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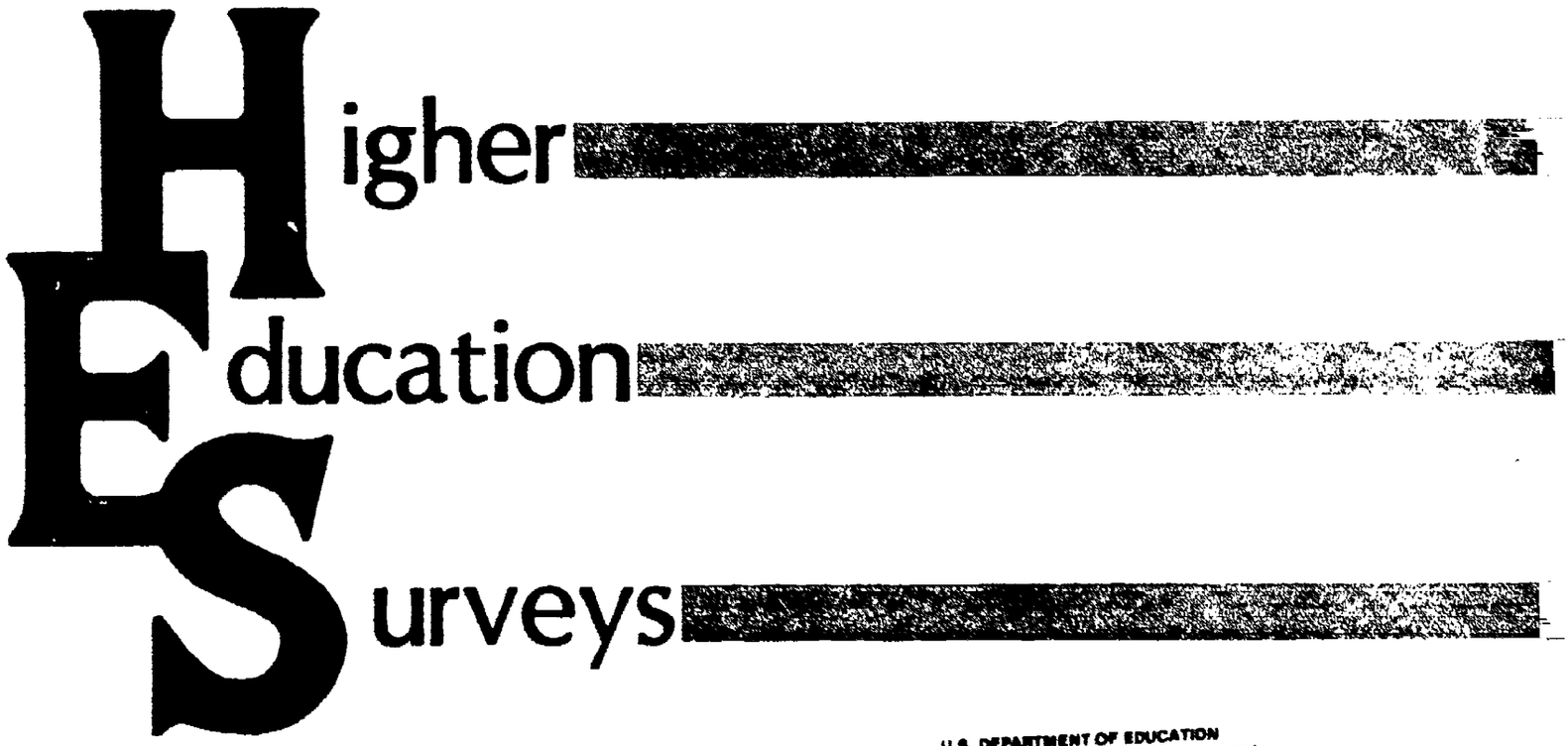
ABSTRACT

The purpose of this survey report is to provide national estimates on the types of students served, the characteristics of faculty used at different instructional levels, the availability and qualifications of teaching and research staff, student enrollment in mathematics/statistics courses, types of degrees offered, and problems in resources encountered by faculty for mathematics and statistics departments at higher education institutions. Prescreened departmental representatives from responding units, in most cases the chairperson, provided assessments in terms of both quantitative and qualitative data. The document includes: (1) an introduction about the background for this survey and the survey universe and respondents; (2) descriptions of mathematics and statistics programs in terms of degrees offered and the nature of the courses of study; (3) faculty teaching characteristics and degree attainment, recruitment statistics, and data on research priorities and teaching satisfaction; (4) frequency data on problem perception within mathematics and statistics departments; (5) differences among the various types of institutions; and (6) appendices with detailed tables, technical notes on survey methodology and reliability, and the survey questionnaire used for this report. (JJK)

SURVEY OF MATHEMATICS AND STATISTICS DEPARTMENTS AT HIGHER EDUCATION INSTITUTIONS



Higher Education Surveys Report
Survey Number 5
December 1990

A Survey System Sponsored by the National Science Foundation, the National Endowment for the Humanities, and the U.S. Department of Education

SURVEY OF MATHEMATICS AND STATISTICS DEPARTMENTS AT HIGHER EDUCATION INSTITUTIONS

Sponsored by:

The National Science Foundation
Directorate for Scientific, Technological, and International Affairs
Division of Science Resources Studies

Written for:

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Directorate for Mathematical and Physical Sciences
Division of Mathematical Sciences

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- Judith Sunley, Director, Division of Mathematical Sciences, National Science Foundation
- Bernard McDonald, Deputy Director, Division of Mathematical Sciences, National Science Foundation
- Patricia White, HES Program Officer, Education and Human Resources Program, Division of Science Resources Studies, National Science Foundation
- Mary Golladay, Director, Education and Human Resources Program, Division of Science Resources Studies, National Science Foundation

Other individuals at the National Science Foundation also contributed to the questionnaire design and presentation of survey results.

From Westat, Debbie Alexander was the data preparation supervisor for the survey, and Sheila Heaviside supervised the telephone followup.

We also acknowledge the indispensable contribution of the many officials, faculty, and staff members at the sampled institutions who completed the survey questionnaires.

Highlights

A 1989 HES survey of mathematics and statistics departments found the following about these disciplines at higher education institutions in the United States. Departmental representatives were asked to provide information for fall 1988 (unless otherwise indicated).

- A screening of institutions to identify mathematics and statistics departments showed there was great diversity in the types of departments offering mathematics and statistics instruction, including many departments in the sciences and social sciences Among those 2,750 departments identified either specifically as mathematics or statistics departments or as the primary location at an institution for offering mathematics, 850 did not offer degrees in mathematics or statistics. Often these departments had a broader focus than mathematics alone.

- The majority of teachers (55 percent) who taught mathematics and statistics classes and students (55 percent) taking those classes in fall 1988 were located in departments offering degrees in mathematics only, while one-fourth were in departments offering both mathematics and statistics degrees. One-fifth of teachers and students were in departments offering neither mathematics nor statistics degrees.

- Mathematics departments were organized to serve large numbers of non-mathematics majors. Departmental representatives estimated that a mean of 80 percent of all students at their institution take at least one course in mathematics or statistics from their department before graduating. They also estimated that their department devoted a mean of 80 percent of teaching time in mathematics or statistics to nonmajors.

- Of 3 million students enrolled in mathematics and statistics courses in fall 1988, one-fifth were enrolled in remedial courses and one-half in nonremedial courses below the level of calculus. An additional one-fifth were enrolled in calculus level courses, and one-tenth were enrolled in advanced or graduate courses.

- An estimated 45,000 people taught mathematical or statistical science classes in fall 1988. Most (59 percent) taught at least one course at the below calculus level; 36 percent, at the calculus level; 34 percent, at the remedial level; 22 percent, at the advanced level; and 11 percent, at the graduate level.

- The percentage of teachers teaching mathematics/statistics classes who were full time in fall 1988 (i.e., held full-time teaching/ research/administrative responsibilities in fall 1988) or held doctorates was greatest at the most advanced instructional levels. At the remedial level, 44 percent of teachers were full time, and 11 percent had doctoral degrees. At the graduate level, 79 percent were full time and 79 percent had doctorates.

- Over the period 1984-85 through 1988-89, departments sought to fill 9,600 full-time positions in mathematics and statistics. When departmental representatives were asked whether vacancies were filled with persons having the advertised qualifications, they indicated that 83 percent were filled with people meeting the advertised qualifications. Approximately 10 percent were filled with people not meeting the advertised qualifications, and 7 percent were left unfilled.

- Two-thirds of representatives from the departments surveyed stated they had seen no change in their department's ability to recruit suitable faculty members over the last two years, while one-fourth said recruiting is now more difficult.

- Sixty-eight percent of departmental representatives felt their institution put more importance on teaching than research in evaluating full-time faculty, and another 11 percent felt teaching was somewhat more important. Interestingly, 31 percent of faculty were in departments where departmental representatives saw research as being more important than teaching. Essentially all departmental representatives stated their institution gave more importance to teaching than research when evaluating part-time faculty.

- Departmental representatives stated that an average of 38 percent of full-time faculty in their department were actively involved in research and publication.

- Of the problems experienced by the mathematics and statistics departments, those most frequently cited by departmental representatives were teaching load (52 percent), funding of faculty travel (47 percent), physical facilities (43 percent), and adequacy of computing equipment (41 percent).

- Departments at doctorate-granting institutions differed from other departments. Though fewer in number, they tended to be larger in size, with one-fourth of both the teachers and students in fall 1988. Unlike representatives from departments at other institutions, representatives from these departments generally felt their institution emphasized research over teaching in evaluating faculty. They stated their department had an average of 57 percent of all faculty actively involved in research. Departmental representatives were also more likely than those at other departments to say that recruiting of suitable faculty had become more difficult.

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Introduction

Great concern has been expressed over the condition of mathematics and statistics education in the United States. Skills in mathematics and statistics are increasingly required in science, industry, and areas not previously considered mathematical, such as the social sciences and humanities. Measures of numeric literacy, however, indicate low levels of proficiency among American students. John Dossey, past president of the National Council of Teachers of Mathematics (NCTM), said: "American students score near the bottom in almost every important area of mathematics when compared to similar students in other nations. Our education system is producing fewer and fewer individuals who can apply mathematics in any meaningful way."[1] Further, if the supply of mathematically proficient individuals falls too low, the ability of schools to hire qualified teachers at both the secondary and postsecondary levels may be affected as well.

Departments in mathematical and statistical sciences differ from many disciplines in the extent to which they are service departments for other disciplines. In many fields, training in mathematics is necessary in order to perform work in the discipline, increasing the demand for courses such as calculus and differential equations. Other fields may not specifically require mathematics for work in the discipline, but majors in those fields may elect to take one or more courses in mathematics or statistics. Thus, mathematics and statistics departments must be organized to serve a large number of nonmajors, especially through providing numerous sections in general introductory courses and those that are common prerequisites. The courses must be scheduled regularly, even if the department is experiencing difficulties in hiring qualified faculty, because many students must complete them as prerequisites for other courses.

Survey Background

This report is based on a study proposed by the Division of Mathematical Sciences of the National Science Foundation. The purpose of the survey was to obtain national estimates on the types of students served, the characteristics of faculty used at different instructional levels, the availability and qualifications of teaching and research staff, student enrollment in mathematics/statistics courses, types of degrees offered, and problems in resources encountered by faculty for mathematics and statistics departments at higher education institutions.[2] Both quantitative and qualitative data were requested with a departmental representative providing assessments for the unit. Opinion data reflect the opinions of the representative of the surveyed departments, and do not necessarily reflect the opinions of the entire staff of the department or the institution as a whole. Departmental representatives were identified through prescreening and by HES representatives. In most cases the representative was the department chair or person responsible for the primary unit where mathematics/statistics is taught. Unless noted otherwise, all figures presented in this report are weighted, nationally representative estimates

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[1] *Washington Post*, March 22, 1989, p. A4.

[2] For simplicity, this report will sometimes use the term "mathematics" to refer to both mathematics and statistics. Both mathematics and statistics departments were included in this survey, but data show that statistics was typically taught in departments of mathematics rather than in separate departments.

based upon the survey results, and comparisons in this report are based on relationships that were statistically significant using the t statistic at the .05 level. This section provides a brief overview of important features of the survey to help in interpreting the results. Detailed tables of the survey findings are presented in Appendix A. More detailed technical information on the sample and survey methodology is in Appendix B.

Much of the analysis in this report is based on characteristics of the institutions where the surveyed depart ients were located, including institutional control (public, private), enrollment size of the institution (small: less than 1,000, mid-sized: 1,000-4,999, and large: 5,000 or more), and the geographic region (Northeast, Central, Southeast, West). An institutional type (doctorate-granting, comprehensive, baccalaureate, specialized, and two-year) based upon a U.S. Department of Education typology in which schools are classified according to the types of degrees offered, the number of degree recipients of each type, and the diversity of program offerings is also used (see Appendix B). However, this institutional classification is not designed to describe the characteristics of an individual mathematics/ statistics department. For example, some institutions that are classified by this typology as doctorate-granting do not offer doctoral degrees specifically in mathematics, while other institutions do offer doctoral degrees in mathematics even though they do not meet the U.S. Department of Education criteria to be classified as doctorate-granting institutions.

Survey Universe and Respondents

The ability to generalize results from this survey is affected by the great diversity found among departments offering mathematics instruction. The survey universe is limited to departments that clearly have mathematics or statistics in their names and those identified as the primary location for mathematics instruction.

Mathematics instruction occurs not only in departments specifically devoted to mathematics and statistics, but also in various departments within the sciences, social sciences, and business. However, because these other departments are likely to be concerned with different issues than mathematics and statistics departments, the survey was conducted of mathematics and statistics departments.[3] The survey thus did not attempt to represent all mathematics instruction. In some of the smaller schools and in many two-year schools, departments specifically devoted to mathematics/statistics did not exist; rather, mathematics was taught within some larger organizational structure. In these cases, the department primarily responsible for teaching mathematics was contacted, even if its mandate was much larger than teaching mathematics and statistics. When such departments were surveyed, departmental representatives were instructed to answer only for their mathematics faculty and courses, not for the entire department.

[3] In initial contacts with the institutions to identify all mathematics and statistics departments, a total of over 100 *additional* departments were identified as providing some instruction in mathematics. These included departments in business administration, operations research, the social sciences, and others.

Considerable diversity also existed among the departmental representatives surveyed, even in basic areas such as the type of degree offered by the department, so that generalizations are difficult without specifying type of degree offered. When the focus is on research conducted in mathematics, it is often useful to focus on departments offering doctoral degrees; in fall 1988 these represent 200 of an estimated 2,750 departments, with 25 percent of both mathematics and statistics teachers and students (Appendix Table A-1). The remaining departments offering degrees in mathematics or statistics included 200 offering master's degrees as their highest degree, 900 offering bachelor's, and 550 offering associate's. Additionally, 350 of the departments did not offer degrees in mathematics or statistics, but offered degrees of some other type (e.g., general studies), and 500 departments offered instruction in mathematics/statistics, but did not offer degrees of any type.

Generally, the highest degrees offered by the departments corresponded relatively closely with institutional type (Appendix Table A-2). As previously noted, institutions classified as doctorate-granting by the U.S. Department of Education typology may not award doctorates in mathematics/statistics, and some not classified as doctorate-granting may award a Ph.D. in mathematics. For example, of the 200 departments offering doctorates, 87 percent were at doctorate-granting institutions. The remainder were offered by institutions not classified as doctorate-granting. Similarly, 74 percent of departments offering master's degrees as their highest degrees were at comprehensive institutions, and 65 percent of those offering bachelor's degrees were at baccalaureate institutions. Departments offering associate's degrees or not offering mathematics degrees were primarily at two-year institutions. This included 100 percent (after rounding) of those offering associate's degrees, 74 percent of those offering other non-mathematics degrees, and 67 percent of those offering no degrees.

Departments offering associate's degrees only and those not offering degrees in mathematics or statistics are sufficiently numerous to have strong effects on overall totals and percentages, and yet may be different in purpose and operations from other departments. In combination, these departments have 18,500 (41 percent) of the faculty, and over one million (42 percent) of the students (Appendix Table A-1). Thus, they are an important part of the nation's instruction in mathematics.

Departments that did not offer degrees in mathematics or statistics generally appeared more similar to departments offering only associate's degrees than they did to other mathematics departments. For example, two-thirds or more of the departments not offering degrees in mathematics or statistics were located at two-year institutions. This was more similar to departments offering only associate's degrees (100 percent) than to other departments (5 percent or fewer; Appendix Table A-2). Again, similar to departments offering an associate's degree as the highest degree, teachers and students at departments not offering degrees in mathematics or statistics tended to be concentrated at the remedial and below calculus levels, with relatively few teachers or students in classes at the advanced or graduate levels (Appendix Table A-3). In contrast, departments offering a

bachelor's degree or higher in mathematics or statistics tended to have higher proportions of their teachers and students in the advanced or graduate courses than the departments not offering mathematics degrees.

Description of Mathematics and Statistics Programs

Results from the survey showed that mathematics and statistics courses were offered by 2,750 departments at 2,600 higher education institutions. Departments differed in whether they offered degrees in mathematics or statistics and in the types of courses that were taken by students. However, departmental representatives were generally quite consistent in stating their department devoted a large portion of its teaching to students not majoring in mathematics or statistics.

Degrees Offered

In fall 1988, a total of 1,800 departments offered undergraduate or graduate degrees in mathematics, 200 offered degrees in statistics, and 800 degrees in computer science (Appendix Table A-4).[4] Departments offering joint degrees in mathematics and statistics were as common as departments offering degrees in statistics (200 departments). Also, 500 departments offered joint degrees in mathematics and computer science, and 400 stated they offered other degrees.

Mathematics degrees tended to be offered at the undergraduate level (either associate's or bachelor's degrees), while most departments offering degrees in statistics included degrees at the graduate level (i.e., master's or doctorates; Appendix Tables A-4, A-5). Over three-fourths of mathematics departments offered their highest degree at the undergraduate level (31 percent, associate's; 49 percent, bachelor's), while contrastingly, three-fourths of statistics departments awarded degrees at the graduate level (40 percent, master's; 38 percent, doctorates; Appendix Table A-4).

