evidence to sustain either view.

The situation in large California junior colleges might be compared with that in a group of four large State University of New York junior colleges which are in the same sample group. In these the ratio of course enrollments to FTE students (as compared with the first column of Table 5.19) was: preparatory, 0.09; pre-calculus, 0.16; analytics and calculus, 0.05, and other, 0.11; total, 0.41. The lower figure for preparatory mathematics in the SUNY institutions may reflect the better minimum secondary school preparation under the requirements of the New York State Board of Regents. The surprising figure for "other" includes a large 0.09 course/student for elementary statistics, which could have been counted as part of the precalculus level. The actual number of statistics course registrations in the four SUNY colleges was over three times the total for the 25 large, and comparable, California colleges. (If the 43 two-year colleges in the SUNY

system had not, by chance, been underrepresented in our sample, the evident contrasts between this group and the California group could have been better portrayed.)

Although the California junior colleges enrolled relatively few students in regular college courses at the pre-calculus level, they enrolled larger than average numbers in such courses as arithmetic, elementary algebra, trigonometry, and slide rule. Such courses may be quite needed; however, a greater expectation in college-level mathematics, statistics, and computing would appear to be socially useful also.

Technical Institutes

Our respondent group included two very large technical institutions specializing in the occupational trades; these offered very little mathematics. Excluding these, and one agricultural-technical college, there were ten smaller technical institutes and technical education centers, varying in size from 200 to 2,800 FTE students. (The two-year college universe probably contains close to 100 such institutions.) The mathematics course per FTE student ratios, as used in Table 5.19 above, were: preparatory, 0.15; pre-calculus, 0.28; analytics and calculus, 0.18; and other, 0.08, totalling 0.69--almost twice as much in each category as in other two-year institutions. This probably should be interpreted as indicating that a larger proportion of students take mathematics, not that individuals take more courses. The course enrollments were, by and large, concentrated in rather traditional combined courses such as college algebra and trigonometry and analytics and calculus. Very little enrollment was reported except in traditional courses in mathematics, except that one institute offered considerable statistics and two others extensive computing. The preparatory-remedial offerings seemed quite consistent with other two-year institutions.