

Statistics Teaching in Colleges and Universities: Courses, Instructors, and Degrees in Fall 1995

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The Conference Board of the Mathematical Sciences (CBMS) is made up of 14 professional organizations in the mathematical sciences. The American Statistical Association is one of these organizations. Every five years since 1965 CBMS has conducted an extensive survey of undergraduate programs in the mathematical sciences in the United States. These studies give a detailed picture of enrollment, faculty, and instructional methods in two-year colleges, four-year colleges, and universities. This article presents selected results from the fall 1995 CBMS survey (Loftsgaarden, Rung, and Watkins 1997) about statistics courses, faculty, and degrees in departments of statistics, departments of mathematics or mathematical sciences, and in mathematics programs at two-year colleges.

KEY WORDS: CBMS Survey; Instructional practices; Statistics enrollment; Statistics faculty.

1. THE FALL 1995 CBMS SURVEY

A brief overview of the fall 1995 CBMS Survey is given here as background for this article. Two extensive questionnaires were used to gather the data. One was used for mathematics programs at two-year colleges and the second was used for departments in the mathematical sciences at four-year colleges and universities.

The two-year college population consisted of the 1,023 schools with mathematics programs which were divided into 10 strata on the basis of control (public or private) and total enrollment of the school. The questionnaire was mailed to a stratified random sample of 250 two-year college mathematics programs and the overall response rate was 65%. No "for profit" two-year schools were included in the CBMS survey.

The second population consisted of 1,396 four-year colleges and universities which were divided into 20 strata on the basis of control (public or private), highest degree offered by the mathematics department (bachelor's, master's, or doctor's), and total enrollment of the school. The questionnaire was mailed to a stratified random sample of 349 four-year college and university mathematics departments and the overall response rate was 66%. In both the two-

year and four-year samples, the strata for the schools with the smallest enrollments were sampled less heavily than the strata for the schools with the largest enrollments. The optimum allocation of the sample among the strata in each population was made assuming the sampling cost was the same in each stratum and using the enrollment for each school and the number of schools in each stratum.

In addition, in the four-year college population, the questionnaire was mailed to any statistics departments at the 349 schools in the sample. In particular, the statistics departments included in the CBMS survey were those teaching undergraduate statistics courses. These statistics departments were classified as bachelor's, master's, or doctor's according to the highest degree offered by the mathematics department at that school. The number of statistics departments in each stratum in the sample was used to project the total number of statistics departments in that stratum in the population. These numbers of statistics departments were in turn used to make projections of all results for statistics departments. Projections for statistics departments were made separately and results kept separate from those for mathematics departments. There were 50 statistics departments in the sample and 35 responded to the survey.

The 1990 CBMS Survey estimated that there were 60 separate statistics departments at the four-year colleges and universities in the population for the survey. For the 1995 CBMS Survey the estimated number of separate statistics departments was 71. Some of these were new since 1990 and the rest missed in 1990. This increase in the number of separate statistics departments undoubtedly accounts for some, but not all, of the increase in enrollments in statistics departments, in the number of faculty in statistics departments, and in the bachelor's degrees in statistics found by the 1995 CBMS Survey.

Counting the number of statistics departments that teach undergraduate courses is not an easy task. The CBMS survey sampled departments that were separate from the mathematics departments, that taught undergraduate courses in statistics, and that may have offered a bachelor's degree in statistics. The best list to start with in finding such departments is ASA's *Schools Offering Degrees in Statistics in the U.S. and Canada Including Departments With Statistics Concentrations, 1995 Edition*. This is a self-reported list and may not be complete. On the other hand, the list includes statistics programs within mathematics departments, biostatistics departments, and so on. Here are two examples. The statistics department at one university has only a graduate program and does not teach undergraduate statistics courses or give a bachelor's degree in statistics. The department of computer science and statistics at another university teaches undergraduate courses in statistics and

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Table 1. Enrollment (in thousands) in Statistics Courses by Level and by Department Where Taught: Fall 1990, 1995; Also by Type of School: Fall 1995. In addition average section size and percentage of students having required computer assignments in elementary level courses by type of school are given for fall 1995.

