Chapter 2

CBMS2010 Special Projects

Each CBMS survey accepts proposals for special projects from various professional society committees. Special projects chosen for one CBMS survey might, or might not, be continued in the next CBMS survey. This chapter presents data from the special projects of CBMS2010:

- The mathematical education of pre-college teachers (Tables SP.1-SP.9)
- Practices in distance-learning courses (Tables SP.10-SP.13)
- Academic resources available to undergraduates (Tables SP.14 and SP.15)
- Interdisciplinary courses in four-year mathematics departments (Tables SP.16 and SP.17)
- Dual enrollments in mathematics and statistics (Tables SP.18 and SP.19)
- Requirements and varieties of majors in mathematics and statistics in four-year mathematics and statistics departments (Tables SP.20-SP.22)
- Availability of upper-level classes in four-year mathematics departments and statistics departments (Tables SP.23 and SP.24)
- Estimates of post-graduation plans of graduates of four-year mathematics departments and statistics departments (Table SP.25)
- Assessment in four-year mathematics departments and statistics departments (Table SP.26)

When there is comparable data in CBMS2005, the appropriate comparison table will be given in the caption if the table number is different from the CBMS2010 table number. Also note that further discussion of the special project issues at two-year colleges is given in the section "Special Topics of Interest to Two-Year-College Mathematics Programs", which is located at the end of Chapter 7.

Terminology: Recall that in CBMS2010, the term "mathematics department" includes departments of mathematics, applied mathematics, mathematical sciences, and departments of mathematics and statistics. These departments may offer a broad spectrum of courses in mathematics education, actuarial science, and operations research, as well as in mathematics, applied mathematics, and statistics. Computer science courses are sometimes also offered by mathematics departments. The term "statistics department" refers to a graduate department of statistics or biostatistics that offers undergraduate statistics courses. Courses and majors from separate departments of computer science, actuarial science, operations research, etc. are not included in CBMS2010. Departments are classified by the highest degree offered; for example, "masters-level department" refers to a department that offers a masters degree but not a doctoral degree.

TABLE SP.1 Percentage of mathematics departments whose institutions offer certification programs for some or all grades K–8, and also for secondary teachers, by type of department in fall 2010. (Data from fall 2000, 2005, when available, in parentheses)

	Percentage whose institutions have a K-8 teacher certification program	Percentage whose institutions have a secondary mathematics certification program
Mathematics Departments		
Univ (PhD)	62 (72,78)	79
Univ (MA)	90 (87,92)	96
Coll (BA)	70 (85,88)	80
Total Math Depts	72 (84,87)	82

Tables SP.1–SP.9: The Mathematical Education of Pre-college Teachers

Percentages of Four-year Mathematics Departments whose Institutions have Elementary and Secondary Teacher Certification Programs

Table SP.1 shows that, in fall 2010, 72% of four-year mathematics departments reported belonging to an institution that offered a teacher certification program for some or all grades K-8; this compares to 87% in 2005 and 84% in 2000. This table breaks down these percentages by the level of department, with the masters-level departments having the largest percentage of K-8 teacher certification programs in each of the three CBMS surveys 2000, 2005, and 2010. It is a bit surprising that these percentages decreased from 2005 to 2010; in both the CBMS 2005 and 2010 surveys, the standard errors on the percentages at each level are about 4-5 percentage points (3% at the doctoral level in 2010). It will be interesting to see the 2015 CBMS estimates. Table SP.1 also shows that in fall 2010 a larger percentage, 82% of four-year mathematics departments, belonged to an institution that offered a secondary teacher certification program; again, the percentage was largest for the masters-level departments.

Table SP.3 shows that the percentage of four-year mathematics departments having a "math specialist" program for any K-8 grade in fall 2010 was 24%, and of those, the percentage having a math specialist program for "early" elementary grades was 58%. A "math specialist" was defined as an elementary teacher who is likely to teach only mathematics courses; "early" was not defined, and it was noted that there is no national standard for which grades are "early" grades, though generally first and second grades are regarded as "early", while grades six and above are regarded as "later". Departments whose institutions had a K-8 certification program and a separate department or school of education were also asked if the mathematics department offered a course that was team-taught by mathematics and education faculty; the percentage of such departments was 8%. In Tables SP.1 and SP.3, these percentages are broken down by type of department.

Teacher Preparation Programs at Two-year Colleges

One finding of the CBMS2005 report was that public two-year colleges offered programs that allow three kinds of students to complete their entire mathematics certification requirements at the two-year college; Table SP.2 updates this data for fall 2010 and shows that teacher preparation programs are growing in two-year colleges. Table SP.2 also shows that two-year institutions were more involved in the preparation of elementary teachers than secondary teachers, though secondary teachers may take their lower-division mathematical requirements at a two-year institution. The three types of students mentioned in Table SP.2 are undergraduates without a bachelors degree ("pre-service teachers"), in-service teachers who already have certification in some other subject, and people who leave a first career to enter a second career in pre-college teaching ("career switchers"). With the exception of certification for in-service middle school teachers, the percentages of two-year institutions with teacher certification programs have all increased from 2005 to 2010 for each of the three kinds of students. While in fall 2010 the percentage of institutions with elementary teacher certification programs in mathematics was down slightly from fall

TABLE SP.2 Percentage of mathematical programs at public two-year colleges (TYCs) having organized programs that allow various types of pre- and in-service teachers to complete their entire mathematics course or licensure requirements in fall 2010. (Fall 2005 data in parentheses.)

	Percentage of TYCs with an organized program in which students can complete their entire mathematics course or licensure requirements
Pre-service elementary teachers	41 (30)
Pre-service middle school teachers	24 (19)
Pre-service secondary teachers	13 (3)
In-service elementary teachers	25 (16)
In-service middle school teachers	12 (15)
In-service secondary teachers	10 (2)
Career-switchers aiming for elementary teaching	30 (19)
Career-switchers aiming for middle school teaching	17 (14)
Career-switchers aiming for secondary teaching	13 (6)

2005 at four-year institutions, at two-year institutions certification programs in mathematics showed the biggest increase at the elementary school level for each of the three kinds of students. In fall 2010, the percentage of public two-year college mathematics programs with a complete certification program at the elementary level was 41%; at the middle-school level, it was 24%, and at the secondary level, it was 13%.

Table SP.4 gives some indication of the role that mathematics programs play in K-8 teacher certification programs at two-year colleges: 36% of mathematics programs assigned a faculty member to coordinate K-8 teacher education in mathematics, 7% offered a special mathematics course for K-8 teachers during a two-year period, 5% offered a mathematics pedagogy course in their mathematics program, and 9% reported that a mathematics pedagogy class is offered outside of the mathematics program. All these percentages were slightly lower than in 2005.

Further discussion of teacher education programs in two-year colleges is contained at the end of Chapter 7: Topics of Special Interest to Two-Year College Mathematics Programs. Among the items noted is that in the past ten years, from fall 2000 to fall 2010, the enrollment in the courses in mathematics for elementary school teachers in two-year colleges has doubled (see Table TYE.3 in Chapter 6). The data from the 2010 CBMS survey show that two-year colleges are becoming a more significant participant in the preparation of teachers.

Four-year Mathematics Departments: Courses Taken by Pre-service K-8 Teachers

For four-year mathematics departments whose institution had a K-8 certification program, the top portion of Table SP.5 shows the distribution of the number of mathematics courses required for “early” K-8 certification (if the institution made a distinction between kinds of K-8 certification, or for all K-8 certi-

TABLE SP.3 Percentages of four-year mathematics departments in universities and four-year colleges that offer K-8 teacher certification programs having various characteristics, by type of department, in fall 2010.

