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CollegeBoard

What Should Students Be Ready For in College?

A Look at First-Year Course Work in Four-Year Postsecondary Institutions in the U.S.

By Emily J. Shaw and Brian F. Patterson

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Abstract

This study examined the English, mathematics, and natural sciences course work taken by students in their first year of college. Four-year postsecondary institutions (k = 110) provided first-year performance data for the first-time, first-year students who began college in the fall of 2006. As in previous research, composition is the most commonly taken English course. However, calculus was more popular than algebra within mathematics, and chemistry was more popular than biology within the natural sciences, both different findings from previous analyses of first-year college course work in those content areas.

Introduction

Early on in Barack Obama's presidency, he announced that his administration had set the following goal: to have the United States lead the world in the number of college graduates by 2020 (April 27, 2009). In an effort to achieve this goal, the Common Core State Standards Initiative was established. This initiative would encourage states to collectively prepare all students to graduate from high school ready for college and work success in an increasingly global economy. This state-led initiative will develop K–12 standards that are aligned with college and work expectations, that will include rigorous content, that will require the application of knowledge through higher-order skills, and that will be internationally benchmarked (Council of Chief State School Officers and National Governors Association, 2009). To develop and validate standards that reflect the knowledge, skills, and abilities necessary to succeed in college, additional empirical evidence about course-taking and performance in college is needed.

A report by Greene and Winters (2005) on high school graduation rates and college readiness rates in the U.S. highlights the urgent need to undertake this large task. In 2002, the national high school graduation rate in public schools was 71 percent, and the percentage of all students leaving high school with the skills and qualifications needed for college was 34 percent.[1] The report also found large racial/ethnic differences in the percentages of students leaving high school prepared to enter a four-year college. Approximately 40 percent of white students, 23 percent of African American students, and 20 percent of Hispanic students graduating from public high schools were college ready.

A recent report captured the varied definitions of college readiness held by different states (Education Week, 2009). Currently, 20 states describe the skills and knowledge needed to succeed in entry-level college course work in their definition of college readiness. These definitions include facets ranging from recommendations on high school courses to take to minimum scores on standardized tests. Thirteen of the 20 states use multiple approaches within their college readiness definition. There are 14 states with definitions involving academic content standards, and there are 13 with definitions that recommend or require certain high school course work. There are also seven states with definitions that include information on academic skills such as time management and successful study habits. Many educators and researchers have noted the similarities between state standards across grades and standards for college success. However, despite such similarities, state standards do differ, and no two states have totally agreed on standards for college readiness.

In addition to focusing on the different components of current college-readiness definitions in use, it is also worthwhile to examine the actual course work taken by students in the first year. Adelman (2004) studied the courses completed by bachelor's degree recipients who graduated from high school in 1972, 1982, and 1992. He identified the top 30 postsecondary courses as the "empirical core curriculum." Adelman's analysis indicated that the empirical core curriculum has remained relatively stable over time and varied by college selectivity. For the 1992 high school graduates (the most recent cohort studied), the 10 most popular courses taken by students in their first year of college were: English Composition, General Psychology, College Algebra, Introduction to Sociology, U.S. History Surveys, General Biology, Physical Education Activities, General Chemistry, Freshman Orientations, and Remedial English/Writing.

As the Common Core State Standards Initiative moves forward, it is important to examine the empirical core curriculum from a more recent cohort of students in order to better understand which courses our high school graduates should be prepared for in college. As the Common Core State Standards will initially be focusing on English and mathematics standards, the current study will focus on the English and mathematics course work taken by 2006 high school graduates in the first year of college. Additionally, this study will examine students' science course work because that will be the next area for which common standards will be developed.

1. In Greene and Winters (2005), college ready was defined as having graduated from high school; having taken four years of English, three years of math and two years each of natural science, social science, and foreign language; and having a NAEP reading score of at least 265, representing a "basic" level of reading achievement.