Where taught	Level	Enrollment (thousands)		1995 enrollment (thousands)			Avg. section size			% of students having required computer assigns.		
		1990	1995	Univ (PhD)	Univ (MA)	Coll (BA)	Univ (PhD)	Univ (MA)	Coll (BA)	Univ (PhD)	Univ (MA)	Coll (BA)
Math Dept	Elem	87	115	23	35	57	41	34	30	39%	34%	61%
	Upper	38	28	10	7	11	na	na	na	na	na	na
Stat dept	Elem	30	49	46	3		52	39		60%	39%	
	Upper	14	17	16	1		na	na		na	na	
2-yr Coll	Elem	54	72				28	(2-yr. coll.)		46%	(2-yr coll.)	
	Total	223	281	95	46	68						

gives a bachelor's degree in statistics. The latter department belongs in the CBMS survey and the former does not. Even including the latter department creates problems. Many of the courses they teach are not statistics courses, some of the faculty do not teach statistics courses, and many of the degrees they give are not in statistics. The authors hope that this discussion gives some insight on why generating a list of statistics departments or counting the number of statistics departments for purposes of the CBMS survey is not easily done.

Because of these difficulties, the procedure used in the past three CBMS Surveys has been to draw a stratified sample of four-year colleges and universities and then include in the sample any statistics departments at those schools that teach undergraduate courses. Large universities with Ph.D. programs in mathematics were heavily sampled in the CBMS survey which means that statistics departments at these schools ended up being heavily sampled as well, as this is where most statistics departments are located.

As a check on results in the CBMS survey, comparisons were made with other surveys whenever possible and agreement was generally good. As one example, results were compared with results from the annual surveys of mathematics departments conducted by the AMS-IMS-MAA Data Committee and published in the *Notices of the AMS*.

2. ENROLLMENT IN STATISTICS COURSES

Sections 2-5 of this article concentrate on statistics in four-year colleges and universities, and Sections 6-9 are concerned with statistics in two-year colleges. When reading the results in this and the following sections, remember that each number given in the tables or in the text is based on a projection from the data in a stratified random sample.

Table 1 and Figure 1 give fall 1995 enrollments in undergraduate statistics courses by level (elementary or upper level) and show where these statistics courses were being taught. [School types, (Univ (Ph.D.), Univ(MA) and College(BA)), in Table 1 and Figure 1 and throughout this article are determined by the highest degree offered by the mathematics department at the school.] Overall there was a 26% increase in enrollments in statistics courses from fall

1990 to fall 1995. During this same time period enrollments in mathematics courses at four-year colleges and universities fell 9%.

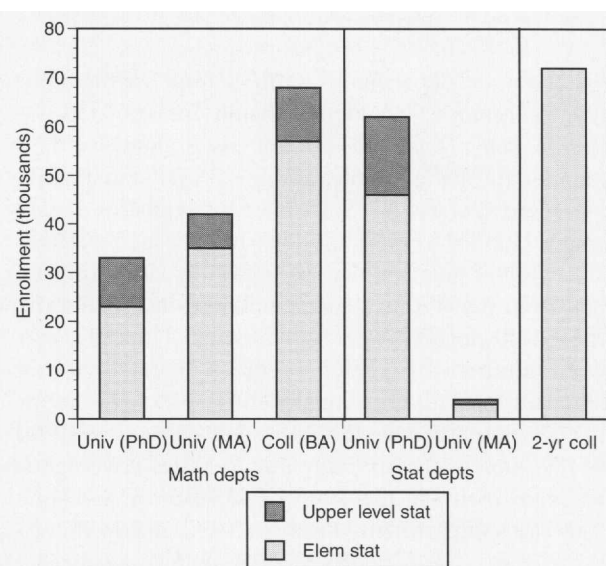


Figure 1. Enrollment (thousands) in Undergraduate Statistics Courses in Departments of Mathematics and Departments of Statistics by Level of Course and Type of School and in Two-Year College Mathematics Programs: Fall 1995.