	Percentage of four-year math depts			
Percentage Where	Univ (PhD) %	Univ (MA) %	College (BA) %	All Math Depts %
Dept. offers a K-8 certification program.	62	90	70	72
Dept. offers program for "math specialists" in any K-8 grades.	36	27	21	24
Of those departments that offer a program for "math specialists" in any K-8 grade, the percentage of depts offering a program for "math specialists" in early elementary grades.	44	72	58	58
Dept. offers courses team-taught with education dept.	11	5	8	8

fication if no distinction was made) among the various levels of departments. The table shows that, most commonly, two mathematics courses were required. The table is broken down by level of department and shows that masters-level departments were more likely to require more than two courses than were doctoral or bachelors-level departments. The bottom portion of the table shows the average numbers of required mathematics courses, methods (pedagogy) courses, and methods courses specifically taught within the mathematics department. Across all levels of departments, the average number of mathematics courses was 2.7, the average number of methods courses was 1.4, and the average number of methods courses taught within the mathematics department was 0.5; the averages in the masters-level departments were slightly higher. The data on numbers of required mathematics courses can be compared to the data in Table SP.5 (for early grade certification or for those programs that did not make a distinction) in the CBMS2005 report (p. 52); the 2005 survey also asked about mathematics course requirements for “later” grade certification.

Four-year mathematics departments with a K-8 certification program were also asked to indicate the core areas in which the mathematics department

TABLE SP.4 Percentage of public two-year colleges (TYCs) that are involved with K-8 teacher preparation in various ways in fall 2010. (Data from fall 2005 in parentheses.)

	Percentage of TYCs
Assign a mathematics faculty member to coordinate K–8 teacher education in mathematics	36 (38)
Offer a special mathematics course for preservice K–8 teachers in 2009–2010 or 2010–2011	7 (11)
Offer mathematics pedagogy courses in the mathematics department	5 (9)
Offer mathematics pedagogy courses outside of the mathematics department	9 (10)

TABLE SP.5 Among all four-year colleges and universities with a K-8 certification program, the percentage of mathematics departments requiring various numbers of mathematics courses for "early" grades certification (if there is a distinction), by type of department, in fall 2010. Also the average number of various courses taught in mathematics and education departments required for "early" grades certification (if there is a distinction), by type of department, in fall 2010. (Table can be compared to Table SP.5 in CBMS2005, where questions were broken down further.)

	Percentage of departments with K-8 certification programs that require various numbers of mathematics courses for "early" certification			
Number of mathematics courses required for "early" grades certification	Univ (PhD) %	Univ (MA) %	Coll (BA) %	All Math %
0 required	7	9	8	8
1 required	15	3	11	10
2 required	38	35	44	42
3 required	22	29	10	14
4 required	11	13	14	14
5 or more required	5	11	13	11
	Average number of various courses required for "early" certification			
Type of required courses	Univ (PhD)	Univ (MA)	Coll (BA)	All Math
Mathematics Department math courses	2.4	3.0	2.7	2.7
Methods (pedagogy) courses (taught in any department)	1.7	1.8	1.3	1.4
Mathematics Department methods (pedogogy) courses	0.6	0.8	0.5	0.5

Some percentages do not total 100% due to round-off.

offered courses specifically designed for elementary school teachers (more than one core area might be addressed in a single course). This data, broken down by level of department, is presented in Table SP.6; in each case, the masters-level departments were the most likely to offer a course addressing each core area. Overall, "numbers/operations" were addressed in specially designed courses offered by the mathematics department in 74% of four-year mathematics departments, "algebra" in 57% of departments, "geometry/measurement" in 69% of departments, "statistics/probability" in 56% of departments, and "methods of teaching elementary mathematics" in 31% of departments. In the 2005 report, data regarding the three most likely mathematics courses taken by elementary pre-service teachers was presented in Table SP.6 of the CBMS2005 report (p. 53).

Table SP.7 gives the rank of the faculty who generally taught the courses addressed in Table SP.6. At the doctoral-level departments, these faculty were most likely other full-time (non-tenure-track) faculty, but at the other levels of departments, they were generally tenured or tenure-track faculty. In Table SP.7 of the CBMS2005 report (p. 54), data on the rank of the most likely course coordinator of a multiple-section course, Elementary Mathematics Education, were presented.

TABLE SP.6 Among mathematics departments at four-year colleges and universities having K-8 certification programs, the percentage of mathematics departments offering various core courses specifically designed for pre-service elementary teachers by type of department in fall 2010. (Table SP.6 in CBMS2005 dealt with mathematics courses likely to be taken in K-8 certification programs.)

	Percentage of mathematics departments with K-8 certification program offering various courses			
Core areas covered by one or more specially designed courses(s) offered by mathematics departments	Univ (PhD)	Univ (MA)	Coll (BA)	All Math
Numbers/Operations	73	92	71	74
Algebra	58	64	55	57
Geometry/Measurement	67	94	64	69
Statistics/Probability	53	76	52	56
Methods of teaching elementary grades mathematics	27	36	31	31

TABLE SP.7 Among mathematics departments at four-year colleges and universities having K-8 certification programs and offering courses in core areas described in Table SP.6, the percentages of the faculty who generally teach these courses by rank and by the type of mathematics department in fall 2010. (Table SP.7 in CBMS2005 dealt with the rank of course coordinator.)

	Percentages of mathematics faculty at mathematics departments with K-8 certification program			
Rank of faculty who generally teach courses of SP.6	Univ (PhD)	Univ (MA)	Coll (BA)	All Math
Tenured/tenure-track faculty	30	79	63	62
Postdocs	0	0	0	0
Other full-time faculty	53	10	25	26
Part-time faculty	8	11	12	11
Graduate teaching assistants	9	0	0	1

Four-year Mathematics Departments: Courses in Secondary Certification Programs

Table SP.8 shows that less than 8% of four-year mathematics departments whose institution offers a secondary certification and has a separate education department or school offered a course that was team-taught with the education department; at doctoral-level departments, this percentage was 15%. Table SP.3 showed that such team-taught courses were offered at about a comparable rate among departments whose institution offered a K-8 certification program.

Table SP.9 gives the percentages of four-year mathematics departments that required courses in specified core areas for secondary mathematics certification, departments where courses in these core areas were not required but were generally taken by pre-service secondary teachers, and departments that offered courses specially designed for pre-service secondary teachers in these core areas. At all three types of departments, modern algebra and geometry were required by more than 85% of departments. At doctoral and masters-level departments, advanced calculus/analysis was required by more than 60% of departments. At masters and bachelors-level departments, statistics was required by more than 90% of departments. Doctoral-level departments were more likely to offer special courses for secondary pre-service teachers, with special geometry courses offered by 41% of the doctoral-level departments. Table SP.9 of the CBMS2005 report (p. 55) presented similar data on history of mathematics courses only.

TABLE SP.8 Among all four-year colleges and universities offering certification programs for pre-service mathematics secondary teachers, the percentage offering team-taught courses with education departments, by type of department, in fall 2010.

	Type of department			
	Univ (PhD)	Univ (MA)	Coll (BA)	All math
Percentage of departments at colleges and universities that have a separate education department	95	100	97	97
Of those with a separate education department, the percentage that offer courses team-taught by education and mathematics faculty	15	5	8	8

TABLE SP.9 Among four-year colleges and universities with secondary pre-service teaching certification programs, for various courses, the percentage of mathematics departments whose program requires the course, or whose students generally take the course, or who offer a special course in the given subject that is designed for secondary teachers, by type of department, in fall 2010.