Similar to mathematics, the highest joint degrees were bachelor's and associate's. This was true for 74 percent of the departments offering joint degrees in mathematics and statistics (i.e., 30 percent, associate's; 44 percent, bachelor's), and for 95 percent of the departments offering joint degrees in mathematics and computer science (18 percent, associate's; 76 percent, bachelor's).

Mathematics was often taught in departments with a much broader scope than mathematics alone. Thus, 800 of the departments responsible for mathematics instruction awarded degrees in computer science, and 400 awarded non-mathematics degrees (Appendix Table A-4). Computer science degrees were seldom offered by mathematics departments at the graduate level (8 percent), but rather at the bachelor's (52 percent) or associate's (39 percent) degree levels. For most non-mathematics degrees offered by the surveyed departments, the highest degree was at the associate's degree level (57 percent), where it is common for students to obtain general degrees.

[4] Some departments offered more than one degree. All numbers are estimates from the HES sample (which is statistically representative of U.S. higher education institutions) and have been rounded to the nearest 100 to avoid overstating the precision of the estimates.

Departmental representatives were asked to indicate whether any other departments at their institutions offered mathematics or statistics degrees. Their responses showed that generally there was a single department offering mathematics and statistics degrees (typically only mathematics) at each institution. Appendix Table A-4 reveals only minor differences between the number of institutions and the number of departments offering mathematics degrees.

Many departments offered more than one type of degree. However, the majority of teachers and students in fall 1988 (55 percent for both) were located in departments offering degrees in mathematics only (Appendix Tables A-6a and A-6b). Departments offering both mathematics and statistics (either as joint or as separate degrees) had 23 percent of the teachers and 26 percent of the students. Substantial numbers of teachers and students were also in departments offering neither mathematics nor statistics degrees (20 percent and 18 percent, respectively), while departments offering only statistics had only 2 percent of the teachers and 1 percent of the students. Thus, statistics was primarily taught and studied together with mathematics, rather than in a separate department.

The type of degree offered varied among different types of institutions. At two-year institutions, though roughly half of both the teachers and students were in departments offering only mathematics degrees, two-fifths of both were in departments offering *neither* mathematics nor statistics degrees. Institutions classified by the U.S. Department of Education as specialized institutions (see page B-8 for definition) were like two-year institutions in that they often placed mathematics students and teachers within departments offering neither mathematics nor statistics degrees. However, since two-year institutions had several times the number of students and faculty as specialized institutions, the vast majority of all students at departments offering neither mathematics nor statistics degrees were at two-year institutions.

Great differences also existed among institutions regarding whether teachers and students were located at departments offering statistics degrees. Because departments offering only statistics degrees had just 2 percent of the teachers and 1 percent of the students, these departments will be combined for analysis purposes with those departments offering both mathematics and statistics degrees (with 23 and 26 percent of the teachers and students, respectively). This provides a measure of the overall availability of statistics, even if not all teachers or students were specifically involved in statistics courses. Using this approach, statistics was found to be most available at doctorate-granting institutions, where three-fifths of both the teachers and students were in departments offering statistics degrees. In contrast, one-third of the teachers and students at comprehensive institutions were in departments offering statistics degrees, and few of the teachers and students at baccalaureate and two-year institutions were in departments offering statistics degrees. The availability of statistics was also closely related to size: one-third of both the teachers and students at large institutions were in departments offering statistics, compared with less than 15 percent at small and midsized institutions.

Nature of Mathematics and Statistics Courses

Departmental representatives were asked to give the percentage of students at their institution that took at least one course from their department and the percentage of their department's teaching time in mathematics and statistics devoted to non-mathematics majors. They were also asked the types of courses taken by students and the average section sizes at various instructional levels.

Percentage of Students Served

Mathematics and statistics departments taught a mean of 80 percent of all students at their institutions (Appendix Table A-7). This pattern was consistent across all categories of institutional characteristics (i.e., control, enrollment size, and region), except for type. Even within institutional type, comprehensive, baccalaureate, and two-year institutions all taught close to the mean of 80 percent of all students; only doctorate-granting institutions (63 percent) and specialized institutions (95 percent) differed significantly from the overall mean. The statistic for doctorate-granting institutions is misleading, because they typically had a department serving a comparable percentage of students (76 percent), but often had a second (or additional) department serving fewer students (34 percent; Table 1). These additional departments, which rarely existed at other institutions, lowered the average per department for doctorate-granting institutions.

Departments at specialized institutions were more likely than those at other institutions to only offer mathematics courses rather than mathematics programs (54 percent, compared with 11 percent or less), so the high percentage of students served may be related to the more general focus of these departments (Table 2).

Other differences among institutions were a somewhat greater percentage of students served at departments at small institutions (85 percent) compared with large institutions (75 percent), and in the Southeast (88 percent) when compared with the Northeast and the West (76 percent).

Table 1. The mean number of departments in mathematics and statistics and the mean percentage of students taking courses from those departments in fall 1988 by type of institution: United States

Institution type	Mean number of departments per institution	Mean percentage of students served	
		By department serving the greatest percentage of students at each institution	By all other departments
Total	1.1	82	53
Institution type			
Doctoral	1.4	76	34
All others	1.0	82	70

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table 2. The number and percentage of departments responsible for mathematics and statistics in fall 1988 by type of program and institutional type: United States

Institution type	Number of departments	Type of program in mathematics/statistics	
		Offer program	Offer courses but no program
		(percent)	
Total	2,750	89	11
Doctoral	250	96	4
Comprehensive	400	99	1
Baccalaureate	700	95	5
Specialized	200	46	54
Two-year	1,200	89	11

NOTE: The numbers of departments have been rounded to the nearest 50. Details may not add to totals and percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Teaching Time Devoted to Nonmajors

Though representatives estimated that their department generally teaches a high percentage of all students at their institution, it is possible that most of these students were in one or two introductory courses. Departments still may primarily teach students majoring in mathematics statistics. To find out what students departments were serving, departmental representatives were asked to state the percentage of their department's teaching time devoted to nonmajors. The answers were quite similar to those concerning the percentage of students taking at least one course from the department. Departmental representatives estimated that a mean of 80 percent of all their department's teaching time was devoted to non-majors, with little variation from that figure among the various institutions (Appendix Table A-7). The greatest exception was at doctorate-granting institutions where responses showed that typically one mathematics/ statistics department existed and devoted 80 percent or more of its time to teaching nonmajors, while other departments devoted relatively more effort to majors. Departmental representatives at two-year institutions reported a greater proportion of time devoted to nonmajors than did those from doctorate-granting, comprehensive, or baccalaureate institutions, but as noted, students at two-year colleges often obtain degrees without specifying a major field.

Types of Courses Taken by Students

Departmental representatives were asked to indicate the total number of sections taught in fall 1988 and the average size of a section for each of five instructional levels (remedial, below calculus, calculus level, advanced, and graduate).[5] By multiplying the number of sections by the average size per section, estimates can be obtained of the total number of students served at

[5] The questionnaire defined a section as each class that was taught separately by an individual instructor. The questionnaire focused on sections rather than courses because it is common for some courses to have many sections that are entirely independent in terms of meeting time and instructor.

that time.[6] Pretest interviews for the survey indicated that the fall term typically represents the peak time for enrollmer' in mathematics and statistics classes (it is the time when many students take the required introductory courses). Consequently, this figure is different from both the total demand for these courses (since some students who take the courses would not be taking them in fall 1988) and the average demand across all terms.

In fall 1988 almost three million students were enrolled in mathematics and statistics courses. Two-thirds of all students were enrolled in introductory courses, with 21 percent of all students enrolled in remedial courses and 48 percent enrolled in nonremedial courses below the calculus level (Figure 1).[7] An estimated 22 percent were enrolled in calculus level courses, while 8 percent were enrolled in advanced courses and 2 percent in graduate courses.

The greatest number of students (1.2 million) were at two-year institutions, where the percentage of students taking introductory courses was much higher: 35 percent were taking remedial courses, and 54 percent were taking nonremedial courses below the calculus level (Appendix Table A-8). In contrast, the percentage of students taking remedial courses was much lower at doctorate-granting (6 percent) and other types of institutions (between 14 and 17 percent). The survey data do not provide a means of directly evaluating potential explanations for this difference. One possibility is that students attending two-year institutions were more likely to need remedial courses; another is that students at other institutions may have taken remedial (or introductory) courses at two-year institutions and transferred these credits to other institutions. Also, there may be differences among institutions in the tendency to offer remedial courses separately from the mathematics and statistics departments.[8]

Differences in the percentage of students taking remedial courses also appeared between public and private institutions (23 and 13 percent, respectively). However, since 63 percent of departments at public institutions were at two-year institutions (compared with only 28 percent at private institutions), the difference may largely be explained by the differences among institutional types (special analysis, not in tables). With two-year institutions excluded, public and private institutions appeared relatively

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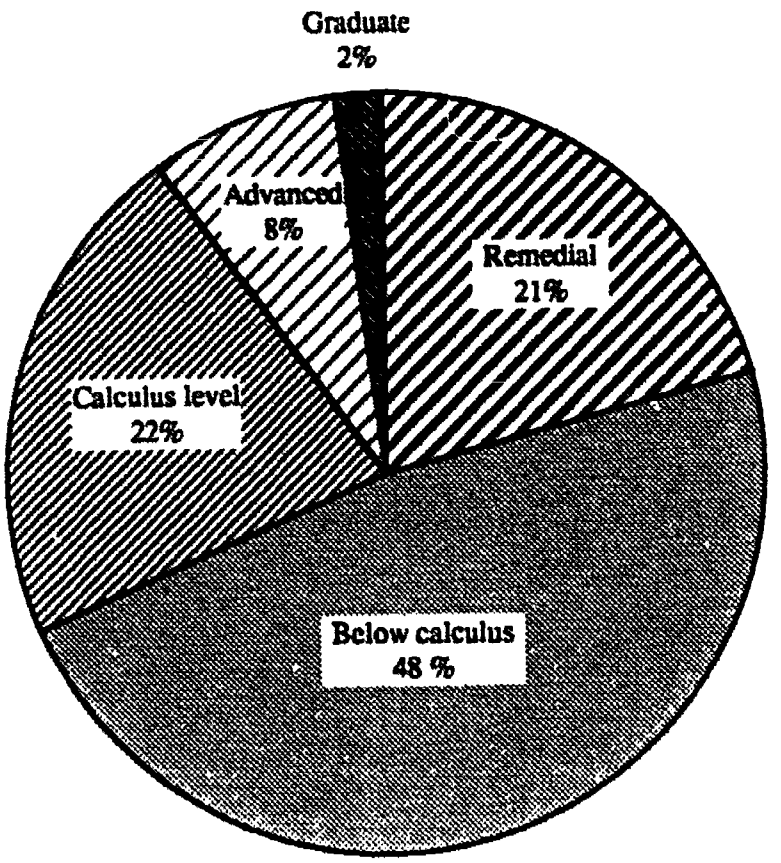
[6] Some double counting will occur through this method, since a student may take more than one mathematics course in a term. However, since most of the students served were nonmajors and most of their courses were at the introductory level, it is likely that the amount of double counting was not great. Double counting in some respects provides a more accurate measure of how many students were taught because a faculty member will have to expend the same resources to teach one student two different classes as to teach two different students two different classes.

[7] At many institutions, remedial courses were taught in separate instructional units, and did not technically fall within mathematics and statistics departments. These figures represent only those courses taught within mathematics and statistics departments, as defined for this survey, and thus underestimate the number of students enrolled in remedial courses.

[8] A survey conducted by the University of Texas indicated that large institutions were more likely to offer such courses through large academic units, while small institutions were more likely to offer the courses within the discipline areas. See *Innovation Abstracts*, Vol. VI, No. 18, published in 1984 by the National Institute for Staff and Organizational Development.

Figure 1. The percentage of students enrolled in mathematics and statistics courses in fall 1988\ by instructional level: United States



NOTE: Figures were calculated by multiplying the number of sections by the average section size. Students are counted once for each course in which they were enrolled. Because of rounding, percentages may not add to 100.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

similar, with 12 percent taking remedial courses at public institutions and 13 percent at private institutions.

These data on the instructional level of courses taken were consistent with the high estimated percentage of nonmajors found to be taking mathematics and statistics courses. To a large degree, each student was likely to take only a limited number of mathematics courses during his/her enrollment at the institution, and these were primarily introductory courses.

Average Section Size of Courses

The mean section size of courses varied according to the level of instruction provided and the characteristics of the higher education institutions. In general, the average section sizes at the calculus level or below were larger (ranging from 24 to 30 students) than at the advanced or graduate level (with mean sizes of 15 and 12, respectively; Appendix Table A-9).

The largest section sizes were at doctorate-granting institutions in courses at the calculus level or below, with mean section sizes ranging from 50 to 57 students. In contrast, section sizes at the same course levels ranged from 18 to 34 at other types of institutions. Doctorate-granting institutions also had higher average section sizes at the advanced level than other types of institutions (24, compared with 12 to 16), although sections tended to be smaller in advanced courses for all institutions.

For all but courses at the graduate level, sections on average had roughly twice as many students at large institutions as at small institutions. To a lesser degree, they were also larger for undergraduate courses at public institutions than at private institutions.

Faculty in Mathematics and Statistics

Departmental representatives were asked to provide basic descriptive information about the number, background, and assignments of the department's faculty, difficulties in recruiting faculty, and faculty teaching and research. Because the departments also included non-mathematics faculty in some cases, they were generally asked to restrict their answers to describing those faculty in mathematics and statistics. Specifically, they were to include faculty that taught at least one mathematics/statistics course in fall 1988.

An estimated 45,000 people taught mathematical or statistical science classes in fall 1988 (Appendix Tables A-10a, A-10b, and A-10c).[9] An estimated 30,000 of these faculty were located at large institutions (5,000 students or more), while only 2,900 were at small institutions (less than 1,000 students). Faculty were most commonly located at public (34,800) and two-year (17,200) institutions; only 5,000 were at baccalaureate institutions and 2,200 at specialized institutions.

Faculty Characteristics

Departmental representatives were asked to describe their faculty in terms of their teaching status (full-time, part-time, or graduate student), their academic degrees, and the instructional levels of the courses they taught.

Teaching Status of Faculty

Faculty often taught at more than one instructional level. Over half (26,400, or 59 percent) taught at least one course in fall 1988 that was below calculus level, 16,250 (36 percent) at the calculus level, 15,300 (34 percent) at the remedial level, 10,150 (23 percent) at the advanced level, and 4,100 (9 percent) at the graduate level (Table 3; Appendix Tables A-11a and A-11b). The percentages of faculty teaching below calculus and remedial level courses reinforce the statistics presented earlier concerning the amount of teaching time devoted to nonmajors. Mathematics and statistics departments did not attempt to place all nonmajors in a limited number of classes and reserve most courses for majors; instead, the introductory and calculus level courses were the primary teaching focus of the faculty.

[9] This estimate includes part-time faculty and graduate students with full responsibility for teaching a class, but excludes teaching assistants who only assisted in a class.

Table 3. The number and percentage of teachers of mathematical/statistical science classes in fall 1988 by employment status and level of instruction: United States

Employment status	Level of instruction*				
	Remedial	Below calculus	Calculus level	Advanced	Graduate
Total					
Number	15,300	26,400	16,250	10,150	4,100
Percent	34	59	36	23	9
Full-time					
Number	6,800	14,700	12,650	9,550	3,950
Percent	15	33	28	21	9
Part-time					
Number	7,800	9,500	2,350	550	150
Percent	17	21	5	1	--
Graduate students					
Number	700	2,200	1,250	50	--
Percent	2	5	3	--	--

-- = Rounds to zero.

*Faculty members were counted once for each course level taught. Percentages are based on the total of 45,000 teachers.

