

APPENDIX II

SAMPLING AND ESTIMATION PROCEDURES

Sampling Procedure

The sampling frame was constructed using *The 1990 Mathematical Sciences Professional Directory* published by The American Mathematical Society and it consisted of those two-year colleges, four-year colleges, and universities in the U.S.A. including the District of Columbia that taught undergraduate mathematics courses. There was a total of 2439 such institutions. During the two years preceding the beginning of this study, the AMS data base was made as complete as possible. Enrollments of the schools were taken from *The HEP 90 Higher Education Directory*.

Institutions were classified according to the highest degree offered by the Department of Mathematics and were titled four-year universities (PhD), four-year universities (MA), four-year colleges (BA) and two-year colleges. This is the same classification used by the AMS/MAA Data Committee, (except for the addition of the two-year colleges), in conducting the annual surveys of Mathematics Departments published in *The Notices of The American Mathematical Society*. In all but one of the previous surveys, the sampling frame was based on a classification of schools used by the Center for Educational Statistics. The classification used for this survey both produces better data for the study of The Mathematical Sciences and Computer Science and produces data comparable with the annual Data Committee surveys.

Two-year colleges and four-year colleges were treated separately. Two-year colleges were divided into 10 strata based on control (public or private) and institutional enrollment. Four-year colleges were divided into 20 strata according to control (public or private), the classification (PhD, MA, and BA) and institutional enrollment. Standard sampling techniques were used to determine the sample size for each stratum and then random samples were drawn from each stratum. Since enrollment was used in the stratification, large schools were sampled much more heavily than small schools. Table 1 gives a short summary of the population and sample sizes.

Two separate questionnaires were used; one for two-year colleges and one for four-year institutions. Questionnaires were mailed to the Mathematics Department or Program at each sampled school. In addition, at the four-year schools all other known Statistics, Computer Science or additional Mathematical Sciences departments (such as Applied Mathematics or Operations Research) were mailed the questionnaire. Only 14 other Mathematical Sciences departments were found at the sampled schools. Copies of the two questionnaires are found in Appendices IV and V.

TABLE 1. Short summary of strata, number of schools in each strata and number of schools in the sample drawn from each strata.

	Number of strata	Population (No. of schools)	Sample (No. of schools)
Universities (PhD)	7	165	89
Universities (MA)	5	236	102
Four-year colleges (BA)	8	1020	123
Two-year colleges	10	1018	212
TOTAL	30	2439	526

TABLE 2. Number of Statistics and Computer Science Departments in the population and in the sample.

	Population	Sample
Statistics		
Universities (PhD)	53	32
Universities (MA)	5	4
Four-year colleges (BA)	2	2
TOTAL STATISTICS	60	37
Computer Science		
Universities (PhD)	136	75
Universities (MA)	107	52
Four-year colleges (BA)	240	36
TOTAL COMPUTER SCIENCE	483	163

Population sizes were estimated from the sampled schools

Table 2 summarizes the population and sample sizes for the separate Computer Science and Statistics Departments at four-year colleges and universities.

All projected enrollments in mathematics, statistics, operations research and computer science courses in four-year schools are based on the enrollments in the departments sampled in this survey. No attempt was made to collect data on enrollments in courses that were taught by other departments at the institutions. A limited attempt was made to estimate such enrollments at two-year colleges.

Estimation Procedures

Course enrollments and other information in this report are projected national figures for all institutions in the frame described above. In nearly all cases the statistics are for Fall 1990.

Projections were made using standard procedures for stratified random samples. For example, for Course A, if stratum i has f_i schools in it of which n_i schools respond with an enrollment for Course A, and E_i is the total enrollment in Course A reported by these n_i schools, then the estimated total enrollment in Course A in stratum i is given by:

$$(N_i/n_i) * E_i.$$

Totals of interest are then computed by adding estimates for appropriate strata.

The procedure used to handle separate departments at the same institution varied with the question. For example, when projecting course enrollments, data from all departments at each school were combined before projections were made. On the other hand, most information on faculty was kept separate for the departments at each school.

Response rates and related information

The response rates are given in Table 3. A summary table by department in four-year schools is given in Table 4. The response rates are down slightly from the 1985-86 survey. However responding schools were spread fairly uniformly across the strata. In addition, sample sizes were larger than in the past so that actual number of respondents was higher than in any previous survey in this series which dates back to 1965-66.

TABLE 3. Population sizes, respondents, and response rates by type of school and department.

	Number of departments	Number in the sample	Respondents	Response rates
Universities (PhD)				
Mathematics	165	89	69	78%
Statistics	53	32	20	63%
Computer Science	136	75	42	56%
Universities (MA)				
Mathematics	236	102	79	77%
Statistics	5	4	3	75%
Computer Science	107	52	21	40%
Four-year colleges (BA)				
Mathematics	1020	123	69	56%
Statistics	2	1	1	100%
Computer Science	240	36	12	33%
Two-year colleges				
Mathematics programs	1018	212	102	48%

TABLE 4. Population sizes, sample sizes, respondents, and response rates by type of department in four-year schools.

	Number of departments	Number in the sample	Respondents	Response rate
Mathematics departments	1421	314	217	69%
Statistics departments	60	37	24	65%
Computer science departments	483	163	75	46%
TOTAL	1964	514	316	61%

TABLE 5. Comparison of actual enrollment of all schools in the population and this same enrollment estimated from responding schools in the sample by type of school.

	Estimated enrollment	Actual enrollment	Error
Universities (PhD)	3,049,266	3,038,912	0.34%
Universities (MA)	2,096,895	2,181,683	-3.89%
Four-year colleges (BA)	2,400,873	2,418,322	-0.72%
TOTAL four-year schools	7,547,034	7,638,917	-1.20%
Two-year colleges	4,691,622	4,630,968	1.31%

The sampling frame had enrollments for all schools. These enrollments for the responding schools were used to project total enrollments for all schools in the population. Actual enrollments were found by adding enrollments for all schools. Table 5 contains a comparison of these results.

A list of all responding departments is included in Appendix III.