	Percentage of departments with secondary certification program where:											
	Course is required				Course is generally taken, but not required				Math dept offers special course in the subject for secondary pre-service teachers			
Course	Univ (Ph.D) %	Univ (MA) %	Coll (BA) %	All math %	Univ (Ph.D) %	Univ (MA) %	Coll (BA) %	All math %	Univ (Ph.D) %	Univ (MA) %	Coll (BA) %	All math %
Advanced Calculus/ Analysis	63	61	46	51	11	3	18	15	17	4	2	4
Modern Algebra	87	92	89	89	5	6	6	6	25	2	4	7
Number Theory	30	30	27	28	23	22	18	20	24	0	3	6
Geometry	86	97	92	92	13	3	6	7	41	15	19	22
Discrete Mathematics	50	74	68	66	6	9	6	6	17	16	6	9
Statistics	76	97	91	90	18	3	5	7	9	11	5	6
History of Math	49	56	53	53	16	17	8	10	25	8	20	19

Tables SP.10–SP.13: Practices in Distance-Learning Courses

In the CBMS 2010 survey, a "distance-learning course" was defined to be a course in which "the instruction occurs with the instructor and the students separated by time and/or place (e.g. where the majority of the course is taught online, or by computer software, by television or by correspondence)". In Appendix I, enrollments for distance-learning courses taught by four-year mathematics and statistics departments are presented; Chapter 6, Table TYE.12 gives the comparable enrollments at two-year college mathematics programs. In fall 2010, by the tables in Appendix I, total distance-learning enrollments were 54,499 enrollments in courses at four-year mathematics departments and 4,171 enrollments in courses at statistics departments; Table TYE.12 shows that there were 187,523 enrollments in distance-learning courses at two-year mathematics programs. These enrollments represent a small percentage of all enrollments (2% of all four-year mathematics department fall enrollments, 4% of all statistics department fall enrollments, and 9% of all two-year college mathematics program fall enrollments). Enrollments in distance-learning courses appear to be growing, and the 2010 survey sought to explore some issues of their use and pedagogy.

Table SP.10 gives the percentages of some practices in distance-learning courses, broken down by the level of department. From Table SP.10 we see that in fall 2010, distance-learning courses were offered by 35% of the four-year mathematics departments and by 39% of the statistics departments. However, 88% of two-year college mathematics programs offered distance-learning courses. At four-year mathematics and statistics departments, the masters-level departments were those most likely to offer distance-learning courses; of four-year mathematics bachelors-level departments, only 28% offered distance-learning courses. Table SP.10 shows that at 72% of four-year mathematics departments offering distance-learning courses, all of the instruction was offered without the instructor being physically present; this was the case at 57% of the statistics departments. Table SP.10 further shows that among those two-year college mathematics programs offering distance-learning

TABLE SP.10 Percentage of mathematics, statistics, and public two-year college departments offering distance learning[1], and use of various practices with regard to distance learning in fall 2010.

	Mathematics Depts				Statistics Depts			Two-Year Colleges
	Univ (PhD)	Univ (MA)	College (BA)	Total	Univ (PhD)	Univ (MA)	Total	
Percentage offering distance learning	48	57	28	35	30	62	39	88
Characterize majority of course instruction:								
All instruction with no instructor physically present	68	61	77	72	83	25	57	na
Some instruction with no instructor physically present	32	39	23	28	17	75	43	na
Format of majority of distance learning:								
Complete online	na	na	na	na	na	na	na	73
Hybrid	na	na	na	na	na	na	na	22
Other	na	na	na	na	na	na	na	5
Instructional materials created by:								
Faculty	41	31	41	39	34	38	36	10
Commercially produced materials	10	16	5	9	0	13	6	12
Combination of both	49	53	53	52	66	50	58	78
How distance learning students take majority of tests:								
Not at a monitored testing site	22	35	33	31	26	29	27	11
At proctored testing site	55	32	37	40	34	29	32	42
Combination of both	23	33	30	29	40	43	41	47
Give credit for distance learning not offered through department:								
Yes	26	29	55	43	19	25	22	na
No	34	32	20	26	35	38	36	na
No department policy	39	39	25	31	47	38	42	na

[1] Distance-learning courses are those courses in which the majority of instruction occurs with the instructor and students separated by time and/or place (e.g. courses in which the majority of the course is taught online, or by computer software, by television, or by correspondence.)

courses, most of the distance-learning courses were completely online at 73% of the two-year college mathematics programs. As shown in Table SP.10, at four-year mathematics departments offering distance-learning courses, the majority of the course materials were created by faculty at 39% of the departments, were commercially produced at 9% of the departments, and were a combination of both at 52% of the departments; these percentages were quite similar in statistics departments (36%, 6%, and 58%, respectively). At two-year college mathematics programs, there was greater use of commercially produced materials and of a combination of faculty-produced along with commercially produced materials: 10% of two-year college mathematics programs offering distance-learning courses used material produced by faculty for the majority of their distance-learning courses, 12% used commercially produced materials, and 78% used a combination of both. As concerns have been expressed about the security of testing in distance-learning courses, the 2010 survey asked whether the majority of tests were given at a proctored testing site; as shown in Table SP.10, this was the case for 40% of four-year mathematics departments (55% of doctoral-level mathematics departments), at 32% of the statistics departments, and at 42% of the two-year college departments offering distance-learning courses; the majority of tests were not at a monitored test site for 31% of four-year mathematics departments, 27% of statistics departments, and 11% of two-year mathematics programs offering distance-learning courses. The 2010 CBMS survey asked departments offering distance-learning courses if they awarded credit for distance-learning courses offered by other institutions; Table SP.10 shows that 26% of four-year mathematics departments and 36% of statistics departments offering distance-learning courses do not award credit for distance-learning courses taken elsewhere.

Table SP.11 examines two distance-learning practices at two-year mathematics programs that offer distance-learning courses, namely, the use of common exams in multiple sections of distance-learning courses, and the time faculty whose total teaching load is all distance-learning courses were required to be on campus. When there were multiple sections of distance-learning classes at two-year mathematics programs offering distance-learning courses, 39% had no common exams in these courses, 20% had common exams in some sections of these courses, and 23% had common exams in all of these courses. Regarding required hours on campus, of two-year college mathematics programs offering distance-learning courses, 8% never required faculty to be on campus, 6% required faculty to be on campus only for scheduled meetings or appointments, and 21% required a specific number of on-campus office hours.

Table SP.12 considers courses that departments offered in both distance-learning and regular format, and asked for a comparison of the courses offered in the two formats. Almost all of the departments that offered distance-learning courses had the same course offered in both formats (89% of four-year mathematics departments, 100% of statistics departments, and 97% of two-year college mathematics programs), and the vast majority believed that the courses were generally the same. The content, goals, and objectives were thought to be the same at 99% of the four-year mathematics departments, 95% of the statistics departments, and 100% of the two-year college mathematics programs. The course outlines were the same at 97% of the four-year mathematics departments, 90% of the statistics departments, and 96% of the two-year college mathematics programs. Instructors were evaluated in the same ways at 81% of the four-year mathematics departments, 83% of the statistics departments, and 78% of the two-year college mathematics programs. Instructors held comparable office hours at 63% of the four-year mathematics departments and 65% of the statistics departments. The classes had the same projects at 72% of the four-year mathematics departments, 53% of the statistics departments, and 49% of the two-year college mathematics programs. The courses made the same use of common exams at 59% of the four-year mathematics departments, 53% of the statistics departments, and 47% of the two-year college mathematics programs. These numbers are broken down further by the level of department but are not very different at the various levels.

The 2010 CBMS survey contained a new question that asked four-year departments to note each upper-level course offered in distance-learning format. The numbers of departments reporting such courses were small, and our estimates are likely unreliable (particularly for statistics departments), but the data gathered are reported in Tables SP.13A and SP.13.B. If distance-learning courses become more common, these baseline data may be of some interest.

TABLE SP.11 Percentages of public two-year colleges (TYCs) with various practices in distance-learning courses in fall 2010.

Distance-learning course exams when there are multiple instructors teaching the course	% of TYCs
No common departmental exams	39
Common departmental exams for some courses	20
Common departmental exams for all courses	23
Not applicable or unreported	18
Requirements of faculty whose entire teaching load is distance-learning courses regarding time required to be on campus to meet with students	
Never	8
Only for scheduled meeting or student appointment	6
A specified number of office hours per week	21
Not applicable or unreported	65

TABLE SP.12 Percentage of four-year mathematics and statistics departments, and public two-year college (TYC) programs, with courses offered in both distance and non-distance-learning formats, and comparison of various practices in the distance learning and the non-distance-learning formats, by type and level of department, in fall 2010.