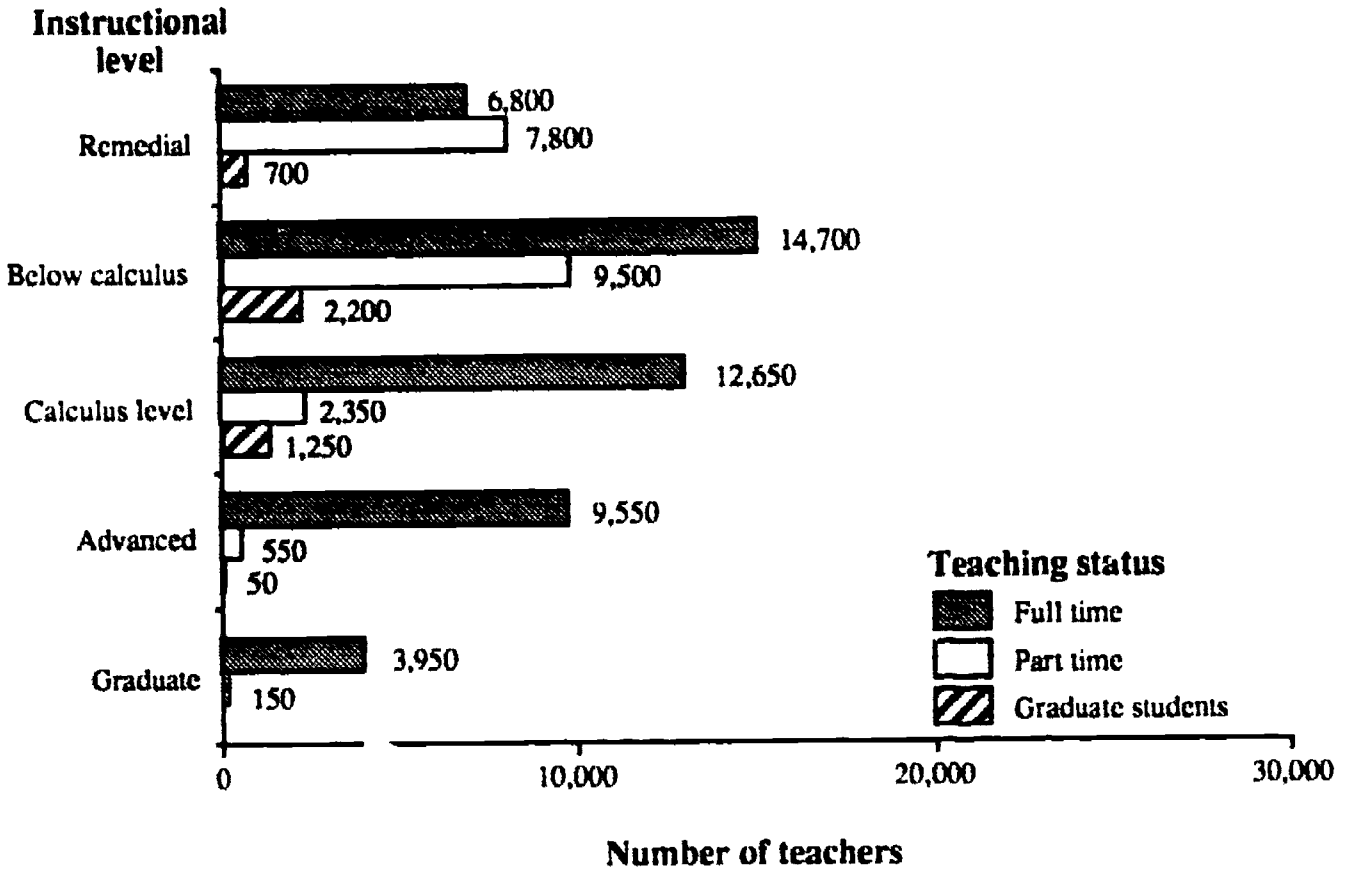
NOTE: Numbers have been rounded to the nearest 50. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

However, faculty teaching assignments varied depending on the type of institution where they taught. Remedial courses were taught by 57 percent of all faculty at two-year institutions, compared with only 7 percent at doctorate-granting institutions (Appendix Table A-12). Advanced courses, in contrast, were taught by 3 percent of faculty at two-year institutions, but by 27 to 42 percent of faculty at other types of institutions. Graduate courses were taught by 25 percent of all faculty (including part-time faculty and graduate students) at doctorate-granting institutions, by 11 percent at specialized institutions, and by 11 percent at comprehensive institutions.

Teaching assignments also depended on faculty members' full-time or part-time status. While there were roughly equal numbers of full-time and part-time faculty teaching remedial courses, the overwhelming majority of faculty teaching at the calculus level or higher were full time (Figure 2). Graduate students were listed separately from full-time and part-time teachers when they taught at the same institution in which they were enrolled. Of course, by this definition, graduate students could not form a large part of mathematics and statistics teachers at most institutions, since many schools do not have graduate students. At doctorate-granting

Figure 2. The number of mathematics and statistics teachers in fall 1988 by instructional level and teaching status: United States



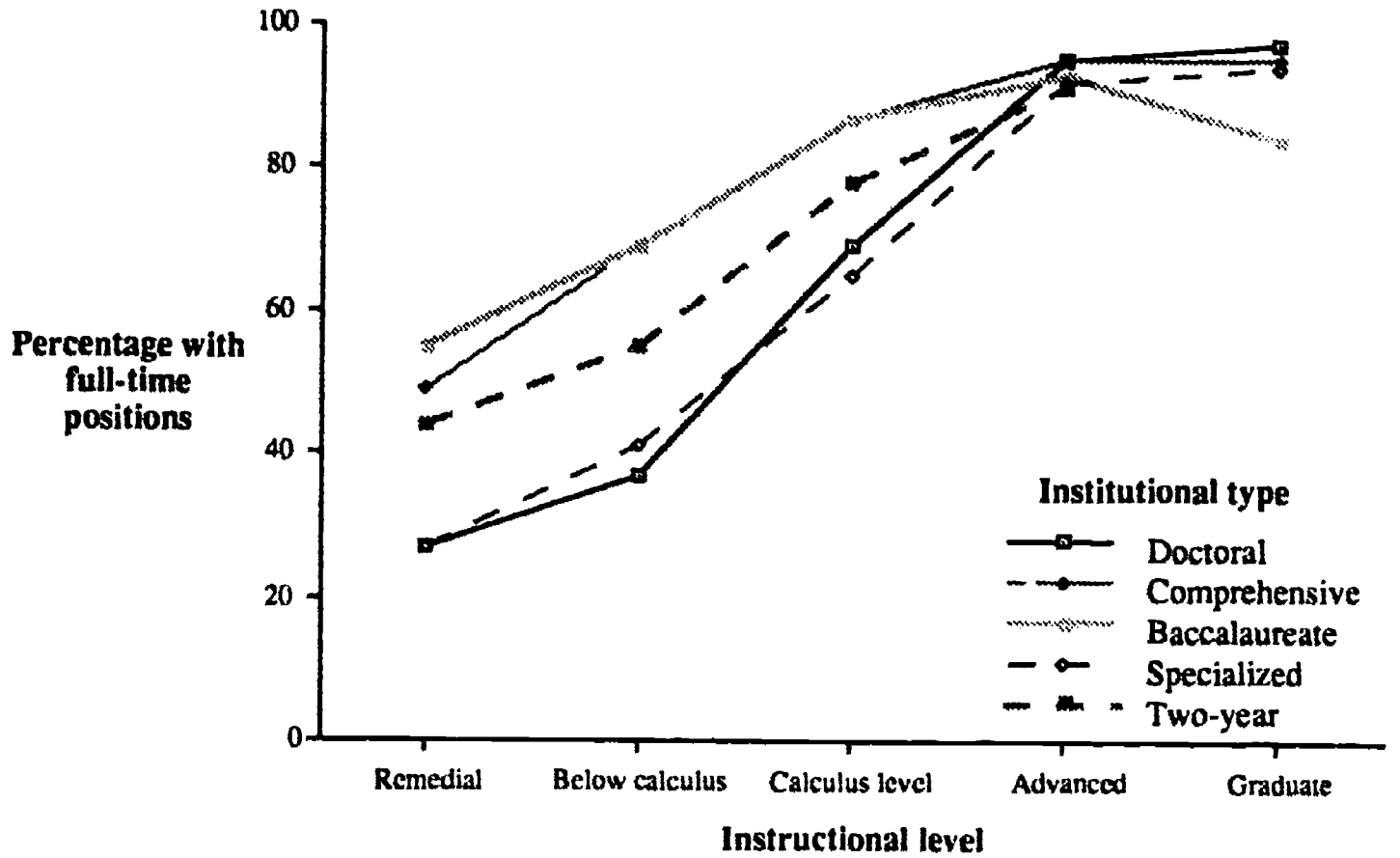
NOTE: Teachers are counted once for each instructional level at which they taught. A teacher is included if he/she taught at least one mathematics/statistics course in fall 1988.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

institutions, half of the instructors of remedial courses and two-fifths of the instructors of below calculus courses were graduate students.

Figure 3 displays full-time teachers by both the type of institution in which they teach and the instructional level of courses they teach. Within each institutional type, the percentage of faculty that were full time generally increased as the course level advanced. Yet institutional type also was important: comprehensive and baccalaureate institutions tended to have a greater percentage of full-time faculty than specialized or two-year institutions.

Figure 3.-- Percentage of mathematics and statistics teachers with full-time positions in fall 1988 by level of instruction and institutional type: United States



NOTE: Teachers are counted once for each instructional level at which they taught. A teacher is included if he/she taught at least one mathematics/statistics course in fall 1988.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Academic Degrees and Employment Status of Faculty

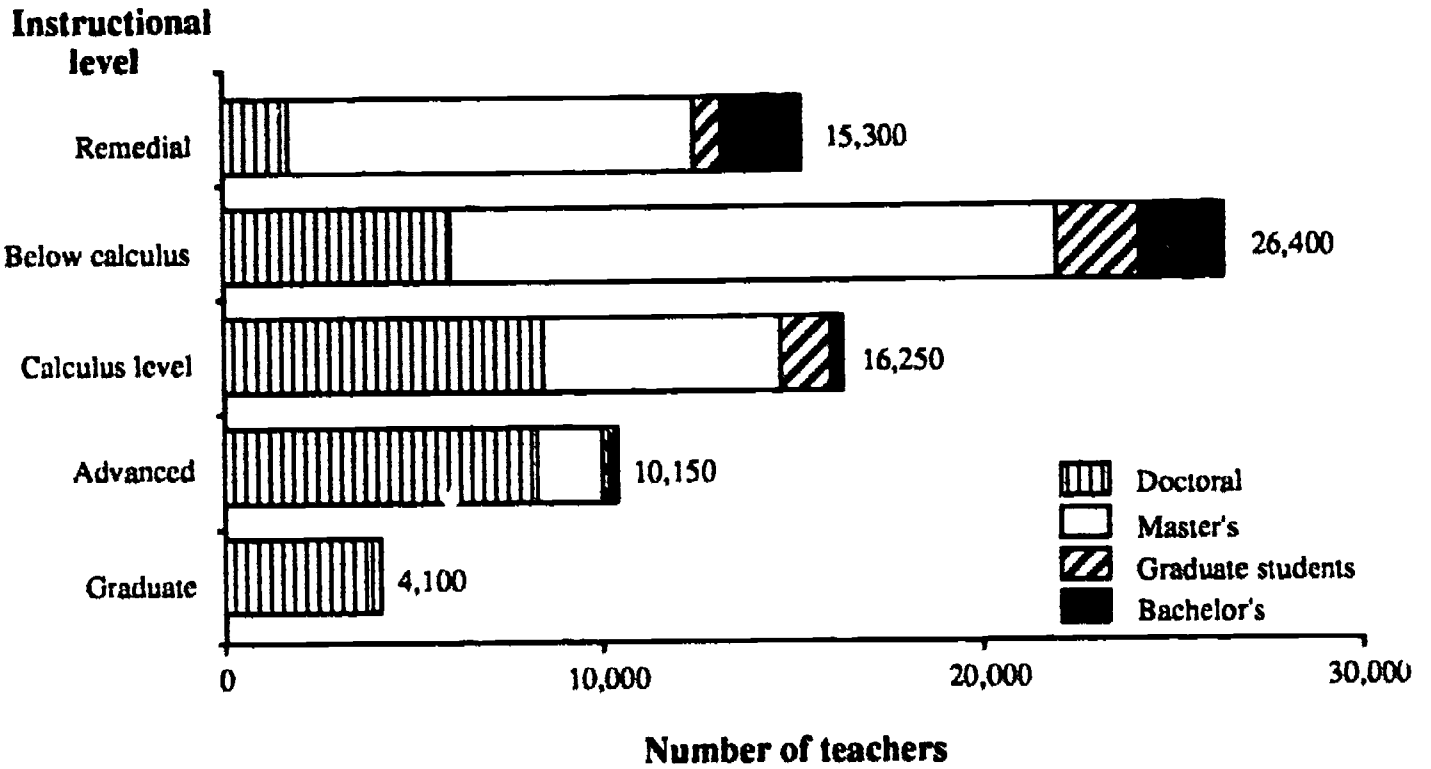
Departmental representatives were asked to provide information on the number of teachers who taught mathematical/statistical science classes in fall 1988. This included the number of teachers by their employment status (i.e., full time and part time) and their highest degree. Additional detail was requested by having departmental representatives provide this information by the instructional level (remedial, below calculus, calculus level, advanced, graduate) of the class taught. (See questionnaire item 3b, Appendix C, for exact wording.) These findings are summarized below.

The academic background of mathematics and statistics faculty varied depending on the instructional level taught. At the remedial level, teachers most commonly had a master's degree as their highest degree (10,700 of

full- and part-time teachers, or 70 percent; Figure 4 and Appendix Table A-13).[10] Roughly equal numbers had bachelor's degrees (2,200) and doctoral degrees (1,700). Teachers for nonremedial courses below the level of calculus also typically had master's degrees (16,050, or 61 percent), though teachers with doctoral degrees were considerably more common here than at the remedial level (5,950, or 22 percent). At the calculus level, teachers with doctoral degrees formed a majority (8,400, or 52 percent), and for even more advanced levels, those with doctoral degrees formed an overwhelming majority (8,250 of 10,150, or 82 percent, at the advanced level and 3,950 of 4,100, or 97 percent, at the graduate level).

The patterns for full-time and part-time teachers were similar to those found overall (Appendix Table A-11). However, part-time teachers rarely had doctoral degrees. At the advanced level essentially equal numbers of

Figure 4. The number of mathematics and statistics teachers at each instructional level in fall 1988 by highest degree of the teachers: United States



NOTE: Teachers are counted once for each instructional level at which they taught. A teacher is included if he/she taught at least one mathematics/statistics course in fall 1988. The highest degrees of graduate students teaching at their own institution are not known.

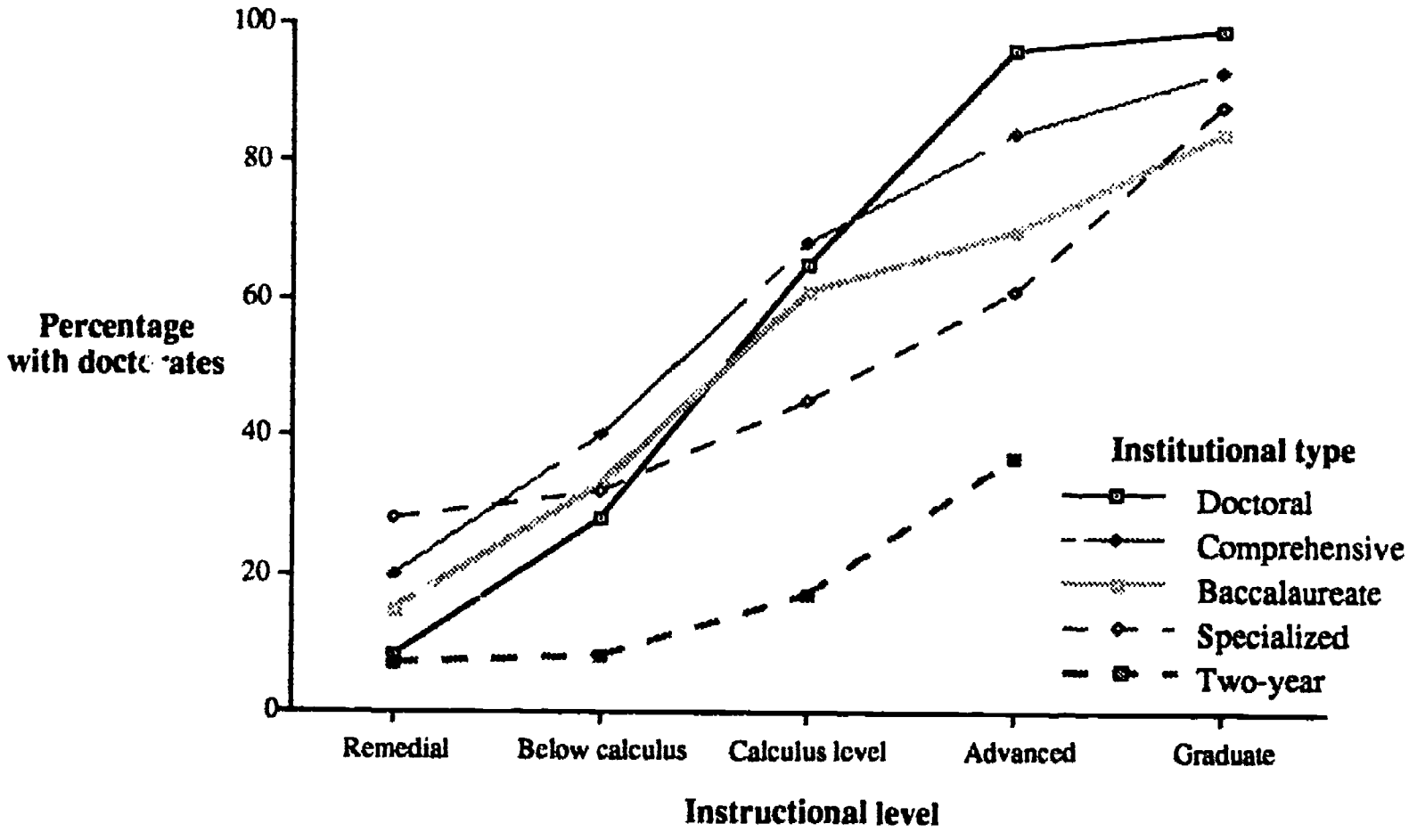
SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

[10] Some additional number of graduate students who were teachers may have had master's degrees. No information was collected on the highest degree of graduate students.

part-time teachers had master's degrees as those who had doctorates, while at the remedial level, relatively few had doctorates. Full-time teachers were much more likely than part-time teachers to have doctorates at every instructional level, though those with doctorates formed a majority only at the calculus level or higher.

Finally, the percentage of faculty holding doctoral degrees, the institutional type, and the instructional level taught were examined together to determine the relationships (Figure 5). Though not all of the individual differences were statistically significant, the general pattern was that, within each institutional type, faculty were more likely to have doctorates at the higher instructional levels. Also, within each instructional level faculty generally were more likely to have doctorates at comprehensive and baccalaureate institutions than at specialized or two-year institutions.

Figure 5.-- Percentage of mathematics and statistics teachers in fall 1988 with doctorates by level of instruction and institutional type: United States



NOTE: Teachers are counted once for each instructional level at which they taught. A teacher is included if he/she taught at least one mathematics/statistics course in fall 1988. The highest degrees of graduate students teaching at their own institution are not known.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Recruitment of Mathematics and Statistics Faculty

To determine whether mathematics and statistics departments have difficulties in recruiting qualified faculty, departmental representatives were asked to give the total number of full-time mathematics and statistics positions that they had attempted to fill, and the suitability and employment status of those hired. Many departments did not attempt to fill any positions in any given year, so departmental representatives were asked to provide their answers for a five-year period (1984-85 through 1988-89). Departments were also asked to evaluate how their ability to recruit suitable faculty members had changed over the last two years. Suitability was measured by having departmental representatives give the number of positions filled by persons who met the advertised qualifications.