Method

Participants

The sample of students in this study is taken from the national SAT® Validity Study sample. Four-year institutions were recruited to provide first-year performance data for the first-time, first-year students who began college in the fall of 2006 in order to validate the SAT for use in admission and conduct-related college success research. Ultimately, 110 colleges and universities provided data files with students' course work and grades that were matched to College Board databases. There were 195,099 students in the original files submitted by the participating institutions. Of that sample, there were 164,331 students with a valid first-year college grade point average (FYGPA), course-level data, and self-reported high school grade point average (HSGPA) provided by students when registering for the SAT or PSAT/NMSQT®.[2]

Design and Procedure

In order to categorize and code the college course work provided by the 110 institutions in the study, an outside research firm was hired. First, the researchers isolated courses for a single institution, then the institutional course catalog with course descriptions was located, and ultimately courses were categorized by their general discipline or content area.[3] Fifteen categories were created. This was followed by an independent reviewer verification to be sure that the categorizations were correct. When a single course was offered through multiple departments or could be interpreted as having multiple content codes (e.g., based on the course name, Statistics in Psychology could be placed in the psychology or the mathematics category), researchers sought to maintain consistency among course-content codes based on the description in the course catalog.

Because the current study would focus on English, mathematics, and natural sciences course work, the authors then further coded these general discipline areas for a specific (e.g., chemistry) and more detailed (e.g., chemistry-organic) content level. To be included in the study, the specific content areas had to meet the following criteria. They had to (a) encompass at least five courses, each of which had at least 10 students and (b) correspond to at least three institutions in the sample. The appendixes contain results by more detailed content areas that met these minimum criteria. If any of these three minimum values were not met, the content area was rolled up accordingly. For example, there were a total of five sedimentology courses, only one of which had at least 10 students with complete data, so that one sedimentology course was rolled up into geology, while the remaining four courses were dropped from analysis due to small sample size. When there was no obvious specific content area into which a detailed content area could be rolled up, those courses were coded as "other." Ultimately, there were 12 specific and 20 detailed categories for English courses; 21 specific and 27 detailed categories for mathematics courses; and 28 specific and 60 detailed categories for natural science courses in colleges and universities.

Results

Table 1 displays descriptive information comparing the institutions in the sample with the target population.[4] There is slight overrepresentation of New England and Southwestern institutions in the sample and underrepresentation of Southern and Midwestern institutions. With regard to selectivity, institutions admitting over 75 percent of students are somewhat underrepresented in the sample. In terms of institution size, the sample underrepresents small institutions and overrepresents large and very large institutions. Finally, the proportions of public and private (nonproprietary) institutions in the sample are relatively similar to the target population.

Table 2 shows the percentage of college course work taken by discipline or general content area across students in their first year of college. The most popular discipline was the social sciences, with 81 percent of students taking at least one course in that field. Social sciences course work was followed by English (72 percent), mathematics (72 percent), and natural sciences (65 percent) course work. Descriptive statistics across students enrolled in at least one course by discipline were also examined in Table 2. Specifically, differences in HSGPA, FYGPA, and content-area course grade average were studied. The course grades reported on in this study are the mean content area course grade for each student who took at

2. The self-reported HSGPA value examined in this study is the most recent HSGPA reported by the student to the College Board.

3. General Content Categories were Arts and Music; Business and Communications; Computer Sciences; Engineering; English; Foreign and Classical Languages; Freshman Experience; History; Humanities; Mathematics; Military; Natural Sciences; Physical Education and Health; Social Sciences; and Other.

4. The target population was the 1,169 four-year public and private (nonproprietary) institutions in the U.S. that provided complete data to the 2006 College Board Annual Survey of Colleges.

least one course in a particular area and, consequently, the student-level means are based on different numbers of courses for different students. Students enrolled in at least one engineering course tended to have had the highest HSGPA (M = 3.76, SD = .45), followed by those enrolled in at least one world languages course (M = 3.68, SD = .47). With regard to FYGPA, students enrolled in at least one world languages course had the highest average FYGPA (M = 3.16, SD = .61), followed by students enrolled in at least one humanities course (M = 3.06, SD = .64). With regard to course grade by content area, students enrolled in at least one military course had the highest average course grade (M = 3.69, SD = .63), followed by students enrolled in at least one freshmen experience course (M = 3.57, SD = .78). Of the more "academic" disciplines, students enrolled in at least one world languages course had the highest average course grade among the different disciplines (M = 3.29, SD = .78).