	Math				Stat			TYC
	Univ (PhD)	Univ (MA)	College (BA)	Total	Univ (PhD)	Univ (MA)	Total	
Some courses in both non-distance and distance-learning formats	93	90	87	89	100	100	100	97
Of those with courses in both formats, the percentage where:								
Contents, goals, and objectives same as in non-distance learning	98	100	99	99	92	100	95	100
Instructors hold comparable office hours on campus	62	73	59	63	56	75	65	na
Instructors participate in evaluation in same way	72	77	86	81	91	75	83	78
Same use of common exams as in face-to-face	56	51	63	59	56	50	53	47
Same course outlines as in face-to-face	95	100	97	97	92	88	90	96
Same course projects as in face-to-face	74	78	68	72	56	50	53	49

TABLE SP.13.A Percentage of four-year mathematics departments offering various upper-level mathematics courses by distance learning, by department type, in fall 2010.

	Mathematics Departments			
	Univ (PhD)	Univ (MA)	College (BA)	Total
E22. Introduction to Proofs	1	4	1	1
E23-1. Modern Algebra I	1	1	0	1
E23-2. Modern Algebra II				
E24. Number Theory	1			0
E25. Combinatorics				
E26. Actuarial Mathematics				
E27. Logic/Foundations (not E22)				
E28. Discrete Structures			0	0
E29. History of Mathematics	3	5	1	2
E30. Geometry	2		0	0
E31-1. Advanced Calculus I and/or Real Analysis I	1	4		1
E31-2. Advanced Calculus II and/or Real Analysis II				
E32. Advanced Mathematics for Engineering and Physical Sciences	1			0
E33. Advanced Linear Algebra (beyond E17, E19)	1			0
E34. Vector Analysis				
E35. Advanced Differential Equations (beyond E18)				
E36. Partial Differential Equations				
E37. Numerical Analysis I and II	1			0
E38. Applied Mathematics (Modeling)				
E39. Complex Variables	1			0
E40. Topology				
E41. Mathematics of Finance (not E26, E38)	1			0
E42. Codes and Cryptology				
E43. Biomathematics			1	1
E44. Operations Research (all courses)				
E45. Senior Seminar/ Independent Study in Mathematics				
E46. Other advanced-level mathematics				
E47. Mathematics for Secondary School Teachers	2	4		1

Note: These estimates are based on small numbers and have large standard error. Blank entries represent courses with no responses while zero entries indicate percentages that round to 0%.

TABLE SP.13.B Percentage of four-year mathematics and statistics departments offering upper-level statistics courses by distance learning, by department type, in fall 2010.

	Mathematics Departments				Statistics Departments		
	Univ (PhD)	Univ (MA)	College (BA)	Total	Univ (PhD)	Univ (MA)	Total
E6. Mathematical Statistics (calculus prerequisite)							
E7. Probability (calculus prerequisite)	1			0	2		1
E8. Combined Probability & Statistics (calculus prerequisite)	1			0			
E9. Stochastic Processes							
E10. Applied Statistical Analysis	1	3		1	5		4
E11. Design & Analysis of Experiments					3		2
E12. Regression (and Correlation)	1		1	1	3		2
E13. Biostatistics					3		2
E14. Nonparametric Statistics					3		2
E15. Categorical Data Analysis							
E16. Sample Survey Design & Analysis							
E17. Statistical Computing							
E18. Data Management							
E19. Senior Seminar/ Independent Studies							
E20. Bayesian Statistics							
E21. Statistical Consulting							
E22. Statistical Software					2		1
E23. Other upper-level Probability & Statistics	2			0			
E23. Other mathematical science courses					3	8	4
F16. Statistical Computing (Math only)							

Note: These estimates are based on small numbers and have large standard error. Blank entries represent courses with no responses while zero entries indicate percentages that round to 0%.

TABLE SP.14 Percentage of mathematics and statistics departments in four-year colleges and universities, and of mathematics programs at public two-year colleges, that offer various kinds of special opportunities for undergraduates, by type of department, in fall 2010. (Fall 2005 data in parentheses.) This table can be compared to Table SP.14 in CBMS2005.

Percentage with special opportunities for undergraduates	Honors sections of courses for majors %	Math or Stat club %	Special programs for women %	Special programs for minorities %	Math or Stat contests %	Special Math or Stat colloquia for undergrads %	Outreach in K–12 schools %
Mathematics Departments							
Univ (PhD)	70 (70)	91 (88)	31 (15)	21 (10)	93 (92)	82 (70)	71 (51)
Univ (MA)	40 (44)	96 (92)	21 (21)	21 (23)	82 (68)	88 (71)	75 (63)
Coll (BA)	15 (18)	75 (66)	16 (4)	12 (6)	62 (62)	51 (37)	40 (26)
Total Mathematics Departments	26 (28)	80 (72)	19 (8)	14 (8)	69 (67)	60 (46)	49 (34)
Statistics Departments							
Univ (PhD)	43 (27)	48 (27)	19 (0)	22 (7)	24 (22)	67 (47)	30 (11)
Univ (MA)	55 (41)	45 (29)	0 (0)	0 (0)	36 (29)	82 (44)	18 (15)
Total Statistics Depts	46 (30)	47 (27)	13 (0)	15 (6)	28 (23)	71 (46)	27 (12)
Two-Year College Mathematics Programs	20 (24)	31 (22)	6 (7)	11 (15)	41 (37)	16 (6)	32 (25)

Note: 0 means less than one-half of 1%.

TABLE SP.15 Percentage of mathematics and statistics departments in four-year colleges and universities, and of mathematics programs in public two-year colleges, that offer various additional special opportunities for undergraduates, by type of department, in fall 2010. (Fall 2005 data, where available, in parentheses.) This table can be compared to Table SP.15, p. 60, of CBMS2005.

Percentage with additional opportunities for undergraduates	Undergrad. Research opportunity %	Indep. Studies opportunity %	Assigned advisors in dept. %	Senior thesis opportunity %	Math career day %	Graduate school advising %	Internship opportunity %	Senior seminar opportunity %	Consulting lab with clients %
Mathematics Departments									
Univ (PhD)	96 (90)	96 (95)	90 (85)	63 (62)	40 (24)	67 (49)	50 (47)	47 (39)	
Univ (MA)	91 (74)	100 (91)	100 (97)	56 (53)	46 (15)	70 (61)	67 (55)	66 (46)	
Coll (BA)	83 (54)	94 (79)	90 (88)	58 (48)	17 (10)	46 (45)	55 (35)	59 (38)	
Total mathematics depts	86 (62)	95 (83)	91 (89)	59 (50)	24 (12)	52 (47)	56 (39)	58 (39)	
Statistics Departments									
Univ (PhD)	85 (60)	90 (62)	89 (73)	54 (27)	30 (15)	66 (56)	69 (47)	30 (15)	32
Univ (MA)	82 (59)	100 (100)	73 (85)	27 (44)	45 (15)	64 (59)	91 (71)	27 (29)	55
Total statistics depts	84 (60)	93 (70)	84 (76)	46 (31)	35 (15)	66 (57)	75 (52)	29 (18)	39
Two-Year College Mathematics Programs	14 (9)	36 (38)	42 (40)	na (na)	na	na	na	na	

Tables SP.14-SP.17: Academic Resources Available to Undergraduates

Tables SP.14 and SP.15 present a spectrum of academic enrichment activities available in various kinds of mathematics and statistics departments at all levels. In most cases the availability of these options has expanded in 2010 over 2005. Generally, the availability of these options increased as departments offered higher-level degrees (e.g. honors sections were available at 70% of doctoral-level four-year mathematics departments but only at 15% of the bachelors-level four-year departments). Special programs for women and minorities have increased at almost all levels of four-year mathematics and statistics departments, and special colloquia for undergraduates have increased for all types of mathematics and statistics programs. Outreach to K-12 schools also has increased at all levels of institutions, including two-year colleges (though the percentage for all four-year mathematics has returned to the level of 2000). More bachelors-level mathematics departments offered undergraduate research opportunities in 2010 than in 2005 (83% in 2010 and 54% in 2005) and senior thesis opportunities (58% in 2010 and 48% in 2005); career days and internship opportunities have increased at all levels of four-year mathematics and statistics departments.