Two-year college mathematics programs accounted for 25.6% of the statistics enrollments, mathematics departments at four-year colleges and universities 50.9%, and statistics departments at universities 23.5%. Two-year colleges accounted for 30.5% of the elementary level statistics enrollments. One number worth noting is the 26.3% decrease in upper level statistics enrollments in mathematics departments from 1990 to 1995. (Overall, there was a 19.3% decrease in enrollment in upper division mathematics courses from 1990 to 1995.)

3. BACHELOR'S DEGREES IN STATISTICS

Table 2 gives the number of bachelor's degrees with a major in statistics granted between July 1, 1994, and June 30, 1995, in departments of mathematics or mathematical sciences and does not include the estimated 188 degrees

Table 2. Bachelor's Degrees in Statistics by Department, by Gender, and by Type of School from July 1, 1994, through June 30, 1995

	Univ (Ph.D.)	Univ. (MA)**	Coll (BA)	Total degrees
<i>Math depts.</i>				
Male	162	50	27	239
Female	162	47	22	231
Total for math depts.	324	97	49	470*
<i>Stat depts.</i>				
Male	264	82		346
Female	157	58		215
Total for stat depts	421	140***		561

* The degrees from math depts. do not include any joint majors with statistics.

** Several of the stat depts. under school type Univ(MA) offer only a bachelor's degree in statistics as the school type is determined by the math department at the school.

*** Several of the stat depts under the school type Univ(MA) are joint depts. such as statistics and computer science. The 140 is the total of all degrees granted from these depts. It is estimated that the number of degrees in statistics is 28.

from mathematics departments with a joint mathematics and statistics major. The degrees listed for statistics departments in Table 2 include all degrees granted by these departments. All of the degrees in Univ(PhD) statistics departments were in statistics. Several of the statistics departments under Univ(MA) are joint departments such as statistics and computer science, etc. By carefully analyzing the responses from these joint departments it is estimated that 28 of these 140 degrees were in statistics. Thus, the estimated total number of bachelor's degrees in statistics from a mathematics or statistics department is 919. This represents a 49% increase over the 618 such degrees in 1990. Some of this increase is probably due to better coverage of statistics departments in the 1995 CBMS survey and some to new statistics departments between 1990 and 1995.

4. FACULTY IN DEPARTMENTS OF STATISTICS

Table 3 gives a breakdown of the 988 full-time and 136 part-time faculty members in departments of statistics at

universities in fall 1995. The breakdown is by type of school, type of faculty member, and gender. Similar results are given for fall 1990, but the data were not gathered in as great a detail in 1990 as they were in 1995.

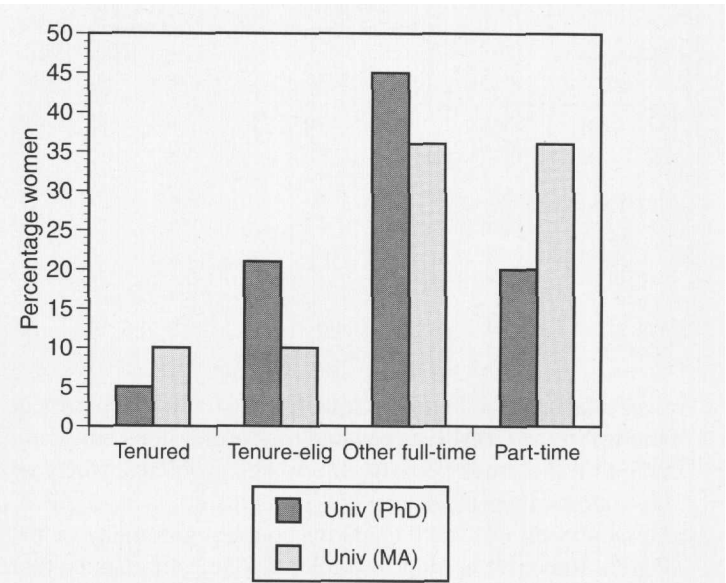


Figure 2. Percentage Women Among Tenured, Tenure-Eligible, Other Full-Time and Part-Time Faculty in Departments of Statistics by Type of School: Fall 1995.