Number of Positions Filled

Over the period 1984-85 through 1988-89, 2,150 departments at higher education institutions have attempted to fill a total of 9,600 full-time positions in mathematics and statistics, with the primary emphasis on positions in mathematics (8,200 positions; Appendix Table A-14). They were successful in filling the great majority of these positions with people meeting the advertised qualifications (76 percent with full-time faculty, and 7 percent with part-time faculty), leaving 17 percent of the positions unfilled or filled by persons not meeting the advertised qualifications (Figure 6).[11] Specifically 10 percent were filled by persons that did not have the advertised qualifications, and 7 percent were not filled.

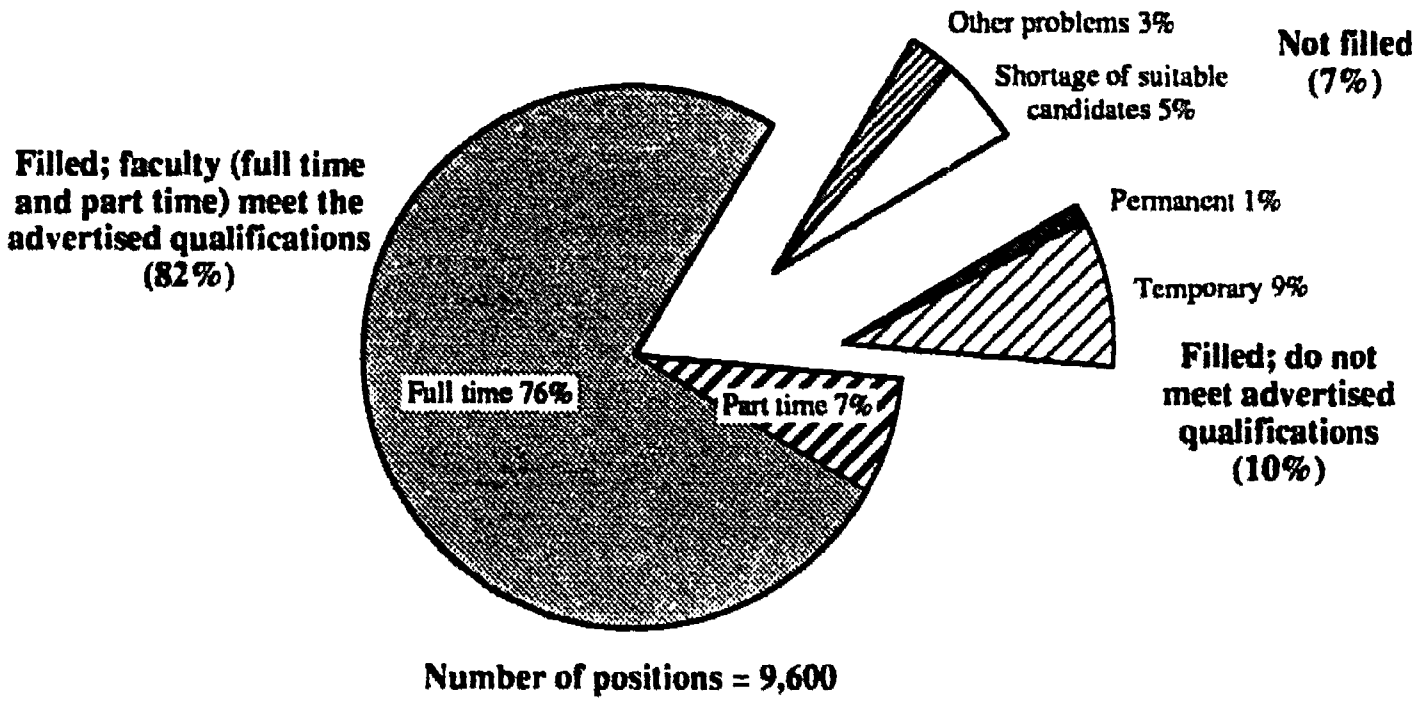
Of that 10 percent filled with persons not meeting the advertised qualifications, 9 percent or 900 positions were filled through temporary appointments and 1 percent or 100 through permanent appointments (Appendix Table A-15a). The remaining 7 percent or 700 positions were left unfilled for at least one year either because of a shortage of suitable candidates (450 positions), or other reasons such as too little time to recruit a second candidate after the first offer of a position was refused or constraints in hiring (250 positions). A total 300 positions were unfilled for two consecutive years.

The greatest difficulty in hiring was experienced by doctorate-granting institutions, which were able to fill only 70 percent of their positions with full-time personnel and 4 percent with part-time personnel meeting the advertised qualifications (Appendix Table A-15b). Two-year institutions, in contrast, were able to fill a greater proportion of their positions (81 percent with full-time and 15 percent with part-time personnel) with persons meeting the advertised qualifications. These differences may reflect the fact that two-year institutions teach relatively few advanced courses, and have relatively few teachers with doctoral degrees, and may suggest that the primary difficulty in hiring is obtaining faculty with advanced degrees.

Small institutions had only 1,100 of the total 9,600 full-time positions to fill. They were less successful than large institutions in filling their positions with full-time faculty meeting the advertised qualifications (61 percent, compared with 77 percent), and tended instead to fill the positions with

[11] This may overstate departments' success in filling positions. If departments anticipated difficulty in hiring, the advertised level of qualifications may have been lower than what they might ideally have sought.

Figure 6. Faculty vacancies at mathematics and statistics departments over the period 1984-85 through 1988-89: United States



NOTE: Because of rounding, percentages may not add to 100. Some double counting of positions occurred because if a position was left unfilled for more than one year, it was counted once for each year in which the department sought to fill the position. A total of 2,150 departments attempted to fill the 9,600 positions.

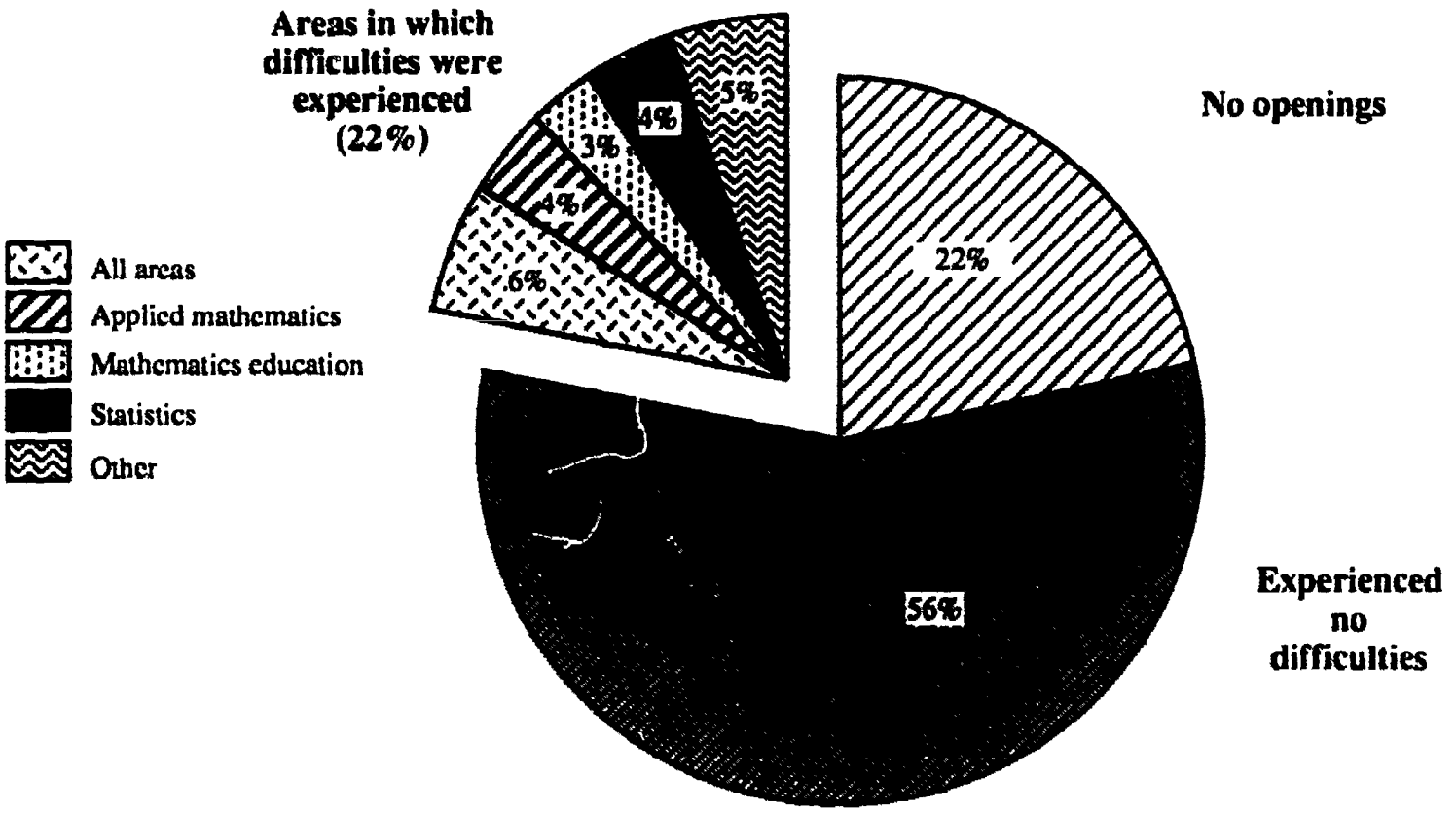
SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

part-time faculty meeting the advertised qualifications (31 percent, compared with 3 percent at large institutions). Large institutions were more likely than small institutions to make temporary appointments if they could not find sufficient people meeting the advertised qualifications (11 percent, compared with 2 percent).

To determine in which subdisciplines departments were having problems recruiting faculty, departmental respondents were asked "In what areas are you seeking faculty members and having the most difficulty in recruiting suitable candidates? Write 'none' if you are not currently experiencing difficulties in recruiting suitable candidates" (Figure 7). Most said their departments had not experienced problems, either because they had not tried to fill any openings over the specified five-year period (22 percent), or because no area provided any difficulty (57 percent). Representatives from the remaining departments experiencing difficulties gave a wide range of responses, with every subdiscipline being mentioned by at least some departments, and 6 percent of departments responding that they had difficulties in all areas.[12]

[12]Responses were coded into the 11 classifications used by the American Mathematical Society in its annual employment survey (algebra and number theory, analysis and functional analysis, geometry and topology, logic, probability, statistics, applied mathematics, computer science, operations research, discrete mathematics, and other), plus three additional classifications (all areas, no areas, and mathematics education) that were frequently mentioned. In some cases, departments specified more than one area of difficulty in recruiting faculty; when this occurred, coding was based on the area mentioned first.

Figure 7. Departmental representatives' assessment of the difficulties experienced by their mathematics and statistics departments in recruiting: United States



NOTE: Categories included within "other" are algebra and number theory, analysis and fractional analysis, geometry and topology, logic, probability, computer science, operations research, and discrete mathematics.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Changes in Ability to Recruit Faculty Members

Two-thirds of the mathematics and statistics departmental representatives stated there had been no change in their department's ability to recruit suitable faculty members over the last two years, while 26 percent said recruiting is now more difficult and 9 percent said it is now less difficult (Appendix Table A-16).

Departmental representatives from departments at doctorate-granting institutions (48 percent) and comprehensive institutions (37 percent) were the most likely to say recruiting had become more difficult, while those at departments at specialized institutions were the least likely (7 percent). Increased difficulties in recruiting were also more likely to be reported by representatives at large institutions (35 percent) than those at small institutions (13 percent).

Representatives from departments that have tried to fill a number of openings may be in a better position to judge the employment market than other departments, simply through having additional experience.[13] By this measure, the likelihood that hiring qualified faculty has become more difficult is strengthened. Of the representatives from those departments trying to fill three or more positions, 35 percent perceived increased difficulty in hiring, compared with only 9 percent of those from departments not seeking to fill any positions.

Faculty Research and Teaching

Departmental representatives were asked to state whether research and publication or teaching performance was more important in evaluating faculty for advancement or salary decisions, and to describe the number of faculty involved in research and their perception of the department's satisfaction with its faculty teaching performance.

Relative Priorities Given to Research and Teaching

Representatives at four-fifths of all mathematics departments felt teaching performance was more important than research for evaluating full-time faculty in their institution--teaching was *much* more important for 68 percent and *somewhat* more important for 11 percent (Appendix Table A-17a). Only 12 percent said that research was somewhat or much more important than teaching at their institution.

Only at doctorate-granting institutions did a majority of departmental representatives indicate that research was more important than teaching at their institution, with 43 percent saying that it was much more important and 36 percent saying it was somewhat more important. Only 3 percent of representatives at doctorate-granting institutions said that teaching was more important than research at their institution.

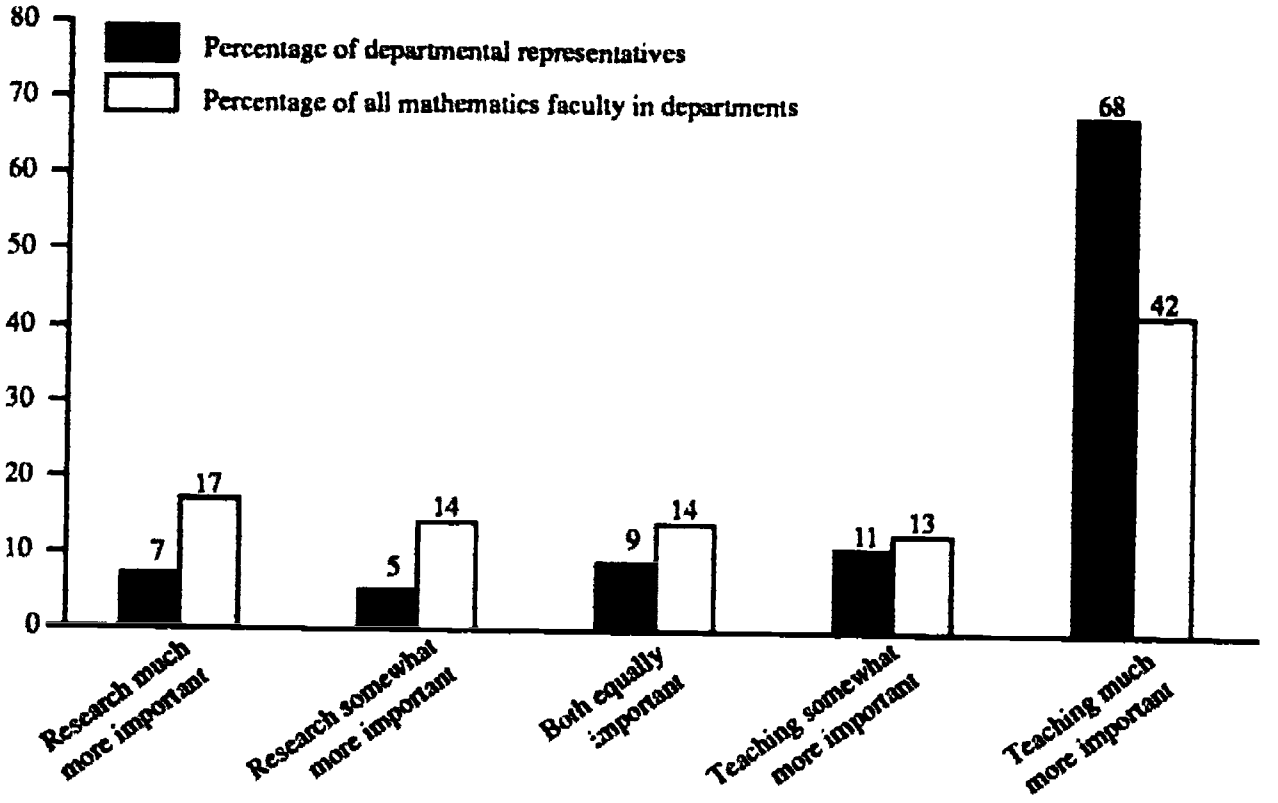
Though relatively few departmental representatives emphasized research over teaching, their departments tended to be large. For example, the departmental representatives most likely to say their institution emphasized research were in departments at doctorate-granting institutions, which had roughly one-fourth of all faculty and students in mathematics. As a result, though most faculty and students were at departments where representatives felt their institution considered teaching to be more important, substantial numbers of students and faculty were at departments where research was more important. Of all full-time faculty in mathematics and statistics departments, 17 percent were at departments where departmental representatives felt their institution viewed research to be much more important than teaching, and an additional 14 percent at departments where research was seen as somewhat more important (Figure 8). Similarly, 14 percent of all students in fall 1988 were in departments where departmental representatives said that at their institution research was much more important than teaching for

[13] However, a position was counted once for each year in which a department tried to fill it, so that departments that were unsuccessful in filling positions are likely to be in the group of departments with the greatest number of openings. Still, while this group may overrepresent departments that experienced difficulties in hiring, that does not necessarily imply that they will have perceived an *increase* in the difficulty of hiring.

evaluating full-time faculty, and an additional 14 percent were at departments where research was somewhat more important.

Departmental representatives consistently indicated that their institution emphasized teaching over research in the case of part-time faculty: 92 percent considered teaching to be much more important than research (Appendix Table A-17b). Except for representatives of departments at doctorate-granting institutions, the percentage rating teaching as much more important was 86 percent or higher for every category of institution. Even at doctorate-granting institutions, only 14 percent of the departmental representatives considered research as more important than teaching for part-time faculty.