Generally, there were small changes from 2005 to 2010 in the percentages of two-year colleges offering these special opportunities. The largest changes were in the percentage offering a mathematics club (up to 31% in 2010 from 22% in 2005) and the percentage offering special colloquia (up to 16% in 2010 from 6% in 2005).

CBMS2010 was also interested in interdisciplinary courses. Table SP.16 gives the percentages of departments that offered none, one, or two or more courses that were "team taught" with a member of another department. Table SP.17 gives the percentages of mathematics departments at four-year colleges and universities that offered a new interdisciplinary course in the last five years; of those that offered such a course, Table SP.17 also gives the percentage of departments that offered courses in various subject areas, as well as the average number of new courses those departments added, broken down by type of department. New interdisciplinary courses were offered most often at doctoral-level, followed by masters-level, departments. The most frequently offered new courses at doctoral-level departments were in mathematical biology, where an average of 1.5 new courses were introduced; the second most popular area was mathematics and business or finance. For masters-level departments, mathematical biology and mathematics and finance or business were the top two areas for new interdisciplinary courses, while for bachelors-level departments, mathematics and education, and mathematics and the humanities, were the most popular areas for new interdisciplinary courses.

TABLE SP.16 Percentages of four-year mathematics and statistics departments offering various numbers of courses team-taught with a member of another department in spring or fall 2010

	Mathematics Departments				Statistics Departments		
Numbers of team-taught courses	Univ (PhD) %	Univ (MA) %	College (BA) %	Total %	Univ (PhD) %	Univ (MA) %	Total %
None	73	70	89	84	78	100	84
One course	15	30	7	12	14	0	10
Two or more courses	12	0	3	4	8	0	6

TABLE SP.17 Percentage of all four-year mathematics departments offering new interdisciplinary courses in the last five years and, among those offering new course(s) in the given area, the average number of new courses offered, by type of department, in fall 2010.

	Univ (PhD)		Univ (MA)		Coll (BA)		All departments	
Percentage that offered any new interdisciplinary course	56		45		30		36	
Of those offering any new course, those offering course in:	Offered new course %	Mean number of new courses	Offered new course %	Mean number of new courses	Offered new course %	Mean number of new courses	Offered new course %	Mean number of new courses
Mathematics and finance or business	24	1.5	20	1.1	1	2.0	8	1.4
Mathematics and biology	41	1.5	20	1.0	3	1.2	12	1.3
Mathematics and the study of the environment	3	1.0	12	1.0	5	1.0	5	1.0
Mathematics and engineering or the physical sciences	13	1.8	9	1.0	4	1.0	6	1.3
Mathematics and economics	4	1.0	5	1.0	3	1.1	4	1.1
Mathematics and social sciences other than economics	1	1.0	5	1.0	0	0	1	1.0
Mathematics and education	18	2.0	14	1.4	13	1.6	14	1.7
Mathematics and the humanities	5	1.0	13	1.0	13	1.4	12	1.3
Other	2	1.0	0	0	10	1.3	8	1.2

Tables SP.18 and SP.19: Dual Enrollments–College Credit for High School Courses

Dual-enrollment courses were defined to be "courses conducted on a high school campus and taught by high school teachers, for which high school students may obtain high school credit and, simultaneously, college credit." This arrangement is not the same as obtaining college credit based on an AP or IB exam. Dual enrollment is encouraged by many state governments as a way of utilizing state-wide educational resources efficiently, and there has been some concern over rising dual enrollments (see, e.g., [B2]).

Table SP.18 shows that dual-enrollment courses were offered predominately by mathematics programs at two-year colleges; in fall 2010, 61% of mathematics programs at two-year colleges, 17% of mathematics departments at four-year colleges and universities, and 8% of statistics departments offered dual-enrollment courses (all of these percentages were increases, except for statistics departments, where the percentage remained the same). The enrollment in dual-enrollment courses offered by mathematics departments in four-year colleges and universities in spring and fall (combined) of 2010 was 42,862, with slightly more than half of the enrollments in the fall 2010. Mathematics programs in two-year colleges had a total of 158,097 enrollments in spring and fall (combined) 2010, almost four times the enrollment from four-year colleges and universities and an 89% increase over 2005. Statistics departments had a much smaller number, 1,573, of dual enrollments, and this was a smaller number than reported in 2005. College Algebra and Precalculus were the courses at two-year college mathematics programs with the largest number of dual enrollments. Calculus dual enrollments at two-year colleges were more than double those at four-year colleges and universities.

The percentage of two-year college mathematics programs entering into dual-enrollment agreements increased from 50% in 2005 to 61% in 2010. With the exception of Calculus I, two-year college mathematics courses incurred large growth in dual enrollments. College Algebra dual enrollments for spring and fall combined increased from 21,275 in 2005 to 52,828 in 2010 (a 148% increase), Precalculus dual enrollments in spring and fall combined increased from 28,451 in 2005 to 43,778 in 2010 (a 54% increase), Calculus I dual enrollments for spring and fall combined increased from 19,406 in 2005 to 20,531 in 2010 (a 6% increase), Elementary Statistics dual enrollments for spring and fall combined increased from 6,088 to 11,768 (a 93% increase), and other course dual enrollments for spring and fall combined increased from 8,497 to 29,192 (a 244% increase). In 2010, two-year mathematics programs' fall dual enrollments represented 13% of College Algebra enrollments, 36% of Precalculus enrollments, 17% of Calculus I enrollments, and 3% of Elementary Statistics enrollments; in each case, except in Calculus I, these percentages were larger than in 2005.

The percentage of four-year mathematics departments entering into dual-enrollment agreements increased from 14% in 2005 to 17% in 2010. At four-year mathematics departments, the biggest gain in dual enrollments was in Elementary Statistics, which went from 1,321 total dual enrollments in fall and spring 2005 to 5,818 total dual enrollments in fall and spring 2010 (a 340% increase). College Algebra increased from 10,719 total dual enrollments in fall and spring 2005 to 16,992 total dual enrollments in fall and spring 2010 (a 59% increase), and Precalculus increased from 3,541 total dual enrollments in fall and spring 2005 to 5,136 total dual enrollments in fall and spring 2010 (a 45% increase). However, Calculus I dual enrollments dropped from 14,030 total dual enrollments in fall and spring 2005 to 10,025 total dual enrollments in fall and spring 2010 (a 29% decrease). Dual enrollments in other courses went from 4,193 in 2005 to 4,891 in 2010. Dual enrollments still account for a small percentage of four-year mathematics department enrollments; e.g. in 2010 they were about 4% of College Algebra fall enrollments, 2% of Precalculus fall enrollments, and 1% of both Calculus I and Statistics fall enrollments. In 2005, dual enrollments were 4% of all fall enrollments.

The fact that two-year mathematics programs offer vastly more dual-enrollment courses and credits than do four-year college and university mathematics departments does not mean that the impact of dual-enrollment programs is primarily in two-year colleges. Many students with dual-enrollment credit go directly from high school to four-year colleges and universities, taking the dual-enrollment credit awarded by the two-year college with them. In many states, public four-year colleges and universities are required by law to accept such credit.