Figure 2 shows the percentage of women among statistics department faculty by type of instructor and type of school.

Table 4 gives the 921 tenured and tenure-eligible faculty in departments of statistics by five-year age intervals and gender. It also gives an age distribution without the breakdown by tenure status and gender. Average ages are given for several categories of faculty in the last column.

Figure 3 is a histogram for the age distribution of tenured and tenure-eligible faculty with each bar broken down by gender. The most female faculty members were found in the 31 to 40 age range. Overall 8.5% of the 921 tenured and tenure-eligible faculty members in statistics departments were women.

Table 5 gives a breakdown of the 988 full-time faculty members in departments of statistics by tenure status, gen-

Table 3. Number of Tenured, Tenure-Eligible, Other Full-Time and Part-Time Faculty in Departments of Statistics by Gender and Type of School: Fall 1995. Also some 1990 data.

	Univ (PhD)				Univ (MA)				Totals				Total
	Ten-ured	Tenure-eligible	Other full-time	Part-time	Ten-ured	Tenure-eligible	Other full-time	Part-time	Ten-ured	Tenure-eligible	Other full-time	Part-time	
Men	617	135	31	97	73	18	7	9	690	153	38	106	987
Women	32	36	25	25	8	2	4	5	40	38	29	30	137
Total 1995	649	171	56	122	81	20	11	14	730	191	67	136	1124
Total 1990	484	184*		67	40	13*		23	524	197*		90	811
Women 1990		91**		na		12**		na		103**		na	

* This number is the total of tenure-eligible and other full-time.

** This number is the total of tenured, tenure-eligible, and other full-time.

Table 4. Percentage Age Distribution of Tenured and Tenure-Eligible Faculty in Departments of Statistics at Universities by Gender. Also average age: Fall 1995

	Percentage of faculty										Total tenured and tenure-eligible faculty	Average age	
	<31	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	>70			
Tenured men	0	3	5	11	13	14	15	9	4	2	100% 921*	52.4	
Tenured women	0	0	1	1	1	1	0	1	0	0		49.0	
Tenure-eligible men	1	8	3	2	1	0	0	0	0	0		921*	36.1
Tenure-eligible women	0	2	2	0	0	0	0	0	0	0		35.5	
Total tenured and tenure-eligible faculty	2	13	11	14	15	15	15	9	4	2	100% 921	48.8	

0 means less than half of 1%

* Total for all four rows in this block

der, and racial/ethnic group. Approximately three-fourths of these faculty members were in the white-not Hispanic group and another 18% were in the Asian/Pacific Islander group. Five percent were Mexican American, Puerto Rican, or other Hispanic.

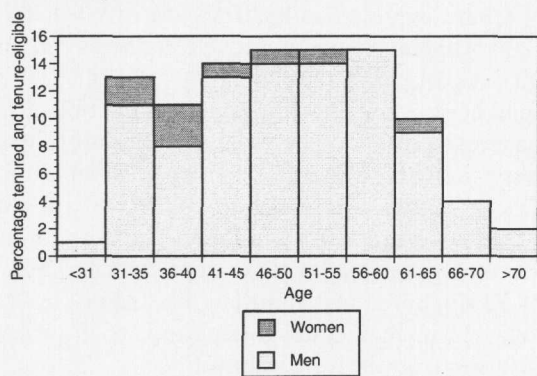


Figure 3. Percentage Age Distribution of Tenured and Tenure-Eligible Faculty in Departments of Statistics at Universities by Gender. Total tenured and tenure-eligible faculty is 921: Fall 1995.