To better understand whether there were differences in course-taking by institutional selectivity, an analysis was conducted using applicant acceptance rates as a proxy for grouping by selectivity level across institutions (the most selective group had less than 50 percent of applicants accepted, followed by institutions accepting 50–75 percent of applicants, followed by those accepting more than 75 percent of applicants). These results, presented in Table 3, show that there is very little variability in course taking by institutional selectivity for course work in the social sciences, English, mathematics, natural sciences, and arts and music. There was, however, some variability in humanities and foreign and classical languages course work, with students at the more selective institutions taking more courses in these disciplines than students in less selective institutions. Also, students at institutions admitting 50–75 percent of applicants or admitting 75 percent or more applicants tended to take more course work in history as well as business and communications than students at more selective institutions.

Focusing on solely English content, Table 4 provides information on students who were enrolled in at least one English course by various English content areas. English Composition was the most popular English content area (85 percent of students were enrolled in at least one composition course), followed by literature (19 percent of students were enrolled in at least one literature course). Table 4 also displays the descriptive statistics across students enrolled in at least one English course by English content area. Students enrolled in at least one journalism course tended to have had the highest HSGPA (M = 3.68, SD = .46), followed by those enrolled in at least one poetry course (M = 3.67, SD = .49). Students enrolled in a college reading course tended to have had the lowest HSGPA (M = 3.27, SD = .54). With regard to FYGPA, students enrolled in at least one creative writing course had the highest average FYGPA (M = 3.26, SD = .55), followed by students enrolled in at least one journalism course (M = 3.19, SD = .58). Students enrolled in at least one reading course also tended to have the lowest FYGPA (M = 2.72, SD = .63). In terms of college English, students enrolled in at least one creative writing course had the highest average course grade (M = 3.52, SD = .63), followed by students enrolled in at least one poetry course (M = 3.40, SD = .71). Students enrolled in at least one English as a second language (ESL) course tended to have the lowest average English course grades (M = 3.00, SD = 1.11). Also, note that students taking ESL courses have the most varied FYGPAs and course grades among all English content areas studied, with standard deviations of .79 and 1.11, respectively (it is also among the most variable group for HSGPA, SD = .55). See Appendix A for information on more detailed English course work content areas.

Turning now to mathematics content, Table 5 provides information on students enrolled in at least one mathematics course by various mathematics content areas. Calculus was the most popular mathematics content area, with 44 percent of students enrolled in at least one calculus course. Algebra was the second most popular first-year math content area, taken by 18 percent of freshmen. Table 5 also displays the descriptive statistics across students enrolled in at least one mathematics course by mathematics content area. Students enrolled in at least one differential equations course tended to have had the highest HSGPA (M = 3.91, SD = .37), followed by those enrolled in at least one linear algebra course (M = 3.89, SD = .37) as well as those enrolled in at least one geometry course (M = 3.89, SD = .39). Students enrolled in one or more basic mathematics course tended to have the lowest HSGPA (M = 3.32, SD = .55). Students enrolled in at least one differential equations course had the highest average FYGPA (M = 3.39, SD = .47), followed by those students enrolled in at least one linear algebra course (M = 3.36, SD = .52). Students enrolled in at least one trigonometry course tended to have the lowest FYGPA (M = 2.70, SD = .72). With regard to course grade by mathematics content area, students enrolled in at least one geometry course had the highest average course grade in mathematics (M = 3.67, SD = .71), followed by students enrolled in at least one differential equations (M = 3.16, SD = .90) or students enrolled in at least one probability course (M = 3.16, SD = .89). Students enrolled in at least one trigonometry course tended to have the lowest average mathematics course grades (M = 2.20, SD = 1.29). See Appendix B for information on more detailed mathematics course work content areas.

Focusing on solely natural sciences content, Table 6 provides information on students enrolled in at least one natural sciences course by various natural sciences content areas. About two-thirds of students completed a course in natural sciences during their freshman year and