A major concern in dual-enrollment courses is the degree of quality control exercised by the department through which college-level credit for the courses is awarded. The lower portion of Table SP.18 examines several kinds of control that the college-level departments might have had over their dual-enrollment courses in fall 2010 and presents a comparison to 2005. Table SP.18 indicates that four-year institutions have increasing influence over dual-enrollment courses as the category of "never" exercising control dropped from 2005 to 2010 for all questions except for "syllabus" (where the percentage of "never" was already low). The percentages for four-year departments were closer to those in two-year departments in 2010 than in 2005. The largest difference in 2010 was that the choice of textbook was always controlled by the department at 71% of two-year mathematics programs and 45% of four-year departments. Final

TABLE SP.18 Percentage of departments offering dual-enrollment courses taught in high school by high school (HS) teachers, enrollments in various dual-enrollment courses in spring 2010 and fall 2010 compared to total of all other enrollments in fall 2010, and (among departments with dual-enrollment programs) percentage of various departmental controls over dual-enrollment courses, by type of department. (Fall 2005 data in parentheses.) The comparable data in the CBMS2005 report is in Table SP.16.

	Four-year Mathematics			Two-year Mathematics			Four-year Statistics		
Percentage of departments with dual-enrollment courses	17% (14%)			61% (50%)			8% (8%)		
Number of dual enrollments in:	Dual Enrollments		Other enrollments	Dual enrollments		Other enrollments	Dual enrollments		Other enrollments
	spring 2010	fall 2010	fall 2010	spring 2010	fall 2010	fall 2010	spring 2010	fall 2010	fall 2010
College algebra	5312	11680	251495	21955	30873	230034			
Precalculus	3184	1952	114256	20847	22931	60998			
Calculus I	5449	4576	334791	9557	10974	85696			
Statistics	3451	2367	208546	7521	4247	134273	1573	0	76702
Other	2725	2166		17413	11779				
Dept. control of dual enroll. courses taught by HS teachers	Never	Sometimes	Always	Never	Sometimes	Always	Never	Sometimes	Always
Textbook choice	18% (41%)	38% (15%)	45% (44%)	14% (14%)	15% (12%)	71% (74%)	38% (36%)	31% (30%)	31% (34%)
Syllabus design/ approval	3% (2%)	2% (6%)	95% (92%)	3% (4%)	1% (7%)	96% (89%)	38% (36%)	62% (0%)	0% (64%)
Final exam design	22% (40%)	32% (30%)	46% (30%)	31% (36%)	28% (28%)	41% (37%)	38% (100%)	62% (0%)	0% (0%)
Choice of instructor	17% (32%)	24% (20%)	59% (48%)	33% (35%)	20% (13%)	47% (52%)	38% (36%)	31% (0%)	31% (64%)
Departmental teaching evaluations required in dual-enrollment courses			40% (16%)			48% (64%)			0% (0%)

TABLE SP.19 Percentage of departments in four-year colleges and universities and in public two-year colleges that assign their own full-time or part-time faculty members to teach, in high school, courses that award both high school and college credit, and number of students enrolled, in fall 2010. (Fall 2005 data in parentheses.) This table was Table SP.17 in CBMS2005.

	Four-year Mathematics Departments	Two-year Mathematics Departments	Statistics Departments
Assign their own members to teach dual-enrollment courses	4% (4%)	22% (12%)	0%
Number of students enrolled	3932 (2874)	6358 (2008)	na

exam design was always under the control of the department at 46% of the four-year colleges and 41% of the two-year colleges, and the choice of instructor was under the control of the department at 59% of the four-year colleges and 47% of the two-year colleges. The percentage of programs requiring teaching evaluations in dual-enrollment courses at two-year colleges dropped from 64% in 2005 to 48% in 2010; at mathematics departments at four-year colleges and universities, this percentage increased from 16% in 2005 to 40% in 2010.

In spite of some of the issues raised in the preceding paragraph, as reported in Table TYF.25 in Chapter 7, among all two-year college survey respondents (including respondents from two-year colleges that do not have dual-enrollment arrangements), 11% of mathematics program heads in two-year colleges saw dual-enrollment courses as a major problem, up six points from 2005. Another 16% found dual-enrollment arrangements somewhat of a problem, down five points from 2005.

Table SP.19 examines the practice of colleges and universities sending their own faculty members into high schools to teach courses that grant both high school and college credit. Although the number of students involved in these courses is smaller than the enrollment in dual-enrollment courses, these programs have grown as compared to 2005 at two-year colleges. In fall 2010, 22% of two-year and 4% of four-year institutions assign and pay their own faculty to teach courses in a high school that awards both high school and college credit. A two-year college faculty member teaching a dual-enrollment course usually was classified as a part-time faculty member at the two-year college that awarded college credit for the course, even though the salary was paid completely by a third party, e.g., the local school district. These direct-pay faculty members at two-year colleges taught 6,358 students in 2010; in 2005, 2,008 students were enrolled in courses for dual high school and college credit taught by two-year college faculty.

Tables SP.20 to SP.24: Curricular Requirements of Mathematics and Statistics Majors in the U.S.

Requirements for a major in mathematics have become more flexible, as can be seen, for example, in the MAA's Committee on Undergraduate Programs in Mathematics (CUPM) recommendations on requirements for the mathematics major [CUPM]. Departments seem to have more tracks (sets of graduation requirements) and more flexible requirements for mathematics majors. The CBMS 2005 survey asked about these requirements, and these questions were repeated in the 2010 survey. In addition, in 2010, departments were asked about the number of different tracks in their major. Table SP.20 summarizes the data on whether various courses were required in all of their majors, in some but not all of their majors, or in none of their majors; these numbers are broken down by the level of the department.

Table SP.20 shows that, in fall 2010, the requirement selected most frequently as being required for all mathematics majors was "at least one computer science course" (required by more than 60% of departments at all levels); the percentage of mathematics departments requiring a statistics course for all majors increased at the doctoral and bachelors-level departments (in the bachelors-level departments, it went from 32% to 55%) from 2005 to 2010.

Historically, Modern Algebra and Real Analysis have been considered required courses for all mathematics majors, and there has been some concern about changes in these requirements (see, e.g., [B3]). Table SP.20 shows that these courses are not required of <u>all</u> mathematics majors in 2010, although the percentages of departments requiring these two

TABLE SP.20 Percentage of four-year mathematics departments requiring certain courses (or exit exam) in all, some, or none of their majors, by type of department, in fall 2010. These percentages can be compared to Table SP.19 in CBMS2005.

Mathematics Department Requirements	Required in all majors			Required in some but not all majors			Not required in any major		
	Univ (PhD) %	Univ (MA) %	College (BA) %	Univ (PhD) %	Univ (MA) %	College (BA) %	Univ (PhD) %	Univ (MA) %	College (BA) %
Modern Algebra I	39	47	62	39	46	27	21	7	11
Real Analysis I	51	46	36	34	36	28	15	18	36
Modern Algebra I or Real Analysis I (major may choose either to fulfill this requirement)	18	20	6	29	17	20	53	63	73
A one-year upper-level sequence	42	49	31	26	11	16	32	40	53
At least one computer science course	61	65	73	18	21	13	21	14	15
At least one statistics course	44	37	55	27	47	25	29	16	20
At least one applied mathematics course beyond course E21	17	32	29	39	32	14	44	36	57
A capstone experience (senior project, thesis, seminar, internship)	30	57	75	19	16	7	50	28	18
An exit exam (written or oral)	10	11	23	2	4	4	88	86	73

courses for all majors generally increased in 2010 over 2005. Of these two courses, Modern Algebra I was a more popular required course at bachelors-level departments (required for all majors at 62% of bachelors-level departments), while Real Analysis I was more frequently required of all majors at doctoral-level departments (required for all majors at 51% of the doctoral-level departments).