Table 6 and Figure 4 give teaching assignments in contact hours per week for tenured and tenure-eligible faculty in statistics departments at Univ(PhD) schools. Since much teaching of statistics takes place in mathematics departments,

teaching assignments for tenured and tenure-eligible faculty in these departments by type of school are also included in Table 6 and Figure 4. Most statistics departments

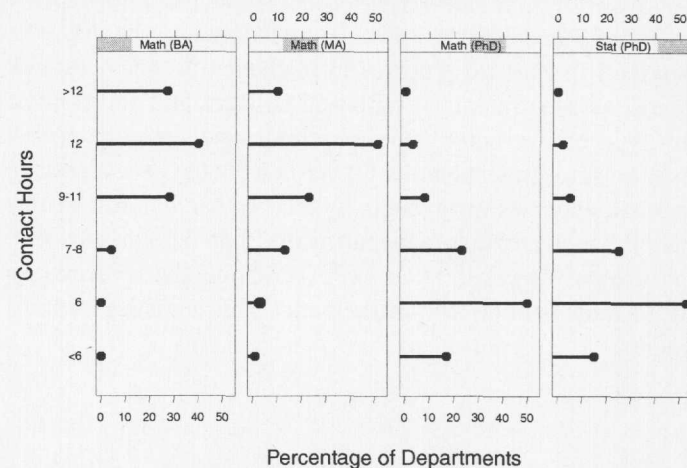


Figure 4. Percentage of Departments of Mathematics and Departments of Statistics Having Various Weekly Teaching Assignments in Classroom Contact Hours for Tenured and Tenure-Eligible Faculty by Type of School: Fall 1995.

at Univ(PhD) schools have doctoral programs and so their teaching assignments are similar to doctoral-granting mathematics departments.

Table 5. Percentage of Gender and of Racial/Ethnic Groups Among Tenured, Tenure-Eligible and Other Full-Time Faculty in Departments of Statistics at Universities: Fall 1995

	Percentage of full-time faculty						Number of full-time faculty
	American Indian/Alaskan	Asian/Pacific Islander	Black not Hispanic	Mexican American, Puerto Rican, other Hispanic	White, not Hispanic	Not known	
All schools							
Tenured men	0	12	0	3	55	1	
Tenured women	0	0	0	1	4	0	
Tenure-eligible men	0	3	1	1	10	0	100%
Tenure-eligible women	0	1	0	0	3	0	988*
Other full-time men	0	1	0	0	2	0	
Other full-time women	0	1	0	0	2	0	
Total full-time men	0	16	1	4	66	1	100%
Total full-time women	0	2	0	1	8	0	988**

0 means less than half of 1%.

* Total for all six rows in this block.

** Total for both rows in this block.

Table 6. Percentage of Departments Having Various Weekly Teaching Assignments in Classroom Contact Hours for Tenured and Tenure-Eligible Faculty in Departments of Mathematics and Departments of Statistics by Type of School: Fall 1995

	Percentage of departments having various contact hours						Number of schools
	< 6 hrs.	6 hrs.	7-8 hrs.	9-11 hrs.	12 hrs.	> 12 hrs.	
<i>Math depts.</i>							
College (BA)	0	0	4	28	40	27	100% 985
Univ (MA)	1	3	13	23	51	10	100% 242
Univ (PhD)	17	50	23	8	3	0	100% 169
<i>Stat depts.</i>							
Univ (PhD)	15	53	25	5	2	0	100% 67

5. TYPE OF INSTRUCTOR FOR STATISTICS COURSES

Table 7 and Figure 5 give a breakdown of the 209,000 students in statistics courses in mathematical sciences and statistics departments at four-year colleges and universities by type of instructor, type of school, and type of department. More students and a higher percentage of students in statistics courses were taught by tenured and tenure-eligible faculty in mathematics departments than in statistics departments. However, at Univ(PhD) schools the percentages were quite similar for mathematics and statistics departments.

