

Appendix II

Sampling and Estimation Procedures

Sampling Procedures

The sampling frame for the 1995 CBMS survey consisted of those two-year and four-year colleges and universities in the U.S. that teach undergraduate mathematics classes. There are 2419 such institutions. Sources used in constructing the sampling frame included (1) the sampling frame for the 1990 CBMS survey; (2) the 1995 *Mathematical Sciences Professional Directory* published by the American Mathematical Society; (3) the HEP 95 *Higher Education Directory*; (4) Integrated Postsecondary Education Data System (IPEDS), National Center for Education Statistics, U.S. Department of Education; (5) *A Classification of Institutions of Higher Education*, 1994 edition, The Carnegie Foundation for the Advancement of Teaching; (6) *Schools Offering Degrees in Statistics in the United States and Canada*, 1995 edition, American Statistical Association; and (7) personal contacts. Two-year private-for-profit schools were not included in this study.

Institutions were classified according to the highest degree, doctoral (PhD), master's (MA), or bachelor's (BA), offered by the main mathematics department or as a two-year college. The abbreviations in parentheses are generic and stand for any form of doctorate, master's, or bachelor's in mathematics, respectively. This is true throughout the report. This is the same classification used for the 1990 CBMS survey. It is also the same classification used by the AMS-IMS-MAA Data Committee (except for the addition of the two-year colleges) in conducting its annual surveys of departments of mathematics and departments of statistics which are published in the

Notices of the American Mathematical Society. This classification is quite appropriate for surveying mathematics departments, and it also enables comparisons between the annual surveys and the CBMS survey.

Four-year colleges and universities were divided into 20 strata according to control (public or private), the classification mentioned above (PhD, MA, and BA), and institutional enrollment. Two-year colleges were handled separately from four-year colleges and universities. Two-year colleges were divided into 10 strata based on control (public or private) and institutional enrollment. Standard statistical procedures were used to draw a stratified random sample of 350 four-year colleges and universities and 250 two-year colleges.

To divide the sample size of 350 among the 20 strata in the four-year college and university population, the variable "institutional enrollment" was used. For an optimal allocation, sample sizes for each stratum must be proportional to $N_i \cdot \sigma_i$, where N_i is the number of schools in stratum i and σ_i is the standard deviation of enrollments in stratum i . Since institutional enrollment was also used in forming the strata, schools of similar size are found in each stratum. Strata that contain large schools have more variability in enrollments (larger σ_i 's) than those containing small schools and hence receive a larger portion of the sample. Thus schools with larger enrollments were more likely to be in the sample than schools with smaller enrollments, and this is seen in Table A2.2. Similar remarks can be made for the two-year colleges.

TABLE A2.1 Number of strata, number of schools and sample sizes by type of school: Fall 1995.

	Number of strata	Population (number of schools)	Sample (number of schools)
Universities (PhD)	7	169	112
Universities (MA)	5	242	120
Four-year colleges (BA)	8	985	117
Two-year colleges	10	1023	250
Total	30	2419	599

Four-year colleges and universities are classified according to the highest degree offered by the main Mathematics Department. The four-year college (BA) group contains all 4-year schools that offer BA Degrees in Mathematics or offer no degree in Mathematics.

Two separate questionnaires were used, one for four-year colleges and universities and one for two-year colleges. Copies of these two questionnaires are found in Appendices IV and V. Questionnaires were mailed to the main mathematics department or mathematics program

at each school in the sample. A statistics department or an additional mathematics department were included in the sample only if the main mathematics department was in the sample. Summary information for the statistics departments is found in Table A2.2.

TABLE A2.2 Population and sample sizes for Statistics Departments at universities by type of school*: Fall 1995.

	Population (number of departments)	Sample size
Universities (PhD)	63	44
Universities (MA)	8	6
Total	71	50

* Schools are classified according to the highest degree of the main Mathematics Department.

Table A2.3 contains a further breakdown of the sampling frame giving population sizes, sample sizes, number of respondents, and response rates. After comparing results in this survey with comparable

results from various other surveys and censuses and generally finding good agreement, there is good reason to believe that the departments that responded to this survey are very representative of the population.

TABLE A2.3 Population sizes, sample sizes, respondents and response rates by type of school and department: Fall 1995

Departments	Number of departments	Number in the sample	Respondents	Response rates
University (PhD)				
Mathematics	169	112	77	69%
Statistics	63	44	30	68%
University (MA)				
Mathematics	242	120	87	73%
Statistics	8	6	5	83%
Four-year colleges (BA)				
Mathematics	985	117	67	57%
Total Mathematics Departments	1396	349	231	66%
Total Statistics Departments	71	50	35	70%
Two-year colleges				
Mathematics Programs	1023	250	163	65%

Estimation Procedures

Course enrollments and other information found in this report were projected from the sample to totals for all institutions in the sampling frame. In nearly all cases, the results are for Fall 1995. All projected enrollments in courses in four-year colleges and universities are based on the enrollments in courses taught in the departments sampled in this survey. No attempt was made to collect data on enrollments in mathematics courses that were taught by other departments at the institutions. A limited attempt was made at two-year colleges to estimate such enrollments, and these enrollments are reported separately in this report.

Projections were made using standard procedures for stratified random samples. For example, if stra-

tum i contains N_i schools of which n_i schools respond with a total enrollment of E_i for Course A, then the projected 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.

Data from any additional mathematics departments at a sampled school were combined with data from the main mathematics department before any projections were made. The data and projections for statistics departments were kept apart from mathematics departments and are reported separately in this report.