Modern Algebra I is not required in any major at 21% of the doctoral-level, 7% of the masters-level, and 11% of the bachelors-level departments, while Real Analysis I is not required in any major at 15% of the doctoral-level, 18% of the masters-level, and 36% of the bachelors-level departments (these percentages are generally slightly up from 2005). In the 2010 survey, the two options "Modern Algebra 1 plus another upper divisional algebra course" and "Real Analysis 1 plus some other upper division analysis course" from the 2005 survey were replaced with two new options: "Modern Algebra I or Real Analysis I (major may choose either to fulfill this requirement)" and "a one-year upper level sequence". The option of choosing one of the two courses was required for all majors at 18% of doctoral, 20% of masters, and only 6% of bachelors-level departments.

Some departments are finding ways to create some depth in their mathematics major without requiring particular mathematics courses. A one-year upper-level sequence was required for all majors in 42% of doctoral-level departments, 49% of masters-level departments, and 31% of bachelors-level departments. A capstone experience (senior project, thesis, seminar,

TABLE SP.21 Percentage of statistics departments requiring certain courses (or exit exam) in all, some, or none of their majors, by type of department, in fall 2010. This table can be compared to Table SP.20 in CBMS2005.

	Required in all majors		Required in some but not all majors		Not required in any major	
Percentage of statistics departments that require:	Univ (PhD) %	Univ (MA) %	Univ (PhD) %	Univ (MA) %	Univ (PhD) %	Univ (MA) %
(a) Calculus I	92	91	6	9	2	0
(b) Calculus II	92	91	6	9	2	0
(c) Multivariable Calculus	69	55	22	27	9	18
(d) Linear algebra/Matrix theory	79	64	15	27	5	9
(e) At least one Computer Science course	60	91	16	0	24	9
(f) At least one applied mathematics course, not incl. (a), (b), (c), (d)	19	64	21	18	59	18
(g) A capstone experience (e.g., a senior thesis or project, seminar, or internship)	43	55	10	9	47	36
(h) An exit exam (oral or written)	10	18	4	0	87	82
(i) One Probability Course	81	91	13	9	6	0
(j) One Mathematical Statistics Course	79	64	12	36	8	0
(k) One Linear Models Course	56	55	13	18	31	27
(l) One Bayesian Inference Course	3	0	10	0	86	100

TABLE SP.22 Percentages of four-year mathematics departments offering varying numbers of tracks in their major, by level of department, in fall 2010.

	Mathematics Departments			
Number of tracks	Univ (PhD) %	Univ (MA) %	College (BA) %	Total %
One or two tracks	26	34	72	60
Three or four tracks	37	46	21	27
More than four tracks	37	17	5	11

Some totals are less than 100% due to round-off.

internship) was required for all majors at 75% of all bachelors-level departments (up from 59% in 2005).

The percentages of departments requiring the options described in the CBMS2010 survey instrument for some of their majors were generally lower than in 2005, and the percentage of departments requiring the given options in none of their majors were generally larger (one exception being the capstone experience), perhaps indicating that in 2010, departments offered tracks for the major with fewer requirements than in 2005. Table SP.22 gives the number of tracks in the major broken down by type of department (this question was new to the CBMS survey in 2010). In fall 2010, 72% of bachelors-level departments and 26% of doctoral-level departments had only one or two tracks in their major, while 37% of doctoral-level departments and 5% of bachelors-level departments had more than four tracks.

Table SP.21 examines requirements for an undergraduate statistics major awarded by statistics departments. Four new options were added in the 2010 survey: “One Probability Course”, “One Mathematical Statistics Course”, “One Linear Models Course”, and “One Bayesian Inference Course”. The options offered in 2005 were required at about the same rates in 2010 as in 2005 with the exception of Multivariable Calculus and Linear Algebra. These two courses were required for all majors by somewhat fewer departments, and required for some but not all majors at more departments; Multivariable Calculus was still required for all statistics majors at 69% of the doctoral-level statistics departments, and Linear Algebra was required for all statistics majors at 79% of the doctoral-level statistics departments. Linear Models was required for all statistics majors at about 55% of statistics departments, while a Bayesian inference course was required by only 3% of doctoral-level statistics departments.

Tables SP.23 and SP.24: Availability of Upper-level Courses in Mathematics and Statistics

Concerns about the availability of upper-level courses in mathematics and statistics led to questions on the 2000 and 2005 CBMS surveys, and this issue was addressed again in 2010. Generally the availability of upper-level courses improved in 2010 and, as was noted in Chapter 1, enrollments in upper-level courses were up in 2010 over 2005.

Table SP.23 examines the availability of many upper-division mathematics courses offered in mathematics departments at least once during the two academic years 2009-2010 and 2010-2011, and Table SP.24 examines the same question for upper-division statistics courses offered in mathematics and statistics departments. For mathematics courses, Table SP.23 shows that over all mathematics departments combined, the percentage of departments offering specific upper-division courses was up for almost every course, and the increase was particularly large for many courses at the bachelors-level departments. For example, in the 2005 survey, Modern Algebra I was reported as being offered by 52% of the bachelors-level departments within a two-year period, while in the 2010 survey that percentage rose to 76%. Advanced Calculus/Real Analysis also jumped from being offered at 57% of the bachelors-level departments in the 2005 survey to 75% in the 2010 survey. Second semester undergraduate courses were up at the doctoral-level departments; for example, Modern Algebra II was offered by 40% of the doctoral-level departments in 2005 and in 59% of the doctoral-level departments in 2010. Similarly, Advanced Calculus/Real Analysis II went from being offered at 62% of the doctoral-level departments in the 2005 survey to 71% in the 2010 survey. Mathematics Senior Seminar/Independent Study increased from 45% of all math-

TABLE SP.23 Percentage of mathematics departments offering various upper-division mathematics courses at least once in the two-academic years 2009-2010 and 2010-2011, plus historical data on the two year period 2004-2006, by type of department. The table can be compared to Table SP.22 in CBMS2005.

		Academic Years 2009-2010 & 2010-2011			
Upper-level mathematics courses	All Math Depts 2004-2006 %	All Math Depts 2009-2011 %	PhD Math %	MA Math %	BA Math %
Modern Algebra I	61	80	85	96	76
Modern Algebra II	21	27	59	49	16
Number Theory	37	51	72	61	45
Combinatorics	22	27	61	53	15
Actuarial Mathematics	11	13	22	23	10
Foundations/Logic	11	11	23	13	8
Discrete Structures	14	30	26	37	30
History of Mathematics	35	49	52	69	45
Geometry	55	74	83	78	71
Math for Secondary Teachers	37	35	35	62	30
Adv Calculus/ Real Analysis I	66	79	94	86	75
Adv Calculus/Real Analysis II	26	31	71	50	20
Adv Mathematics for Engineering/Physics	16	12	41	19	5
Advanced Linear Algebra	19	23	61	48	11
Introduction to Proofs	na	57	73	77	50

TABLE SP.23 (continued) Percentage of mathematics departments offering various upper-division mathematics courses at least once in the two academic years 2009-2010 and 2010-2011, plus historical data on the two-year period 2004-2006, by type of department. The table can be compared to Table SP.22 in CBMS2005.

		Academic Years 2009-2010 & 2010-2011			
Upper-level math courses, continued	All Math Depts 2004-2006 %	All Math Depts 2009-2011 %	PhD Math %	MA Math %	BA Math %
Vector Analysis	9	11	26	15	7
Advanced Differential Equations	13	16	48	24	8
Partial Differential Equations	19	26	74	56	11
Numerical Analysis I and II	47	42	84	63	31
Applied Math/Modeling	26	37	60	41	33
Complex Variables	37	44	80	65	33
Topology	32	25	65	40	15
Mathematics of Finance	8	12	29	16	7
Codes & Cryptology	8	11	22	11	9
Biomathematics	8	12	36	21	5
Operations Research	12	17	31	27	13
Math senior seminar/Ind study	45	65	67	85	61
All other advanced-level mathematics	na	25	46	43	17

TABLE SP.24 Percentage of mathematics and statistics departments offering various undergraduate statistics courses at least once in two academic years 2004-2005 and 2005-2006 and at least once in the two academic years 2009-2010 and 2010-2011, by type of department. This table can be compared to Table SP.23 in CBMS2005.