Figure 8. Departmental representatives' assessment of the relative importance of research versus teaching in evaluating full-time faculty at their institution and the percentage of all mathematics faculty in the departments: United States



NOTE: Teachers are counted once for each instructional level at which they taught. A teacher is included if he/she taught at least one mathematics/statistics course in fall 1988. The highest degrees of graduate students teaching at their own institution are not known.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Faculty Research Efforts

Departmental representatives were asked to describe the involvement of their department's full-time faculty in research/publication and education research/publication. For each area, they were asked to state the number actively involved, the number that applied for Federal support, and the number that received Federal support.

Of 24,450 full-time faculty in the mathematical and statistical sciences, 9,150 (38 percent) were actively involved in research and publication (Appendix Table A-18a). Research involvement was greatest at doctorate-granting institutions (77 percent), and least at two-year institutions (4 percent).

Of those involved in research and publication, 3,400 (37 percent) applied for Federal support in 1987, and of those applying, 2,100 (61 percent) received it.[14] Among active researchers, applications for Federal support were more common at doctorate-granting institutions (where 49 percent applied) than at two-year institutions (8 percent), and at large institutions (40 percent) compared with small institutions (27 percent).

Research and publication was less common in mathematics and statistics education, involving 2,750 (11 percent) of the full-time faculty (Appendix Table A-18b). Variations in the proportion of all full-time faculty at each type of institution were relatively small, ranging from 8 percent at two-year institutions to 14 percent at comprehensive institutions, a difference that was nevertheless statistically significant.

Responses showed that 550 (20 percent) of mathematics education researchers applied for Federal support in 1987, and 49 percent of them received Federal support. Applications for support were more common at doctorate-granting institutions (28 percent of those actively involved in education research/publication) than at two-year institutions (11 percent).

Satisfaction with Teaching

Departmental representatives were asked to rate their satisfaction with both their department's quality of teaching and student outcomes from the teaching, on a scale from 1 (not at all satisfied) to 10 (very satisfied). They were asked to do this rating for each of the instructional levels.

Departmental representatives' evaluations were generally positive, with mean ratings of 6.2 or higher (Appendix Tables A-19a and A-19b). For each instructional level, departmental representatives were more satisfied with the quality of teaching than with student outcomes, with the mean rating for quality of teaching ranging from 7.5 to 8.6, while the mean rating for student outcomes ranged from 6.2 to 8.0. They were also more satisfied with teaching in advanced and graduate courses (8.5 to 8.6 for quality of teaching, and 7.7 to 8.0 for student outcomes) than in remedial courses (7.5 and 6.2, respectively).

[14] Strictly speaking, some of those applying for Federal support may not have been active in research if they failed to receive the support, and it was their only means of financing the research.

The differences among the evaluations of departmental representatives at different institutions were generally small and statistically insignificant. Even some of the largest differences (e.g., between representatives at small schools and those at large schools at the graduate level) were not statistically significant.

Problems in Mathematics and Statistics Departments

Departmental representatives were given a list of 21 potential problems and ask to indicate which they experienced. From those they checked, they were asked to rank the five greatest problems.

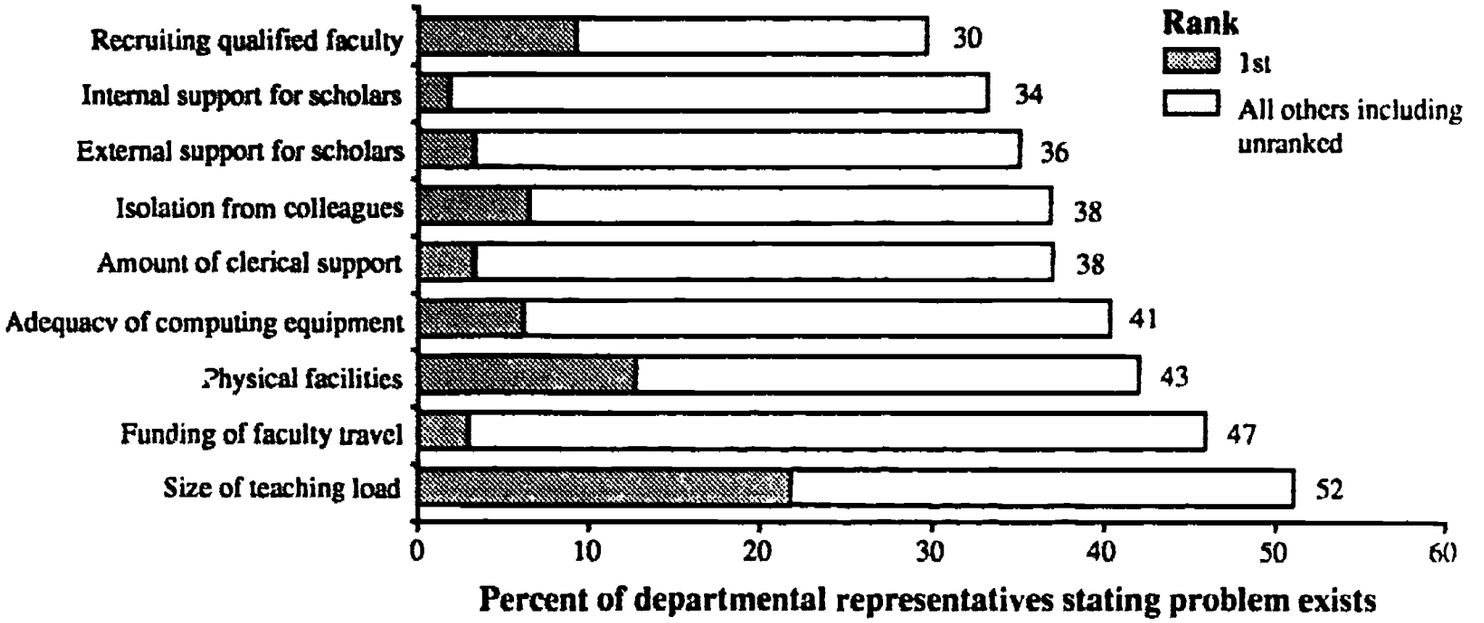
The problems checked most frequently were teaching load (52 percent), funding of faculty travel (47 percent), physical facilities (43 percent), and adequate computing equipment (41 percent; Appendix Table A-20). The problems ranked as the most important were teaching load (43 percent of those citing it as a problem), recruiting and retention of qualified faculty (31 percent), and physical facilities (30 percent).[15] In some cases, departmental representatives' rankings of the problems produced considerably different results than measures of the frequency of the problems. For example, the funding of faculty travel was one of the most frequently cited problems, yet few representatives ranked it as the most important. On the other hand, recruiting qualified faculty was less often mentioned as a problem, but a much higher percentage of representatives ranked it as the greatest problem; in fact, the differences in percentages was sufficiently large that a greater total *number* ranked it as the greatest problem as well (Figure 9).

To a large degree, the list of problems provided in the questionnaire centered on problems related to research (and to graduate students), since other portions of the questionnaire collected information on teaching. Thus, the problems should not be expected to be equally applicable to all institutions. Consequently, there was considerable variation among institutions. While the average number of problems checked per departmental representative was 5.0, the mean number of problems ranged from 3.5 problems per representative at two-year institutions to 9.0 problems at doctorate-granting institutions (Figure 10). The greatest differences between the responses of departmental representatives at doctorate-granting and those at two-year institutions concerned faculty and graduate students (the second of which applies only to doctorate-granting institutions), yet significant differences also existed in responses relating to institutional support and faculty resources. Another difference among institutions was that departmental representatives at large institutions cited more problems (6.8) than those at small institutions (3.6); again, this was true for each of the three categories of problem areas.

While departmental representatives at doctorate-granting institutions cited the greatest number of problems, there was actually great variation among institutions depending on the individual problem being mentioned. Perhaps the most consistent result was that representatives at specialized institutions were typically the least likely to mention any particular

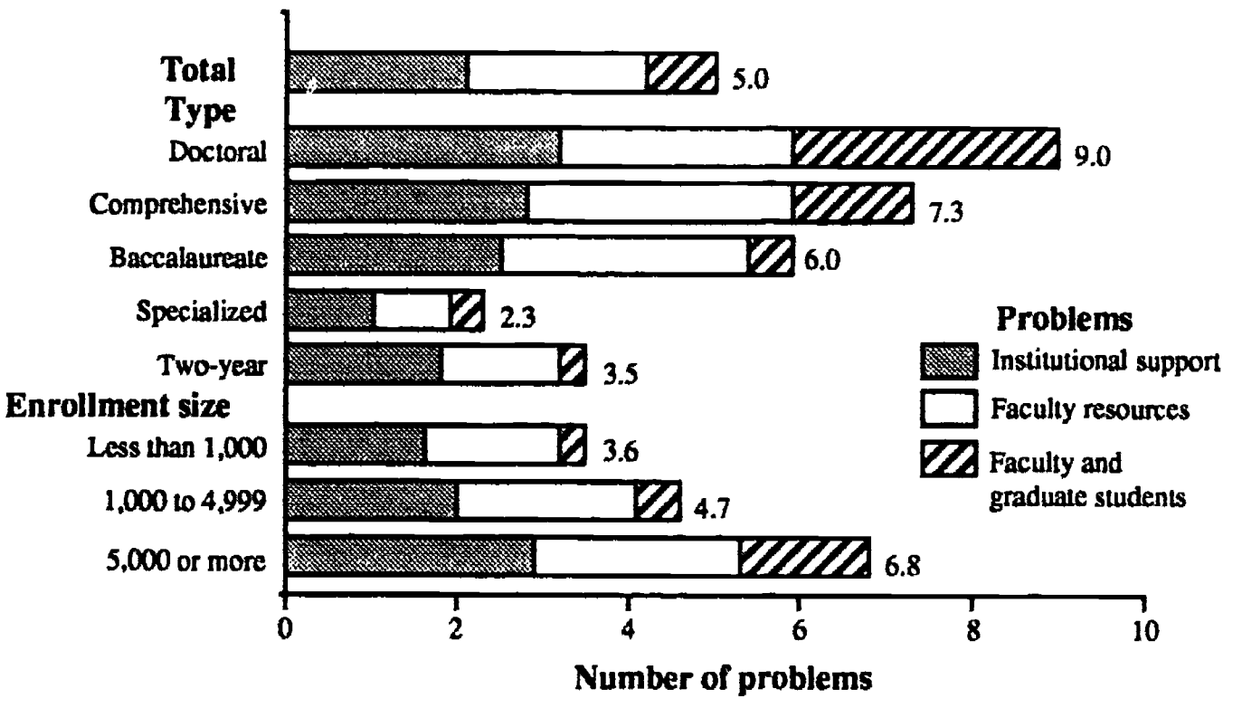
[15] Percentages do not add to 100 because each percentage is computed from a different base.

Figure 9. Ranking of the nine problems reported most often by representatives of mathematics and statistics departments: United States



SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Figure 10. Mean number of problems checked by mathematics and statistics departmental representatives by type of problem and institutional characteristic: United States



SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

problem. For example, the funding of faculty travel was mentioned by most representatives at comprehensive (62 percent) and baccalaureate institutions (59 percent), but by only 13 percent of departmental representatives at specialized institutions (Appendix Table A-21). Departmental representatives at doctorate-granting institutions were likely to cite problems concerning physical facilities (77 percent) and external support for scholars (70 percent), in contrast with those at specialized institutions (8 and 19 percent, respectively). The most frequently cited problem--teaching load--was noted more often by departmental representatives at comprehensive (68 percent) and baccalaureate institutions (65 percent) than those at doctorate-granting institutions (43 percent). One of the problems spread most uniformly across institutions was the amount of clerical support. Responses were similar--35 percent by most representatives at two-year institutions cited this as a problem, as did 41 percent at comprehensive and baccalaureate institutions.

Departmental representatives at large institutions typically were more likely to mention problems than those at small institutions, including differences concerning physical facilities (64 percent versus 31 percent).

Differences Among Institutional Types

The introduction of this report noted that institutional type (i.e., doctorate-granting, comprehensive, baccalaureate, specialized, and two-year) is important in determining the nature of mathematics and statistics departments at any particular institution. This section provides a brief summary of the major differences, presented earlier, between departments at different types of institutions.

Departments differed considerably in the types of programs offered. Many (850) departments did not offer degrees in mathematics or statistics; these departments were typically at two-year institutions, and often had a broader focus than mathematics and statistics alone. Together with other departments providing degrees no higher than associate's degrees in mathematics, these departments had 41 percent of the faculty and 42 percent of the mathematics students in fall 1988. Their primary focus was on teaching rather than research. Teaching tended to be concentrated on classes at the remedial and below calculus levels.

Departments offering doctoral degrees in mathematics were fewer in number (200 departments), but larger in average size, accounting for 25 percent of all teachers and students. Departmental representatives at doctorate-granting institutions (a group roughly, but not exactly, equivalent to those offering doctoral degrees) were the only category (of respondents) for which a majority said that research was more important than teaching when evaluating faculty at their institution. In fact, 78 percent of all full-time faculty in these departments were actively involved in research and publication, and these researchers accounted for 57 percent of all full-time faculty actively involved in research in mathematics. These departments also faced different problems than other departments. Departmental representatives cited a greater total number of problems faced, and were more likely to cite problems with physical facilities, the amount of external

support for faculty scholarly activity, and difficulties in recruiting qualified faculty. Also, while two-thirds of all departmental representatives said there had been no change in their ability to recruit suitable faculty members over the last two years, 48 percent of the departmental representatives at doctorate-granting institutions said recruiting had become more difficult. Though they represented departments with a greater proportion of teachers and students in advanced or graduate courses than other representatives, a substantial portion of the teaching effort was still devoted to the calculus level or below.

Appendix A

Detailed Tables

DETAILED TABLES

Table A-1. Number and percentage of departments offering, the number of teachers who taught, and the number of students enrolled in mathematics/statistics courses in fall 1988 by highest degree offered in mathematics/statistics: United States

Characteristic	Total	Highest degree offered in mathematics/statistics[1]				Other degrees only[2]	No degrees[2]
		Doctoral	Master's	Bachelor's	Associate's		
Departments[3]							
Number	2,750	200	200	900	550	350	500
Percent	100	8	8	32	21	13	18
Teachers[4]							
Number	45,000	11,450	6,150	8,900	10,050	3,700	4,750
Percent	100	25	14	20	22	8	11
Students[5]							
Number	2,977,350	740,500	442,650	552,500	723,100	229,000	289,600
Percent	100	25	15	19	24	8	10

[1]The classification of the highest degree offered is based upon the highest degree offered by a mathematics/statistics department, not by the institution as a whole.

[2]These departments were the primary locations for teaching mathematics/statistics at their institutions, but either offered no degrees or only degrees other than in mathematics/statistics.

[3]Some institutions have more than one department in mathematics/statistics. Each department is counted individually.

[4]The total number of faculty is unduplicated, but percentages were calculated by counting faculty members once for each class level taught. Figures represent the number who taught at least one mathematics/statistics course in fall 1988.

[5]The number of students is estimated by multiplying the number of sections offered and the mean section size. Students are counted once for each section taken to give this estimation of the number of students who were enrolled in mathematics/statistics courses in fall 1988.

NOTE: The numbers of departments, teachers, and students have been rounded to the nearest 50. Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-2. Percentage of mathematics and statistics departments by institutional type and highest degree offered in mathematics/statistics: United States

Characteristic	Total	Highest degree offered in mathematics/statistics[1]				Other degrees only[2]	No degrees[2]
		Doctoral	Master's	Bachelor's	Associate's		
Number of departments[3]	2,750	200	200	900	550	350	500
Percentage in each institutional type							
Total	100	100	100	100	100	100	100
Doctoral	9	87	13	1	0	3	–
Comprehensive	15	8	74	25	0	2	1
Baccalaureate	25	0	6	65	0	9	12
Specialized	8	5	2	6	–	13	19
Two-year	44	0	5	3	100	74	67

– = Rounds to zero.

[1]The classification of the highest degree offered is based upon the highest degree offered by a mathematics/statistics department, not by the institution as a whole.

[2]These departments were the primary locations for teaching mathematics/statistics at their institutions, but either offered no degrees or only degrees other than in mathematics/statistics.

[3]Some institutions have more than one department in mathematics/statistics. Each department is counted individually.

NOTE: The numbers of departments have been rounded to the nearest 50. Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-3. Percentage of faculty and students in fall 1988 by level of instruction and highest degree offered by departments in mathematics and statistics: United States

Characteristic	Highest degree offered in mathematics/statistics[1]				Other degrees only[2]	No degrees[2]
	Doctoral	Master's	Bachelor's	Associate's		
Faculty[3]						
Number of teachers	11,550	6,100	8,900	10,050	3,700	4,750
Percentage (duplicated)						
Remedial	7	21	31	60	57	47
Below calculus	39	55	64	69	74	66
Calculus	45	36	47	27	24	23
Advanced	32	33	41	2	9	5
Graduate	26	15	1	0	2	0
Students[4]						
Number of students	740,050	442,650	552,500	723,100	229,000	289,600
Percentage (total)	100	100	100	100	100	100
Remedial	7	16	16	37	38	25
Below calculus	37	47	48	52	49	65
Calculus	38	23	24	11	10	8
Advanced	13	12	12	1	2	1
Graduate	4	2	--	0	1	0

-- = Rounds to zero.

[1]Classification is based upon the highest degree offered by a mathematics/statistics department, not by the institution as a whole.

[2]These departments were the primary locations for teaching mathematics/statistics at their institutions, but either offered no degrees or only offered degrees other than in mathematics/statistics.

[3]Total number of faculty is unduplicated, but percentages were calculated by counting faculty members once for each class level taught. Therefore, percentages add to more than 100. These figures represent faculty who taught at least one mathematics/statistics course in fall 1988.

[4]Number of students is estimated by multiplying the number of sections offered and mean section size. Students are counted once for each section taken to give this estimation of the number of students who were enrolled in mathematics/statistics courses in fall 1988. Percentages may not add to 100 because of rounding.