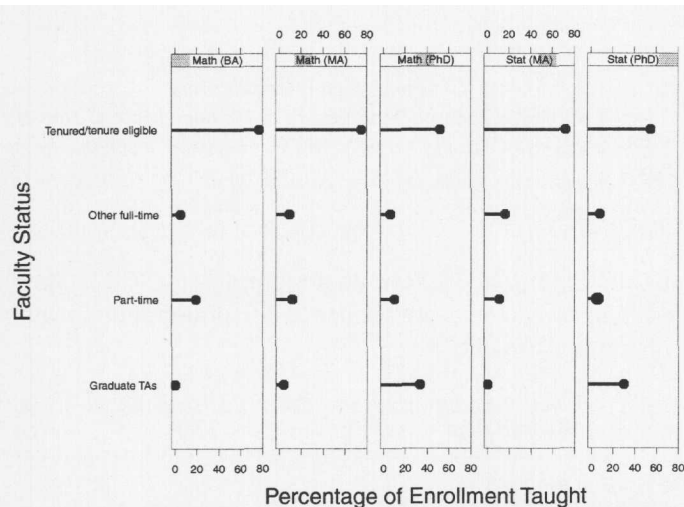


Figure 5. Percentage of Enrollment in Undergraduate Statistics Courses Taught in Departments of Mathematics and Departments of Statistics by Type of School and by Type of Instructor: Fall 1995.

In fall 1995, statistics was taught to 143,000 students in four-year college and university mathematics or mathematical sciences departments. How many full-time equivalent (FTE) faculty were needed to teach these students? The 1995 CBMS Survey Report gives the number of sections of statistics classes, the number of sections of these classes taught by tenured or tenure-eligible faculty, and the teaching assignments in contact hours, all by type of school. Using this information it is straightforward to com-

pute that the number of full-time equivalent tenured or tenure-eligible faculty used to teach undergraduate statistics courses is 707 at bachelor's colleges, 388 at master's universities, and 288 at Ph.D. universities for a total of 1,383 FTE tenured or tenure-eligible faculty. These faculty teach 71% of the 143,000 students in undergraduate statistics classes in mathematics departments; the remaining 29% of these students are taught by other full-time faculty, part-time faculty, and graduate teaching assistants. Many of the full-time faculty teaching statistics classes in mathematics departments have Ph.D.s in statistics. In addition to the undergraduate statistics classes considered here, there is some graduate-level statistics taught in mathematics departments. Thus, the number of FTE tenured or tenure-eligible faculty teaching statistics classes in mathematics departments is probably somewhat larger than the 1,383 above.

Table 7. Percentage of Enrollment in Undergraduate Statistics Courses in Departments of Mathematics and Departments of Statistics by Type of Instructor and Type of School: Fall 1995.

	Percent of enrollment in stat courses taught by				Stat enroll. 1000s
	Tenured/tenure-eligible	Other full-time	Part-time	Grad TAs	
<i>Math depts</i>					
Coll (BA)	77	5	19	0	100% 68
Univ (MA)	75	9	12	4	100% 42
Univ (PhD)	52	6	10	33	100% 33
<i>Stat depts.</i>					
Univ (MA)	72	16	11	0	100% 4
Univ (PhD)	55	8	6	30	100% 62

6. OVERVIEW OF TWO-YEAR COLLEGE MATHEMATICS PROGRAMS

Two-year colleges in the United States serve about 5,400,000 students. In fall 1995, the 1,023 two-year colleges with mathematics programs taught 46% of all collegiate enrollment in mathematics. (We use the term "mathematics



Table 8. Enrollment in Thousands in Two-Year College Mathematics Programs in Elementary Statistics and in all Mathematics and Statistics Classes: Fall 1965-1995.

Year	1965	1970	1975	1980	1985	1990	1995
Enrollment in elementary statistics	4	11	23	20	29	47	69
Total enrollment in math and stat	343	571	864	953	936	1295	1456
Elem stat as a percentage of total	1.2%	1.9%	2.7%	2.1%	3.1%	3.6%	4.7%

program” because the majority of two-year colleges now administer mathematics as part of a larger divisional structure rather than as a separate department. We know of no two-year college with a statistics department or program.) Fifty-three percent of the enrollment in mathematics programs was in remedial courses—that is, courses at or below the level of second year high school algebra.