		AY 2009-10 & 2010-11					AY 2009-10 & 2010-2011		
Upper-level statistics courses	All Math Depts 2004-2006 %	All Math Depts %	PhD Math %	MA Math %	BA Math %	All Stat Depts 2004-2006 %	All Stat Depts %	PhD Stat %	MA Stat %
Mathematical Statistics	38	42	51	49	40	76	78	85	62
Probability	51	37	57	33	33	86	63	60	69
Combined Probability and Statistics	na	26	33	34	23	na	37	33	46
Stochastic Processes	6	9	33	7	5	43	37	40	31
Applied Statistical Analysis	13	13	25	18	10	65	50	52	46
Experimental Design	6	10	13	26	6	54	51	50	54
Regression & Correlation	6	11	21	15	8	62	71	65	85
Biostatistics	4	4	10	7	3	25	27	22	38
Nonparametric Statistics	2	5	11	12	2	38	30	27	38
Categorical Data Analysis	1	1	5	3	0	21	31	27	38
Sample Survey Design	4	2	6	4	1	49	41	42	38
Stat Software & Computing	3	5	14	10	2	43	na	na	na
Stat Computing	na	na	na	na	na	na	41	35	54
Stat Software	na	na	na	na	na	na	35	32	43
Data Management	0	1	2	0	1	5	10	5	23
Bayesian Statistics	na	na	na	na	na	na	36	31	50
Statistical Consulting	na	na	na	na	na	na	29	17	63
Senior Seminar/ Independent Study	3	12	9	15	11	41	44	43	46

Note: 0 means less than one-half of one percent.

ematics departments combined that reported it as being offered in the 2005 survey to 65% that reported it as offered in the 2010 survey.

Table SP.24 examines the analogous question for statistics courses offered in mathematics departments and statistics departments. The list of statistics courses was revised in 2010, increasing the number of upper-divisional statistics offerings for undergraduates that could be reported in statistics departments. Upper-level course offerings in probability were down in both mathematics and statistics departments, but other offerings were reasonably comparable. Over the past ten years, the offering of Mathematical Statistics has decreased: in the 2000 survey it was offered by 52% of mathematics departments and 90% of statistics departments, but in 2010, it was offered by 42% of mathematics departments and 78% of statistics departments. In Chapter 3, Table E.3 will show that while enrollments in elementary statistics courses have increased dramatically, enrollments in upper-level statistics courses have decreased in mathematics departments and increased in statistics departments, with the total from both departments down 6% in 2010 from the total in 2005 (though some of this change may be attributable to changes made in the expanded list of elementary-level statistics courses listed on the questionnaires).

Table SP.25: Estimates of Post-Graduation Plans of Graduates of Four-Year Mathematics Departments and Statistics Departments

Table SP.25 gives estimates from four-year mathematics departments and statistics departments of the post-graduation plans of their 2009-2010 graduating majors, broken down by the level of department. The estimates of the percentage of students taking jobs in business, government, etc. were slightly up at the bachelors and doctoral-level mathematics departments (but down at masters-level departments), while the percentages of students pursuing pre-college teaching were slightly down at bachelors and doctoral-level mathematics departments (but up at masters-level departments). In the 2010 survey (for the first time), the percentage of students who went to graduate school was broken into two parts: those going on to graduate study in mathematics and those doing graduate or professional study in an area outside of mathematics. The doctoral-level departments estimated that 10% of mathematics majors went to graduate or professional school outside of mathematics and 15% went to graduate school in mathematics; these estimates were 4% and 12% (resp. 8% and 17%) at masters (resp. bachelors) level mathematics departments. Using these reported percentages (15%, 12%, 17%) of mathematics

TABLE SP.25 Departmental estimates of the percentage of graduating mathematics or statistics majors from academic year 2009-2010 who had various post-graduation plans, by type of department, in fall 2010. (Data from fall 2005, when available, in parentheses.) 2005 data from Table SP.24 in CBMS2005.

	Mathematics Departments			Statistics Departments	
Departmental estimates of post-college plans	Univ (PhD) %	Univ (MA) %	College (BA) %	Univ (PhD) %	Univ (MA) %
Students who went into pre-college teaching	13 (16)	48 (44)	27 (32)	1 (1)	1 (0)
Students who went to graduate school in the mathematical or statistical sciences	15	12	17	23	29
Students who went to graduate or professional school outside of mathematics/statistics	10	4	8	5	5
Students who took jobs in business, government, etc.	27 (19)	19 (21)	30 (29)	41 (16)	45 (36)
Students who had other plans known to the department	5 (4)	3 (1)	4 (2)	2 (0)	3 (6)
Students whose plans are not known to the department	30 (39)	14 (18)	13 (17)	29 (65)	18 (28)

majors going to graduate school in mathematics and the number of majors (excluding computer science majors and mathematics education majors) reported in Chapter 3 Table E.1, the number of new graduate students would be estimated at 2,262 students. The 2010 Annual Survey reported the number of first-year, full-time, U.S. citizen graduate students (at masters and doctoral programs in mathematics and statistics) in fall 2010 to be 3,401 (2,809 excluding statistics) (2010 Annual Survey Supplemental Table GS.1). These numbers are not directly comparable for a number of reasons, including some first-year graduate students graduated in previous years and some majors may not be U.S. citizens, but this comparison indicates that the percentages of majors going to graduate work in mathematics reported in the CBMS survey are not unreasonable.

In the 2005 survey, 65% of the statistics departments' students post-graduation plans were unknown to the department; however, in the 2010 survey statistics departments had a clearer picture of their graduates' post-graduation plans, as only 29% of the students had unknown plans in 2010. A large percentage (41% from doctoral-level departments and 45% from masters-level departments) of statistics department graduates were estimated to take jobs in business, government, etc., and 23% of students from doctoral-level statistics departments and 29% of students from masters-level statistics departments were thought to have gone to graduate school in statistics. Only 1% of statistics graduates were estimated to have taken jobs in pre-college teaching.

Table SP.26: Assessment Activities in Four-Year Mathematics Departments and Statistics Departments

State governments, national accrediting agencies, and professional organizations such as the Mathematical Association of America have placed great emphasis on department assessment activities. In the 2005 CBMS survey, four-year mathematics and statistics departments were asked to identify which of a list of assessment activities they had performed over the last six years. This question was repeated in the 2010 CBMS survey, and a summary of the responses appears in Table SP.26. Most assessment activities were reported to have been used by a higher percentage of departments in 2010 than in 2005; for example, the use of outside reviewers was up at all levels of mathematics and statistics departments, and the study of data on students' progress in later courses was reported at higher rates in 2010 than in 2005 in most levels of mathematics and statistics departments. For all levels of mathematics and statistics departments, over 60% of departments reported that they had made changes to their undergraduate program based on assessment activities.

TABLE SP.26 Percentage of four-year mathematics and statistics departments undertaking various assessment activities during the last six years, by type of department, in fall 2010. (Data from fall 2005 in parentheses.) 2005 data from Table SP.25 in CBMS2005.

	Four-year Mathematics Departments			Statistics Departments	
Percentage using various assessment tools	Univ (PhD) %	Univ (MA) %	College (BA) %	Univ (PhD) %	Univ (MA) %
Consult outside reviewers	53 (47)	48 (45)	31 (29)	42 (37)	80 (59)
Survey program graduates	71 (62)	80 (81)	71 (74)	63 (54)	70 (71)
Consult other departments	54 (51)	45 (41)	26 (35)	47 (29)	60 (56)
Study data on students' progress in later courses	62 (45)	65 (52)	55 (38)	41 (30)	40 (56)
Evaluate placement system	72 (72)	51 (72)	60 (51)	12 (5)	30 (15)
Change undergraduate program due to assessment	78 (76)	76 (72)	69 (76)	61 (69)	80 (29)