NOTE: Students are counted once for each section taken. The numbers of departments, teachers, and students have been rounded to the nearest 50.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-4. Number and percentage of institutions and departments by type of degree offered and highest degree offered within each field: United States

Degree offered	Mathematics	Statistics	Computer science[1]	Other[1]	Joint degrees	
					Mathematics/ statistics	Mathematics/ computer science
Number of institutions offering degree[2]	1,700	200	800	400	150	450
Percentage (total)	100	100	100	100	100	100
Associate's	30	6	39	58	31	16
Bachelor's	50	17	53	28	43	78
Master's	11	37	6	9	18	4
Doctoral	10	39	2	5	8	1
Number of departments offering degree	1,800	200	800	400	200	500
Percentage (total)	100	100	100	100	100	100
Associate's	31	6	39	57	30	18
Bachelor's	49	16	52	28	44	76
Master's	11	40	6	10	18	4
Doctoral	10	38	2	6	8	1

[1]Departments were sampled only if they were labeled as mathematics or statistics departments, or if they were the primary location for teaching mathematics or statistics. Independent computer science departments and other independent departments such as psychology, sociology, economics, and education are not included in these estimates.

[2]If more than one department at an institution offered degrees in mathematics/statistics, only the department offering the highest degree in the specified discipline is counted here.

NOTE: Estimates on the numbers of departments and institutions have been rounded to the nearest 50. Departments or institutions that offered a degree in more than one discipline are counted in each column that applies. Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-5. Number and percentage of departments offering mathematical/statistical science degrees by type of degree: United States

Field	Degrees offered by Department[1,2]							
	Associate's degree		Bachelor's degree		Master's degree		Doctoral degree	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Mathematics	600	21	1,200	44	350	13	200	6
Statistics	--	1	100	4	150	6	100	3
Computer science	350	13	500	18	50	2	--	1
Other	250	10	150	5	50	2	--	1
Joint degrees								
Mathematics/statistics	50	2	100	4	50	2	--	1
Mathematics/computer science	100	3	400	14	--	1	--	--

-- = Rounds to zero.

[1]Includes all departments with mathematics or statistics in their title, as well as the single department with the primary responsibility for teaching mathematics/statistics if no mathematics or statistics department exists.

[2]Percentages are based upon the estimate of 2,750 departments offering instruction in mathematics/statistics. It is not meaningful to add percentages because some departments offer more than one degree.

NOTE: Numbers are rounded to the nearest 50.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-6a. The number and percentage of teachers who taught mathematical/statistical science classes in fall 1988 by degree offered (through department) and by institutional characteristic: United States

Institutional characteristic	Teachers				
	Number	Degree offered (percent)			
		Mathematics only	Statistics only	Both mathematics and statistics*	Neither mathematics nor statistics
Total	45,000	55	2	23	20
Type					
Doctoral	11,300	38	6	55	1
Comprehensive	9,300	67	–	32	1
Baccalaureate	5,000	85	0	6	10
Specialized	2,200	54	–	16	30
Two-year	17,200	52	–	4	44
Control					
Private	10,200	67	1	15	17
Public	34,800	52	2	25	20
Enrollment size					
Less than 1,000	2,900	38	0	11	51
1,000 - 4,999	12,100	66	1	3	29
5,000 or more	30,000	52	2	32	13
Region					
Northeast	11,300	57	1	21	21
Central	11,200	47	2	28	22
Southeast	10,500	57	2	15	26
West	12,000	60	2	27	11

– = Less than 1 percent.

*Includes departments offering separate degrees in both mathematics and statistics, and departments offering joint degrees in mathematics and statistics.

NOTE: The numbers of teachers have been rounded to the nearest 100. Details may not add to totals and percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-6b. The number and percentage of students in mathematical/statistical science classes in fall 1988 by degree offered (through department) and by institutional characteristic: United States

Institutional characteristic	Students[1]				
	Number	Degree offered (percent)			
		Mathematics only	Statistics only	Both mathematics and statistics[2]	Neither mathematics nor statistics
Total	2,977,400	55	1	26	18
Type					
Doctoral	735,000	36	5	59	--
Comprehensive	661,500	65	--	34	--
Baccalaureate	282,300	84	0	6	10
Specialized	106,000	58	--	9	32
Two-year	1,192,600	53	--	7	40
Control					
Private	479,600	64	1	20	14
Public	2,497,800	53	1	27	19
Enrollment size					
Less than 1,000	101,800	47	0	14	39
1,000 - 4,999	738,800	64	1	5	30
5,000 or more	2,147,700	52	2	33	13
Region					
Northeast	673,600	50	--	25	24
Central	708,600	49	2	30	19
Southeast	704,800	59	2	17	23
West	890,400	60	2	30	9

-- = Less than 1 percent.

[1]Figures calculated by multipling the number of sections reported and the average section size. Students are counted once for each mathematics/statistics class in which they are enrolled.

[2]Includes departments offering separate degrees in both mathematics and statistics, and departments offering joint degrees in mathematics and statistics.

NOTE: The numbers of students have been rounded to the nearest 100. Details may not add to totals and percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-7. The mean percentage of students taking at least one course in mathematics or statistics from mathematical/statistical science departments, and the mean percentage of departmental teaching time spent on nonmajors by institutional characteristic: United States

Institutional characteristic	Students taking at least one[1] course from department	Teaching time devoted to[2] nonmajors
Total	80	80
Type		
Doctoral	63	67
Comprehensive	84	75
Baccalaureate	82	70
Specialized	95	87
Two-year	79	90
Control		
Private	83	74
Public	78	85
Enrollment size		
Less than 1,000	85	79
1,000 - 4,999	81	80
5,000 or more	75	82
Region		
Northeast	76	77
Central	81	82
Southeast	88	80
West	76	82

[1]Figures are departmental representatives' estimates of the percent of students who take at least one mathematics/statistics course during the course of their enrollment at the institution.

[2]Figures are departmental representatives' responses to questionnaire item 2b "what percentage of your department's teaching time in mathematics/statistics is spent teaching non-majors?"

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-8. The number and percentage of students in mathematical/statistical science classes in fall 1988 and by class level and institutional characteristic: United States

Institutional characteristic	Number of students* (in thousands)	Percentage enrolled at each class level				
		Remedial	Below calculus	Calculus level	Advanced	Graduate
Total	2,977	21	48	22	8	2
Type						
Doctoral	735	6	37	39	13	4
Comprehensive	661	17	49	22	11	2
Baccalaureate	282	16	46	27	12	--
Specialized	106	14	46	19	17	3
Two-year	1,193	35	54	10	1	0
Control						
Private	480	13	41	31	12	2
Public	2,498	23	49	20	7	1
Enrollment size						
Less than 1,000	102	24	49	19	8	--
1,000 - 4,999	739	23	54	17	6	--
5,000 or more	2,137	21	46	23	8	2
Region						
Northeast	674	18	49	22	9	2
Central	709	18	43	29	9	2
Southeast	705	22	56	16	5	1
West	890	27	44	20	8	2

-- = Rounds to zero.

*The number of students is estimated by multiplying the number of sections offered and the mean section size. Students are counted once for each section taken to give this estimation of the number of students who were enrolled in mathematics/statistics courses in fall 1988.

NOTE: The numbers of students have been rounded to the nearest 1,000. Details may not add to totals and percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-9. The number of (courses) sections in mathematical/statistical science in fall 1988 and the mean section size by class level and institutional characteristic: United States

Institutional characteristic	Number of sections					Mean section size				
	Remedial	Below calculus	Calculus level	Advanced	Graduate	Remedial	Below calculus	Calculus level	Advanced	Graduate
Total	22,900	42,300	19,900	11,650	4,100	26	30	24	15	12
Type										
Doctoral	1,150	6,400	5,700	3,900	2,800	54	57	50	24	11
Comprehensive	3,450	8,800	4,900	3,950	1,000	29	34	28	16	10
Baccalaureate	1,800	4,650	3,100	3,400	50	23	26	20	12	7
Specialized	700	1,750	900	950	200	--	--	--	--	--
Two-year	15,800	20,750	5,250	500	NA	24	27	19	15	NA
Control										
Private	2,850	7,100	5,350	4,150	900	21	24	20	12	13
Public	20,050	35,200	14,550	7,500	3,250	28	34	26	19	11
Enrollment size										
Less than 1,000	1,200	2,300	1,050	750	50	19	20	14	10	--
1,000-4,999	7,300	13,450	5,200	3,350	350	23	28	21	12	--
5,000 or more	14,400	26,500	13,650	7,550	3,700	35	40	34	21	12
Region										
Northeast	5,400	8,450	5,750	3,300	1,050	25	32	25	16	14
Central	4,500	10,150	5,250	2,950	1,100	24	28	24	14	10
Southeast	5,700	12,600	4,150	2,300	850	24	27	20	13	10
West	7,300	11,100	4,750	3,100	1,100	30	32	25	17	11

-- = Too few cases for a reliable estimate.

NA = Not applicable.

NOTE: The numbers of sections have been rounded to the nearest 50. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-10a. The percentage of teachers who taught mathematical/statistical science courses in fall 1988 who were full time* by class levels taught and by institutional characteristic: United States

Institutional characteristic	Number of teachers	Class level taught				
		Remedial	Below calculus	Calculus level	Advanced	Graduate
Total	45,000	15	33	28	21	9
Type						
Doctoral	11,300	2	15	31	30	24
Comprehensive	9,300	12	40	33	34	10
Baccalaureate	5,000	18	47	44	39	
Specialized	2,200	9	22	26	25	10
Two-year	17,200	25	38	19	2	0
Control						
Private	10,200	13	32	36	32	8
Public	34,800	16	33	26	18	9
Enrollment size						
Less than 1,000	2,900	23	39	30	22	1
1,000 - 4,999	12,100	20	40	30	21	2
5,000 or more	30,000	12	29	27	21	12
Region						
Northeast	11,300	14	28	29	22	9
Central	11,200	12	31	28	22	9
Southeast	10,500	18	40	28	19	8
West	12,000	17	32	28	21	9

*All percentages are based on the total number of teachers, with full-time teachers, part-time teachers, and graduate students combined. Teachers may teach at more than one class level, but had to have taught at least one mathematics/statistics course in fall 1988.

NOTE: The numbers of teachers have been rounded to the nearest 100. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-10b. The percentage of teachers who taught mathematical/statistical science courses in fall 1988 who were part time* by class levels taught and institutional characteristic: United States

Institutional characteristic	Number of teachers	Class level taught				
		Remedial	Below calculus	Calculus level	Advanced	Graduate
Total	45,000	17	21	5	1	0
Type						
Doctoral	11,300	1	9	3	1	1
Comprehensive	9,300	10	15	4	2	1
Baccalaureate	5,000	14	20	6	3	0
Specialized	2,200	24	32	13	2	1
Two-year	17,200	32	31	5	0	0
Control						
Private	10,200	13	20	8	3	1
Public	34,800	19	22	4	1	0
Enrollment size						
Less than 1,000	2,900	18	25	9	3	0
1,000 - 4,999	12,100	21	25	4	1	0
5,000 or more	30,000	16	19	5	1	0
Region						
Northeast	11,300	20	18	7	1	1
Central	11,200	15	20	4	1	0
Southeast	10,500	14	20	4	1	0
West	12,000	20	26	6	1	0

*All percentages are based on the total number of teachers, with full-time teachers, part-time teachers, and graduate students combined. Teachers may teach at more than one class level, but had to have taught at least one mathematics/statistics course in fall 1988.

NOTE: The numbers of teachers have been rounded to the nearest 100. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-10c. The percentage of teachers who taught mathematical/statistical science teachers in fall 1988 who were graduate students* by class level taught and institutional characteristic: United States

Institutional characteristic	Number of teachers	Class level taught				
		Remedial	Below calculus	Calculus level	Advanced	Graduate
Total	45,000	2	5	3	0	0
Type						
Doctoral	11,300	4	17	11	0	0
Comprehensive	9,300	3	3	1	0	0
Baccalaureate	5,000	1	0	0	0	0
Specialized	2,200	0	1	1	0	0
Two-year	17,200	0	0	0	0	0
Control						
Private	10,200	0	2	2	0	0
Public	34,800	2	6	3	0	0
Enrollment size						
Less than 1,000	2,900	0	0	0	0	0
1,000 - 4,999	12,100	0	0	0	0	0
5,000 or more	30,000	2	7	4	0	0
Region						
Northeast	11,300	1	1	2	0	0
Central	11,200	3	6	5	0	0
Southeast	10,500	1	7	3	0	0
West	12,000	1	5	1	0	0

*All percentages are based on the total number of teachers, with full-time teachers, part-time teachers, and graduate students combined. Teachers may teach at more than one class level, but had to have taught at least one mathematics/statistics course in fall 1988.

NOTE: The numbers of teachers have been rounded to the nearest 100. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-11a. Total number of teachers, sections, and students for mathematical/statistical science classes in fall 1988 by level of instruction: United States

Employment status, highest degree of teacher, and section characteristic	Level of instruction				
	Remedial	Below calculus	Calculus level	Advanced	Graduate
Sum across departments[1]					
Total teachers[2]	15,300	26,400	16,250	10,150	4,100
Full time, total[3]	6,800	14,700	12,650	9,550	3,950
Doctoral	1,350	5,200	7,950	8,000	3,850
Master's	4,850	8,700	4,550	1,450	100
Bachelor's	600	800	200	50	--
Part time, total	7,800	9,500	2,350	550	150
Doctoral	350	750	450	250	100
Master's	5,850	7,350	1,750	300	50
Bachelor's	1,600	1,400	100	--	0
Graduate students	700	2,200	1,250	50	--
Sections					
Total number	22,900	42,300	19,900	11,650	4,100
Total students	635,650	1,423,000	642,200	230,250	46,650

-- = Rounds to zero.

[1]Sums have been rounded to the nearest 50.

[2]Figures reflect teachers who taught at least one mathematics/statistics course in fall 1988.

[3]Teachers were counted as full time if they had full-time teaching/research/administrative positions in fall 1988.

NOTE: Teachers are counted once for each instructional level at which they taught, so the estimates in one column may not be added to those in another without encountering duplication. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-11b. Mean number of teachers, sections, and students for mathematical/statistical science classes in fall 1988 by level of instruction: United States

Employment status, highest degree of teacher, and section characteristic	Level of instruction				
	Remedial	Below calculus	Calculus level	Advanced	Graduate
Mean per department[1]					
Total teachers[2]	7.1	9.2	6.1	6.4	8.8
Full time, total[3]	3.3	5.6	5.2	6.0	8.5
Doctoral	0.7	2.0	3.3	9.1	8.3
Master's	2.4	3.3	1.9	0.9	0.2
Bachelor's	0.3	0.3	0.1	--	--
Part time, total	3.8	3.7	1.0	0.3	0.3
Doctoral	0.2	0.3	0.2	0.2	0.2
Master's	2.9	2.8	0.7	0.2	0.1
Bachelor's	0.8	0.5	--	--	--
Graduate students	0.4	0.9	0.5	--	--
Sections					
Number	11.1	16.1	8.2	7.4	9.0
Average size	25.6	29.8	23.5	15.2	11.5
Total students	310	543	265	145	102

-- = Rounds to zero.

[1]The means per department are based only on those departments which provided instruction at a given class level in fall 1988.

[2]Figures reflect teachers who taught at least one mathematics/statistics course in fall 1988.

[3]Teachers were counted as full time if they had full-time teaching/research/administrative positions in fall 1988.

NOTE: Teachers are counted once for each instructional level at which they taught, so the estimates in one column may not be added to those in another without encountering duplication. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-12. The number and percentage of teachers of mathematical/statistical science classes in fall 1988 by institutional type and level of instruction: United States

Institutional type	Total number of teachers[1]	Percentage at each level of instruction[2]				
		Remedial	Below calculus	Calculus level	Advanced	Graduate
Total	45,000	34	59	36	23	9
Doctoral	11,300	7	41	45	32	25
Comprehensive	9,250	25	58	38	36	11
Baccalaureate	5,050	33	68	50	42	1
Specialized	2,150	33	55	41	27	11
Two-year	17,200	57	69	25	3	0

[1]Figures included teachers who taught at least one mathematics/statistics course in fall 1988. Numbers have been rounded to the nearest 50. Details do not add to total because of rounding.

[2]Faculty members were counted once for each level of instruction. Percentages add to more than 100 because many teachers taught at more than one class level.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-13. Number and percentage of teachers of mathematical/statistical science classes in fall 1988 by highest degree obtained and level of instruction: United States

Highest degree obtained	Level of instruction				
	Remedial	Below calculus	Calculus level	Advanced	Graduate
			(Number[1])		
Total	15,300	26,400	16,250	10,150	4,100
Doctoral	1,700	5,950	8,400	8,250	3,950
Master's	10,750	16,050	6,300	1,750	100
Bachelor's	2,200	2,200	300	100	--
Graduate students[2]	700	2,200	1,250	50	--
			(Percent[3])		
Total	100	100	100	100	100
Doctoral	11	22	52	82	97
Master's	70	61	39	17	3
Bachelor's	14	8	2	1	--
Graduate students[2]	5	8	8	1	--

-- = Rounds to zero.

[1]Teachers include those who taught at least one mathematics/statistics course in fall 1988. Teachers are counted once for each institutional level at which they taught so the estimates in one column may not add to those in another without encountering duplication. Sums have been rounded to the nearest 50. Details may not add to totals because of rounding.

[2]The highest degree of graduate students teaching classes is unknown.

[3]Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-14. Number of full-time positions in mathematics/statistics that departments attempted to fill over the period 1984-85 to 1988-89 by institutional characteristic: United States

Institutional characteristic	Total*	Mathematics	Statistics	Other
Total	9,600	8,200	800	550
Type				
Doctoral	2,950	2,350	500	100
Comprehensive	2,350	1,950	250	150
Baccalaureate	1,550	1,500	50	--
Specialized	300	300	--	0
Two-year	2,450	2,100	50	300
Control				
Private	3,250	2,850	150	300
Public	6,350	5,400	700	250
Enrollment size				
Less than 1,000	1,100	850	--	250
1,000 - 4,999	2,700	2,550	50	50
5,000 or more	5,800	4,800	700	300
Region				
Northeast	2,000	1,700	150	100
Central	2,500	1,900	250	300
Southeast	2,600	2,350	200	50
West	2,550	2,300	200	100

-- = Rounds to zero.