An estimated 7,578 people had a full-time permanent job teaching in a mathematics program at a two-year college. (The number of part-time instructors was nearly double that.) Eighty-two percent of the full-time permanent faculty had a master’s degree and 17% had a doctorate as their highest degree. Forty percent were women and 13% ethnic minorities, about the same percentages as in the pool of U.S. citizens granted master’s degrees in 1992–1993 [1995 *Digest of Education Statistics*, National Center for Education Statistics]. They taught an average of 15.8 hours a week with 48% teaching additional hours for extra pay at their own college. Working conditions are generally not as good as in four-year colleges. However, 61% of full-time permanent faculty members had a fully enclosed private office and 76% had a computer or terminal in their office.

7. STATISTICS ENROLLMENT IN TWO-YEAR COLLEGES

Eighty percent of two-year college mathematics programs offered a course the program head classified as “elementary statistics (with or without probability)” and 5% offered a course classified as “probability (with or without statistics).” The fall 1995 enrollments were 69,000 and 3,000, respectively. In 1970 only 41% of the two-year college mathematics programs offered a course in elementary statistics. The growth in enrollment in the elementary statistics course over the last 30 years has been phenomenal (see Table 8), far outstripping the increase in total enrollment in mathematics programs.

In 1995 enrollment in elementary statistics was larger for the first time than enrollment in the first semester of mainstream calculus.

In the CBMS surveys, mathematics program heads were asked to estimate enrollment in elementary statistics taught outside the mathematics program. The total estimated in 1995 was only 9,000, a number that hasn’t varied much from 1970. Two-thirds of this enrollment was in business divisions and most of the rest in the social sciences.

For every 100 two-year college students who began a calculus sequence (mainstream or non-mainstream, inside or outside mathematics programs) in fall 1995, there were 95 who enrolled in introductory statistics or probability (inside or outside mathematics programs).

8. INSTRUCTION IN TWO-YEAR COLLEGE STATISTICS COURSES

Students taking elementary statistics in a two-year college had the benefit of a small class size (mean of 27.9). Fewer than 1% of sections had an enrollment over 60.

While 94% of sections of elementary statistics were taught primarily by the standard lecture method, there were indications that two-year college faculty were following the recommendations of statisticians as to how the introductory course should be taught:

- 39% of sections included a writing component such as projects or reports.
- 29% of sections assigned group projects.

Given their more limited resources, two-year college instructors made fairly heavy use of technology:

- 29% of all sections used graphing calculators.
- 46% of all sections required computer assignments.
- 21% of all sections met at least once a week in a classroom equipped with computers for students.

9. STATISTICIANS IN TWO-YEAR COLLEGES

About 168 or 2% of the 7,578 full-time permanent faculty members in two-year college mathematics programs were reported to have their highest degree in statistics. About 13 of these had doctorates and the rest master’s degrees. Of the approximately 14,400 part-time and full-time temporary faculty members, about 189 or 1% had their highest degree in statistics, about 23 of whom had doctorates. (Part-time faculty members taught 32% of the sections of elementary statistics.)

Jobs teaching full-time in a two-year college mathematics program are highly prized. In a typical two-year college, there is the opportunity to teach a wide range of courses to a wide range of students. Compared to universities, there is little committee work, little demand for research or publication, an opportunity to teach extra hours for extra pay, and job security. One trade-off is a teaching assignment of 15 to 16 hours a week rather than the 12 hours at many regional universities and four-year colleges.

Consequently, jobs are hard to get. As a lower bound on the number of people who would like one of the 350 or so jobs that become available annually, mathematics program heads estimated that 3052 of their 14,266 part-time faculty members are seeking such full-time employment.

Two-year college mathematics programs generally do not think first of a statistician when hiring. However, we have not heard of any reluctance to hire statisticians to teach in two-year college mathematics programs as long as they are



capable of and willing to teach mathematics courses. The minimum qualification is typically a master's degree in the mathematical sciences, although sometimes mathematics is specified.

One key to getting a full-time permanent position is to take one of the more readily available part-time or full-time temporary jobs first. Of the estimated 350 people newly hired as full-time permanent faculty members in two-year college mathematics programs for 1995–1996, 62% had taught previously in that program either on a full-time temporary or part-time basis.

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