*Some double counting of positions occurred because if a position was left unfilled for more than one year, it was counted once for each year in which the department sought to fill the position.

NOTE: Estimates have been rounded to the nearest 50. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-15a. Departmental recruitment of mathematics/statistics faculty (number) over the period 1984-85 to 1988-89 by institutional characteristic: United States

Institutional characteristic	Number* of full-time positions	Filled with people meeting advertised qualifications		Filled with people not meeting advertised qualifications		Not filled for at least one year		Vacancies for two years
		Full time	Part time	Temporary	Permanent	Shortage of suitable candidates	Other reasons	
Total	9,600	7,300	650	900	100	450	250	300
Type								
Doctoral	2,950	2,050	150	400	--	200	200	150
Comprehensive	2,350	1,850	100	300	--	100	--	50
Baccalaureate	1,550	1,150	50	150	50	150	--	50
Specialized	300	250	--	--	--	--	50	50
Two-year	2,450	1,950	350	50	--	50	50	--
Control								
Private	3,250	2,250	400	300	50	150	50	100
Public	6,350	5,000	250	550	50	300	200	200
Enrollment size								
Less than 1,000	1,100	700	350	--	--	50	0	--
1,000 - 4,999	2,700	2,150	100	200	50	150	50	100
5,000 or more	5,800	4,450	200	650	50	250	200	200
Region								
Northeast	2,000	1,600	50	100	50	50	100	50
Central	2,500	1,800	250	300	--	100	50	50
Southeast	2,600	1,900	150	250	50	200	50	100
West	2,500	1,950	200	250	0	100	50	50

-- = Rounds to zero.

*Some double counting of positions occurred because if a position was left unfilled for more than one year,it was counted once for each year in which the department sought to fill the position.

NOTE: Estimates have been rounded to the nearest 50. Details may not add to totals because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5). National Science Foundation, 1990 (survey conducted in 1989).

Table A-15b. Departmental recruitment of mathematics/statistics faculty (percent) over the period 1984-85 to 1988-89 by institutional characteristic: United States

Institutional characteristic	Number* of full-time positions	Filled with people meeting advertised qualifications		Filled with people not meeting advertised qualifications		Not filled for at least one year	
		Full time	Part time	Temporary	Permanent	Shortage of suitable candidates	Other reasons
				(percent)			
Total	9,600	76	7	9	1	5	3
Type							
Doctoral	2,950	70	4	13	1	6	6
Comprehensive	2,350	79	3	13	1	3	-
Baccalaureate	1,550	73	5	9	3	9	-
Specialized	300	79	1	6	2	1	12
Two-year	2,450	81	15	1	1	1	1
Control							
Private	3,250	70	13	10	2	5	2
Public	6,350	79	4	9	1	4	3
Enrollment size							
Less than 1,000	1,100	61	31	2	2	5	0
1,000 - 4,999	2,700	80	3	8	2	5	2
5,000 or more	5,800	77	3	11	1	4	4
Region							
Northeast	2,000	82	3	6	3	2	4
Central	2,500	72	9	11	1	4	3
Southeast	2,600	73	6	9	1	8	2
West	2,500	77	8	10	0	3	2

- = Rounds to zero.

*Some double counting of positions occurred because if a position was left unfilled for more than one year,it was counted once for each year in which the department sought to fill the position.

NOTE: Estimates have been rounded to the nearest 50. Details may not add to totals and percentages may not add to 100 due to rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-16. Departmental representatives' assessments of changes in the ability of their department to recruit suitable faculty members in the last two years by institutional characteristic: United States

Institutional characteristic	Now more difficult	No change	Now less difficult
		(percent)	
Total	26	65	9
Type			
Doctoral	48	41	11
Comprehensive	37	49	14
Baccalaureate	25	68	7
Specialized	7	84	9
Two-year	21	71	8
Control			
Private	21	71	8
Public	29	61	10
Enrollment size			
Less than 1,000	13	80	7
1,000 - 4,999	26	65	9
5,000 or more	35	54	11
Region			
Northeast	17	68	16
Central	26	69	5
Southeast	25	64	10
West	33	61	6
Number of openings (1984-85 through 1988-89)			
None	9	85	6
1-2	24	70	6
3 or more	35	50	14

NOTE: Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-17a. Departmental representatives' assessment of the relative importance given to research/publication versus teaching performance in evaluating full-time faculty in mathematical/statistical science at their institution by institutional characteristic: United States

Institution characteristic	Assessment of importance (percent)				
	Research much more important	Research somewhat more important	Both equally important	Teaching somewhat more important	Teaching much more important
Total	7	5	9	11	68
Type					
Doctoral	43	36	18	1	2
Comprehensive	8	6	19	29	38
Baccalaureate	3	1	10	17	69
Specialized	5	3	23	1	68
Two-year	1	0	2	5	92
Control					
Private	4	3	12	16	65
Public	9	6	8	8	70
Enrollment size					
Less than 1,000	3	0	7	6	84
1,000 - 4,999	2	2	8	13	75
5,000 or more	16	12	13	11	48
Region					
Northeast	10	5	20	13	52
Central	7	5	6	15	67
Southeast	5	5	3	12	74
West	5	4	10	5	76

NOTE: Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-17b. Departmental representatives' assessment of the relative importance given to research/publication versus teaching performance in evaluating part-time faculty in mathematical/statistical science at their institution by institutional characteristic: United States

Institution characteristic	Assessment of importance (percent)				
	Research much more important	Research somewhat more important	Both equally important	Teaching somewhat more important	Teaching much more important
Total	--	1	2	5	92
Type					
Doctoral	5	9	12	21	53
Comprehensive	0	0	1	3	96
Baccalaureate	0	0	0	5	95
Specialized	0	1	8	0	91
Two-year	0	--	0	3	97
Control					
Private	--	1	2	7	90
Public	--	1	1	3	94
Enrollment size					
Less than 1,000	0	--	--	4	95
1,000 - 4,999	--	--	2	4	94
5,000 or more	1	2	3	6	88
Region					
Northeast	1	1	3	9	86
Central	--	2	1	2	94
Southeast	0	--	1	5	94
West	1	--	2	4	94

-- = Less than 1 percent.

NOTE: Percentages may not add to 100 because of rounding.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-18a. Total number of full-time faculty in mathematics/statistics departments, and number and percentage involved in research/publication by institutional characteristic: United States

Institutional characteristic	Number of full-time faculty	Research/publication					
		Actively involved		Applied for Federal support		Received Federal support	
		Number	Percent of full-time faculty	Number	Percent of those actively involved	Number	Percent of those who applied
Total	24,450	9,150	38	3,400	37	2,100	61
Type							
Doctoral	6,800	5,250	77	2,550	49	1,700	66
Comprehensive	6,250	2,400	38	600	24	200	36
Baccalaureate	3,450	800	23	150	17	100	70
Specialized	1,350	--	--	--	--	--	--
Two-year	6,600	300	4	50	8	--	--
Control							
Private	6,400	2,500	39	950	39	650	68
Public	18,050	6,700	37	2,450	27	1,450	58
Enrollment size							
Less than 1,000	1,550	200	12	50	27	--	--
1,000 - 4,999	6,750	1,600	24	450	27	200	52
5,000 or more	16,150	7,400	46	2,950	40	1,800	62
Region							
Northeast	6,400	2,600	41	1,050	41	650	63
Central	5,800	2,450	42	750	31	500	64
Southeast	5,850	1,800	30	650	35	300	50
West	6,350	2,350	37	950	41	650	65

-- = Too few cases for a reliable estimate.

NOTE: Estimates have been rounded to the nearest 50.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-18b. Total number of full-time faculty in mathematics/statistics departments, and number and percentage involved in education research/publication by institutional characteristic: United States

Institutional characteristic	Number of full-time faculty	Education research/publication					
		Actively involved		Applied for Federal support		Received Federal support	
		Number	Percent of full-time faculty	Number	Percent of those actively involved	Number	Percent of those who applied
Total	24,450	2,750	11	550	20	300	49
Type							
Doctoral	6,800	750	11	200	28	150	72
Comprehensive	6,250	900	14	200	24	50	31
Baccalaureate	3,450	450	12	50	17	–	–
Specialized	1,350	–	–	–	–	–	–
Two-year	6,600	550	8	50	11	–	–
Control							
Private	6,400	950	15	200	20	–	–
Public	18,050	1,800	10	350	21	200	49
Enrollment size							
Less than 1,000	1,550	250	15	50	12	–	–
1,000 - 4,999	6,750	750	11	100	15	–	–
5,000 or more	16,150	1,800	11	400	24	200	51
Region							
Northeast	6,400	900	14	100	12	–	–
Central	5,800	700	12	200	31	100	50
Southeast	5,850	550	9	50	12	–	–
West	6,350	650	10	200	28	100	50

– = Too few cases for a reliable estimate.

NOTE: Estimates have been rounded to the nearest 50.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-19a. Departmental representatives' mean level of satisfaction with quality of teaching in mathematics/statistics by level of instruction and institutional characteristic: United States

Institutional characteristic	Quality of teaching				
	Remedial	Below calculus	Calculus level	Advanced	Graduate
Total	7.5	7.9	8.3	8.5	8.6
Type					
Doctoral	6.9	7.0	7.5	8.3	8.6
Comprehensive	7.6	7.7	8.2	8.6	8.7
Baccalaureate	7.2	7.7	8.3	8.4	8.1
Specialized	--	--	--	--	--
Two-year	7.6	8.1	8.5	8.4	NA
Control					
Private	7.4	8.0	8.3	8.5	8.7
Public	7.5	7.8	8.4	8.4	8.6
Enrollment size					
Less than 1,000	7.4	8.0	8.1	8.4	5.8
1,000 - 4,999	7.5	8.0	8.6	8.5	8.8
5,000 or more	7.6	7.6	8.0	8.5	8.7
Region					
Northeast	7.3	8.0	8.5	8.7	8.9
Central	7.5	7.9	8.2	8.2	8.5
Southeast	7.7	7.7	8.3	8.4	8.5
West	7.4	8.0	8.3	8.6	8.7

-- = Too few cases for a reliable estimate.

NA = Not applicable.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-19b. Departmental representatives' mean level of satisfaction with student outcomes in mathematics/statistics by level of instruction and institutional characteristic: United States

Institutional characteristic	Student outcomes				
	Remedial	Below calculus	Calculus level	Advanced	Graduate
Total	6.2	6.7	7.4	7.7	8.0
Type					
Doctoral	5.0	5.9	6.4	7.3	8.0
Comprehensive	6.0	6.3	7.0	7.7	7.8
Baccalaureate	6.0	6.7	7.3	7.8	8.4
Specialized	--	--	--	--	--
Two-year	6.4	6.9	7.8	7.8	NA
Control					
Private	6.4	6.9	7.3	7.8	8.4
Public	6.1	6.5	7.5	7.7	7.8
Enrollment size					
Less than 1,000	6.4	7.0	7.5	7.9	5.8
1,000 - 4,999	6.4	6.8	7.7	7.8	8.1
5,000 or more	5.8	6.3	7.0	7.6	8.0
Region					
Northeast	6 2	6.8	7.3	7.8	8.3
Central	6.3	6.7	7.5	7.6	7.9
Southeast	6.5	6.6	7.5	7.7	7.6
West	5.9	6.6	7.4	7.9	8.2

-- = Too few cases for a reliable estimate.

NA = Not applicable.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-20. Percentage of mathematics/statistics departmental representatives who indicated their department experienced problems and their ranking of those problems: United States

Departmental problems	Percent reporting problem	Percent ranking problems as					Mean rank
		Most important	Second	Third	Fourth	Fifth	
Institution support services							
Physical facilities	43	30	24	12	12	9	2.9
Adequate computing equipment	41	15	25	24	9	8	3.2
Sufficient library resources	27	14	10	10	21	14	4.0
Funding of telephones and mailing	9	7	9	11	8	9	4.7
Sponsorship of colloquia and conferences	24	9	4	7	6	24	4.8
Amount of clerical support	38	9	20	19	12	19	3.8
Amount of technical support	25	7	8	11	19	15	4.5
Encouragement from institution	26	11	9	13	22	12	4.2
Faculty resources							
Availability of research assistants	17	4	7	9	15	15	4.8
External support for scholarly activity	36	9	14	16	17	15	4.0
Internal support for scholarly activity	34	5	18	20	17	10	4.0
Funding of faculty travel	47	6	21	20	18	11	3.8
Teaching load	52	43	17	13	7	8	2.6
Isolation from colleagues	38	17	18	12	17	13	3.6
Faculty and graduate students							
Recruiting and retention of qualified faculty	30	31	12	13	11	6	3.3
Preparation of beginning graduate students	8	9	3	11	14	11	4.7
Quantity of graduate students	9	9	13	9	11	11	4.5
Teaching load for graduate assistants	4	4	5	6	18	15	4.9
Language problems	12	6	14	10	5	23	4.5
Non-language problems of international teaching staff	5	0	10	15	2	11	5.0
Resources for teaching/research assistantships	14	4	13	11	13	15	4.6
Other	12	55	17	15	5	3	2.0

NOTE: Only departments experiencing problems in an area were asked to provide a rank. Problems not ranked among the top five were left unranked by the respondents.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Table A-21. The percentage of mathematics and statistics departmental representatives who indicated their department experienced each of the nine most frequently cited problems by institutional characteristic: United States

Institutional characteristic	Teaching load	Funding of faculty travel	Physical facilities	Adequate computing equipment	Amount of clerical support	Isolation from colleagues	External support for scholars	Internal support for scholars	Recruiting qualified faculty
Total	52	47	43	41	38	38	36	34	30
Type									
Doctoral	43	48	77	36	39	25	70	48	51
Comprehensive	68	62	55	42	41	42	59	51	40
Baccalaureate	65	59	41	42	41	56	44	53	36
Specialized	32	13	8	15	38	15	19	15	26
Two-year	43	41	39	46	35	33	19	18	20
Control									
Private	52	44	35	37	36	42	36	37	31
Public	51	50	49	44	39	34	35	31	29
Enrollment size									
Less than 1,000	40	43	31	41	39	37	30	31	25
1,000 - 4,999	55	45	35	38	34	46	31	32	30
5,000 or more	56	54	64	46	43	26	46	38	34
Region									
Northeast	57	42	56	38	39	50	32	34	28
Central	50	44	34	34	31	35	41	36	28
Southeast	56	46	42	44	44	36	35	32	38
West	43	57	42	47	36	31	34	33	25

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Appendix B

Technical Notes

Higher Education Surveys (HES)

The Higher Education Surveys (HES) system was established to conduct brief surveys of higher education institutions on topics of interest to Federal policymakers and the education community. The system is sponsored by the National Science Foundation, the U.S. Department of Education, and the National Endowment for the Humanities.

HES questionnaires typically request a limited amount of readily accessible data from a subsample of institutions in the HES panel, which is a stratified, nationally representative sample of 1,093 colleges and universities in the United States. Each institution in the panel has identified a HES campus representative, who serves as survey coordinator. The campus representative facilitates data collection by identifying the appropriate respondent for each survey and distributing the questionnaire to that person.

Survey Methodology

This mail survey was conducted at the request of the National Science Foundation to provide reliable national estimates on teaching and research in mathematics and statistics departments at higher education institutions. The survey universe included (1) departments clearly identifying mathematics or statistics in their name, and (2) those identified as the primary location for mathematics instruction.

The sample for this survey consisted of half of the HES panel (546 institutions), but excluded institutions not offering mathematics or statistics (e.g., medical schools and law schools). Initially, screening contacts were made to each of the 546 institutions to identify all departments that teach mathematics or statistics. This resulted in a list of close to 700 departments. Considerable variability occurred among institutions in the departments named, with some institutions including departments such as business administration, operations research, and psychology. The survey was limited primarily to departments clearly identifying mathematics or statistics in their names, because of the small number of these additional departments identified, the variability among institutions in naming such departments, and, most importantly, the likelihood that those departments faced different issues than the departments more traditionally identified with mathematics and statistics. An exception is that many small, two-year, and specialized institutions do not have a mathematics or statistics department per se, but offer mathematics or statistics through a more comprehensive department. These departments were included in the sample if the institutional representatives identified them as the primary location for mathematics instruction. Following these criteria, a total of 557 eligible mathematics and statistics departments were identified.[1]

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[1] The word "departments" is used to follow the conventions of most higher education institutions responding to the survey. In some institutions, different names (or organizational structures) were used (e.g., Science Division); these also were considered as departments for this survey if so designated by the institution.

The questionnaire was mailed on May 9, 1989. Depending on the method specified by each institution's HES coordinator, the questionnaires were sent either directly to the department chairmen identified through the above procedure or to the coordinators, who sent the questionnaires to the department chairmen. Telephone followup for nonresponse was begun on May 31. Completed questionnaires were examined for internal inconsistencies and missing data. Telephone followup was performed to verify the information in question. Data collection ended on July 14, 1989. Upon receipt of the questionnaire, each department was classified into one of three categories: departments offering substantial courses or a program in mathematics or statistics (490 departments); mathematics courses within a department not focused on mathematics (32 departments); and no mathematics courses (19 departments). Departments in the third category could not respond meaningfully to the questionnaire and were excluded from the analysis. Data were adjusted for questionnaire nonresponse and weighted to national totals using the following procedure. A separate base weight was calculated for each of the 22 strata, based upon the probability of selection of the sampled institutions within each stratum. Nonresponse weights were also calculated for each stratum, based on the ratio of the sum of the number of responses and the number of refusals to the number of responses. The final weight was the product of the base weight and the nonresponse weight.

The overall response rate was 97 percent, based on 541 responses from 557 eligible departments. Response rates were relatively uniform across institutional characteristics. The response rates were 97 percent each for department at private and public institutions. Responses by type of institution ranged from 96 percent for departments at two-year institutions to 98 percent for departments at comprehensive and doctoral institutions.

The item response rate was 99 percent or higher for most items on the questionnaire (Appendix Table B-1). The only items receiving a response rate lower than 95 percent were the rankings of the top five problems experienced by departments (93 percent), and the areas in which departments experienced difficulties in recruiting suitable faculty members (85 percent). For all other items, item nonresponse was minimal, and statistics presented in this report may be interpreted as representing all mathematics and statistics departments as defined in this survey.

Table B-1. Response rate for each item on the mathematics and statistics questionnaire: United States

Question number	Description	Response rate	
		Unweighted	Weighted
1	Degrees offered	100	100
2	Students served by department	99	99
3	Number teaching mathematics/statistics	100	100
	By employment status, highest degree, and level	99	99
4	Number of sections by class level	99	100
	Average section size by class level	98	99
5	Satisfaction with quality of teaching	97	98
	Satisfaction with student outcomes	95	94
6a-6d	Number of positions attempted to fill	100	100
6e	Number of vacancies for at least two consecutive years	96	97
6f	Difficult areas when seeking faculty members	85	78
7	Changes in ability to recruit suitable faculty	100	100
8	Problems in department	100	100
	Rank of top five problems	93	95
9	Number of full-time faculty	100	100
	Actively involved in research/publication	100	100
	Applied for Federal support	99	99
	Received Federal support	95	95
10	Importance of research/publication	100	100
11	Permission to release data	100	100

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

Reliability of Survey Estimates

The findings presented in this report are estimates based on the sample from the HES panel and, consequently, are subject to sampling variability. If the questionnaire had been sent to a different sample, the responses would not have been identical; some figures might have been higher, while others might have been lower. The standard error is a measure of the variability due to sampling when estimating a statistic. It indicates how much variability there is in the population of possible estimates of a parameter for a given sample size. Standard errors can be used as a measure of the precision expected from a particular sample. If all possible samples were surveyed under similar conditions, intervals of 1.96 standards below to 1.96 standard errors above a particular statistic would include the true population parameter being estimated in about 95 percent of the samples. This is a 95 percent confidence interval. For example, the estimated mean percentage of students at an institution taking at least one mathematics course from the department is 80.5 percent and the estimated standard error is 1.2. The 95 percent confidence interval for this statistic extends from 80.5 - (1.2 x 1.96) to 80.5 + (1.2 x 1.96), or from 78.1 to 82.9 percent. This means one can be 95 percent confident that this interval contains the true population value. Estimates of standard errors for the estimates were computed using a replication technique known as jackknife replication. Jackknife replication involves constructing a number of subsamples (replicates) from the full sample and computing the statistic of interest for each replicate. The mean square error of the replicate estimates around the full sample estimate provides an estimate of the variance of the statistic. Some key statistics and their estimated standard errors are shown in Appendix Table B-2. Unless noted otherwise, all comparisons made in this report are statistically significant.

Survey estimates are also subject to errors of reporting and collection. These errors, called nonsampling errors, can sometimes bias the data. While general sampling theory can be used to determine how to estimate the sampling variability of a statistic, nonsampling errors are not easy to measure and usually require that an experiment be conducted as part of the data collection procedures or the use of data external to the study.

Nonsampling errors may include such factors as differences in the respondents' interpretation of the meaning of the questions, differences related to the particular time the survey was conducted, and errors in data preparation. During the design of the survey and survey pretest, an effort was made to check for consistency of interpretation of questions and to eliminate ambiguous items. The questionnaire was pretested with respondents like those who completed the survey, and the questionnaire and instructions were extensively reviewed by NSF. Manual and machine editing of the questionnaires was conducted to check the data for accuracy and consistency. Cases with missing or inconsistent items were recontacted by telephone; data were keyed with 100 percent verification.

Opinion data may be biased if the respondents wish to promote a particular viewpoint concerning mathematics and statistics, or if they are simply mistaken in a systematic manner in their impressions. Also, to limit respondent burden, some questions asked for general impressions instead

Table B-2. Selected standard errors by institutional characteristic: United States

Institutional characteristic	Mean percentage of students taking mathematics or statistics from department		Total number of people teaching mathematical/ statistical science classes in fall 1988		Percentage of departments reporting that it is now more difficult to recruit new faculty		Percentage of departments reporting problems with physical facilities		Percentage of departments ranking teaching load as the most important problem*		Percentage of departments for which teaching was much more important than research in evaluating faculty	
	Estimate	Standard error	Estimate	Standard error	Estimate	Standard error	Estimate	Standard error	Estimate	Standard error	Estimate	Standard error
Total	80.5	1.2	45,011.7	1,610.0	25.6	2.4	43.0	2.3	42.8	3.4	68.0	2.0
Type												
Doctoral	63.4	3.0	11,308.0	916.2	47.6	4.9	77.0	3.6	20.3	6.3	2.5	1.4
Comprehensive	83.6	2.0	9,264.8	526.1	37.1	4.7	55.1	5.0	56.7	7.1	37.9	4.8
Baccalaureate	82.0	2.8	5,049.1	314.5	25.4	4.4	41.2	4.7	46.8	6.8	69.3	4.9
Specialized	95.0	3.1	2,171.1	526.1	6.9	4.6	8.4	5.9	53.3	16.6	68.2	11.0
Two-year	79.3	1.5	17,218.7	1,055.3	20.6	3.8	39.3	4.0	34.8	6.7	92.3	2.4
Control												
Private	83.1	2.1	10,181.6	840.4	21.4	3.4	35.4	3.3	49.9	4.9	64.9	4.3
Public	78.4	1.2	34,830.1	1,624.5	28.6	2.7	48.8	3.1	37.3	4.6	70.2	2.3
Enrollment size												
Less than 1,000	85.4	3.2	2,885.8	421.8	13.2	4.4	31.1	3.7	44.3	8.0	83.9	5.5
1,000 - 4,999	81.2	1.4	12,099.8	1,003.2	25.8	3.7	35.1	3.4	48.0	5.8	75.1	3.2
5,000 or more	75.4	1.4	30,026.1	1,433.2	34.6	3.7	64.1	3.7	34.5	5.1	47.5	3.0
Region												
Northeast	75.9	2.7	11,261.0	1,293.4	16.8	4.0	55.5	6.5	38.6	6.8	51.8	5.5
Central	80.8	2.3	11,237.5	1,238.2	25.9	3.8	33.9	4.7	43.7	6.0	67.3	4.6
Southeast	87.8	2.1	10,483.2	1,244.1	25.3	4.1	41.9	4.1	38.3	7.7	74.0	4.4
West	76.1	2.2	12,029.9	1,183.5	32.9	6.1	41.9	5.8	53.2	8.3	76.1	4.1

*Based on those departments that reported teaching load was a problem.

SOURCE: Higher Education Surveys, Survey of Mathematics and Statistics Departments at Higher Education Institutions (HES 5), National Science Foundation, 1990 (survey conducted in 1989).

of requesting specific numerical estimates. However, in many cases the survey responses will represent the only existing data regarding certain issues and, hence, are valuable even given these limitations.

Institutional Type Relationships

The data in this report are presented as "total" figures, which represent all kinds of institutions grouped .ogether, and for institutions broken down by institutional control and institutional "type." These classifications are:

- Institutional control
  - Public
  - Private
- Types of institutions are based on the U.S. Department of Education's Higher Education General Information Surveys (HEGIS) classifications and are defined below.
  - Doctorate-granting: schools characterized by a significant level and breadth of activity in and commitment to doctoral-level education as measured by the number of doctorate recipients and the diversity in doctoral-level program offerings.
  - Comprehensive: schools characterized by diverse post-baccalaureate programs (including first-professional) but which do not engage in significant doctoral-level education.
  - Baccalaureate: schools characterized by their primary emphasis on general undergraduate, baccalaureate-level education, and which are not significantly engaged in post-baccalaureate education.
  - Specialized schools: baccalaureate or post-baccalaureate schools characterized by a programmatic emphasis in one area (plus closely related specialties), as measured by the percentage of degrees granted in the program area. Some examples of specialized schools are engineering schools and seminaries.
  - Two-year: schools that confer at least 75 percent of their degrees and awards for work below the bachelor's levels.

Institutional control and type of institution are related to each other. More specifically:

- Among doctoral institutions, 68 percent of the mathematics/statistics departments are at institutions that are public.
- Among comprehensive institutions, 62 percent are at institutions that are public.

- Among baccalaureate institutions, 83 percent are at institutions that are private.
- Among specialized institutions, 85 percent are at institutions that are private.
- Among two-year institutions, 72 percent are at institutions that are public.
- Among public institutions, 63 percent are at institutions that are two-year.
- Among private institutions, 41 percent are at institutions that are baccalaureate.

Appendix C

Survey Questionnaire

OMB # 3145-0009
Exp. 1/31/90

Higher Education Surveys

SURVEY #5
SURVEY OF MATHEMATICS AND STATISTICS DEPARTMENTS

May 1989

Dear Colleague:

I am writing on behalf of the National Science Foundation to request your participation in the Higher Education Survey (HES) of mathematics and statistics departments.

A major project is currently underway to assess the status of the mathematical sciences in U.S. colleges and universities. In this survey, the focus is on the availability and use of resources in mathematics and statistics departments; we ask about your ability to get qualified teaching faculty, your division of teaching among full-time and part-time faculty, problems you face in research and teaching, and your department's level of scholarly activity. These data will enable the National Science Foundation to design policies for reinvigorating instruction and research in mathematics. While your participation is voluntary, we hope you will take the time to answer these questions so that the data we collect will be representative of the universe of mathematics and statistics departments in postsecondary institutions.

A copy of the HES report will be sent to your institution after this study is completed. If you have any questions about the survey, please call Bradford Chaney of Westat (800-937-8281).

Thank you for your assistance.

Sincerely,

Judith S Sunley

Judith Sunley
Director, Division of
Mathematical Sciences

Sponsored by the National Science Foundation, the National Endowment for the Humanities, and the Department of Education

General Information

1a. Please check the degrees offered by the institution through your department in each category.

Field	Associate	Bachelor's	Master's	Doctoral
Mathematics	☐	☐	☐	☐
Statistics	☐	☐	☐	☐
Computer science	☐	☐	☐	☐
Other (specify) _____	☐	☐	☐	☐
Joint degrees				
Mathematics/statistics	☐	☐	☐	☐
Mathematics/computer science	☐	☐	☐	☐

1b. Please check which of the following degrees are offered by other departments in your institution.

Field	Associate	Bachelor's	Master's	Doctoral
Mathematics	☐	☐	☐	☐
Statistics	☐	☐	☐	☐
Computer science	☐	☐	☐	☐

2a. What percentage of students at your institution take at least one course in mathematics or statistics from your department?

Percentage of students _____

2b. What percentage of your department's teaching time in mathematics/statistics is spent teaching non-majors? (Include time spent in teaching advanced courses to non-majors, such as differential equations to physics majors.)

Percentage of teaching time _____

3a. How many people taught mathematical/statistical science classes in your department in Fall 1988? Include part-time faculty and graduate students with full responsibility for teaching a class, but do not include teaching assistants who are only assisting in a class.

Number of teachers _____

3b. Of those in 3a, please state the number of teachers who taught mathematical/statistical science classes in Fall 1988 at the levels listed below. If a teacher taught classes at more than one level in Fall 1988, count him/her once for each level. Write "0" where a category does not apply (e.g., if you have no teacher whose highest degree is a master's degree and who is teaching advanced courses). Consider a teacher full-time if the teacher had full-time teaching/research/administrative responsibilities within your institution in the Fall 1988 term.

Employment status and highest degree of teachers	Number of teachers who taught a class in Fall 1988 at the following level: Remedial	Below calculus	Calculus level	Advanced	Graduate
Full-time in Fall 1988					
Doctoral	____	____	____	____	____
Master's	____	____	____	____	____
Bachelor's	____	____	____	____	____
Part-time in Fall 1988					
Doctoral	____	____	____	____	____
Master's	____	____	____	____	____
Bachelor's	____	____	____	____	____
Graduate students at your institution	____	____	____	____	____

4. At each level below for Fall 1988, how many sections were taught and what was the average size of a section? (For this survey, a section is each class that is taught separately by an individual instructor. For example, the standard calculus course may have several sections, if each section is taught separately.)

	Class level: Remedial	Below calculus	Calculus level	Advanced	Graduate
Number of sections	____	____	____	____	____
Average section size	____	____	____	____	____

5. How satisfied are you with the teaching at each level listed below? Rank them on a scale from 1 to 10, with 1 indicating you are not at all satisfied and 10 indicating you are very satisfied.

	Level of satisfaction (from 1 to 10)	
	Quality of teaching	Student outcomes
Remedial	_____	_____
Below calculus	_____	_____
Calculus level	_____	_____
Advanced	_____	_____
Graduate	_____	_____

Availability of Faculty Candidates in Mathematical/Statistical Science for the Last Five Years

6. Please respond to the following concerning your success in recruiting mathematical/statistical science faculty in your department for the last five academic years (i.e., recruiting faculty to begin in the period 1984-85 to 1988-89).

a. How many full-time faculty positions did you attempt to fill in the last five years? **Please note:** count a position **once for each year** that you tried to fill it (e.g., if a position was left unfilled in one year and you again sought someone to fill it the next year, count it as two positions that you tried to fill).

_____ In mathematics

_____ In statistics

_____ Other (specify)_____

_____ Total (Should also equal the sum of b, c, and d below)

b. How many of the total in (a) were you able to fill with persons who met the advertised qualifications?

_____ Full-time faculty

_____ Part-time faculty

c. How many of the total in (a) were filled with persons who did not meet the advertised qualifications?

_____ Temporary appointments

_____ Permanent appointments

d. How many of the total in (a) did you not fill for at least one year because:

_____ There was a shortage of suitable candidates

_____ Other reasons (specify)_____

e. For how many positions did you have a vacancy for at least two consecutive years?

_____

f. In what areas are you seeking faculty members and having the most difficulty in recruiting suitable candidates (e.g., numerical analysis, algebraic geometry, mathematics education, etc.)? Write "none" if you are not currently experiencing difficulties in recruiting suitable candidates.

_____

7. How has your ability to recruit suitable faculty members changed in the last two years?

- ☐ It is now more difficult to recruit new faculty.
- ☐ No change.
- ☐ It is now less difficult to recruit new faculty.

Problems in Your Department

8. The preceding questions focused on the teaching of mathematics in your department. In this question, the focus is primarily on research in mathematics. Surveys by the Conference Board of the Mathematical Sciences (CBMS) have indicated that many departments experience problems in the areas listed below. Please check those areas that are a problem for your department. Of those that you checked, pick the 5 which present the greatest problems for mathematical/statistical science in your department, and write the rank, with "1" indicating the greatest problem, "2" indicating the second greatest problem, etc.

	Problem in your department	Rank (top 5 on this page)
Institutional support services		
a. Physical facilities (buildings, offices classrooms, wiring, etc.)	a. ☐	____
b. Availability of or access to adequate computing equipment	b. ☐	____
c. Sufficient library resources	c. ☐	____
d. Funding of telephones and mailing	d. ☐	____
e. Sponsorship of colloquia and conferences at your institution	e. ☐	____
f. Amount of clerical support	f. ☐	____
g. Amount of technical support	g. ☐	____
h. Encouragement from institution	h. ☐	____
Faculty resources		
i. Availability of research assistants	i. ☐	____
j. Availability of external support for faculty scholarly activity	j. ☐	____
k. Availability of internal institutional support for faculty scholarly activity	k. ☐	____
l. Funding of faculty travel	l. ☐	____
m. Teaching load	m. ☐	____
n. Isolation from colleagues with similar scholarly interests	n. ☐	____
Faculty and graduate students		
o. Recruiting and retention of qualified faculty	o. ☐	____
p. Preparation of beginning graduate students	p. ☐	____
q. Quantity of graduate students	q. ☐	____
r. Teaching load for graduate assistants	r. ☐	____
s. Language problems of faculty members or assistants whose first language is not English	s. ☐	____
t. Cultural or other non-language problems of international teaching assistants or faculty members	t. ☐	____
u. Availability of resources for teaching/research assistantships	u. ☐	____
v. Other (specify)_____	v. ☐	____

Faculty Scholarly Activity

9. What is the total number of full-time faculty members in mathematical/statistical science in your department (excluding visiting professors, but including postdoctoral associates and faculty members on leave, on sabbatical, or otherwise temporarily absent)?

Number of full-time faculty_____

Of these, how many:	Mathematical sciences: Research/ publication	Mathematical sciences: Education research/publication
a. Are actively involved in:	_____	_____
b. Applied for Federal support for their work during January 1, 1987-December 31, 1987?	_____	_____
c. Of those in (b), how many received Federal support for their work based on that application?	_____	_____

10. Which of the following best describes the relative institutional importance given to research/publication as compared with classroom teaching performance in evaluating faculty for advancement and/or salary decisions?

Full-time faculty (excluding temporary faculty)

- ☐ Research/publication is much more important than teaching.
- ☐ Research/publication is somewhat more important.
- ☐ Both are equally important.
- ☐ Teaching is somewhat more important.
- ☐ Teaching is much more important.

Part-time or temporary faculty

- ☐ Research/publication is much more important than teaching.
- ☐ Research/publication is somewhat more important.
- ☐ Both are equally important.
- ☐ Teaching is somewhat more important.
- ☐ Teaching is much more important.

11. Do we have permission to release these data to the National Science Foundation with your institutional identification code? All information published by NSF will be in aggregate form only.

- ☐ Yes
- ☐ No

Please sign_____

Thank you for your assistance.
Please return this form by May 26 to:

Higher Education Surveys
WESTAT
1650 Research Boulevard
Rockville, MD 20850

Please keep a copy of this survey for your records. Person completing this form:

Name_____

Title_____

Telephone (___)_____

If you have any questions or problems concerning this survey, please call Bradford Chaney at (800) 937-8281 (toll-free).