chemistry was the most popular natural sciences content area (47 percent of students were enrolled in at least one chemistry course), followed by biology (35 percent of students were enrolled in at least one biology course), physics (20 percent of students were enrolled in at least one physics course), and geology (15 percent of students were enrolled in at least one geology course). Table 6 also displays the descriptive statistics across students enrolled in at least one natural sciences course by natural sciences content area. Students enrolled in at least one natural sciences course categorized as "Other" (e.g., History of Science or Informatics for Scientists) tended to have had the highest HSGPA (M = 3.96, SD = .36), followed by those enrolled in at least one ecology course (M = 3.85, SD = .42). Students enrolled in at least one pharmacology course tended to have had the lowest HSGPA (M = 3.41, SD = .55). With regard to FYGPA, students enrolled in at least one natural sciences course categorized as "Other" had the highest average FYGPA (M = 3.31, SD = .63), followed by students enrolled in at least one neuroscience course (M = 3.30, SD = .54). Students enrolled in at least one pharmacology course tended to have the lowest FYGPA (M = 2.55, SD = .79). In terms of course grade in the natural sciences content area, students enrolled in at least one agriculture course had the highest average course grade (M = 3.74, SD = .66), followed by students enrolled in at least one natural sciences course categorized as "Other" (M = 3.70, SD = .60). Students enrolled in at least one zoology course tended to have the lowest average natural sciences course grades (M = 2.54 SD = 1.09). See Appendix C for information on more detailed natural sciences course work content areas.

Discussion

This study provides an overview of the types of English, mathematics, and natural sciences courses students are taking in their first year of college, as well as the grades students are attaining in these courses. The value in examining students' early college course work is to gain an understanding of what students must be prepared and ready for prior to postsecondary education in order to thrive in and continue on to graduate from a four-year college. With academic success in the first year of college being so critical for retention and ultimately graduation (Allen, 1999; Murtaugh, Burns, & Schuster, 1999; Wilson, 1983), it seems both timely and imperative to examine first-year college course work in English, mathematics, and science. With the movement toward defining common standards, this study can only inform the important work being done to ensure that students from across the U.S. are graduating from high school prepared for college, work, and success in the global economy.

Additionally, for many years there have been important national discussions regarding college readiness. College readiness has been defined and operationalized in numerous ways — minimum qualifications necessary to have a college application considered or college entrance exam score benchmarks, for example (Greene & Forster, 2003). This study informs the conversation of what students should be ready for in college. The study delves more deeply into the criterion of college readiness by examining the actual course work taken by thousands of college freshmen across the country.

The results from the study showed that the students in the sample most often take courses in the social sciences, English, mathematics, and natural sciences in their first year of college, and this was true for institutions of varying selectivity levels. The most popular English courses taken in the first year were composition, followed distantly by literature. This is not surprising as composition is typically a requirement in the first year of college. In previous research, composition has been found to be the most popular course taken by first-year students (Adelman, 2004). The finding that students who have taken at least one ESL course have the most variable HSGPAs, FYGPAs, and course grades in ESL may be related to a number of factors such as their varied levels of English proficiency, varied first languages, or because ESL students may not be subject to the ceiling effects that may be present in nonremedial English courses with more highly proficient English students enrolled.

For mathematics, the most popular course was calculus, followed distantly by algebra. This is a notable finding, given that much of the college readiness research has focused on algebra as opposed to calculus (e.g., ACT, 2005). Among the 1992 high school graduates, 19.6 percent had taken algebra while 10.3 percent had taken calculus in the first year of college (Adelman, 2004). This is quite different from the findings in this study and suggests that students attending four-year colleges have taken more math courses in high school than in the past.

For the natural sciences, the study showed that less than two-thirds of students take a science course in their first year of college. The two most popular natural science courses taken by students in this study were chemistry followed by biology, which is somewhat different from the previous popularity rankings of the two courses, which found biology to be slightly more popular than chemistry in the first year of college among 1992 high school graduates (Adelman, 2004). Similarly, in a recent report on benchmarks for college readiness, biology benchmarks were developed though chemistry benchmarks were not (ACT, 2005). The findings from this study suggest that math and science course work taken in the first year of college may have changed over time. Calculus and chemistry may play a more central role in first-year course work, though algebra and biology, respectively,

had been more commonly considered in previous college readiness research.

The variation in high school performance, first-year college performance and actual course performance by the different courses students enrolled in likely reflects some level of self-selection. For example, it was not necessarily surprising that students enrolled in at least one reading course in the first year of college tended to have the lowest HSGPAs and lowest FYGPAs. College reading courses are typically developmental courses (Caverly, Nicholson, & Radcliffe, 2004). The converse is true for students taking at least one course in differential equations. This is typically thought of as being an advanced or more challenging mathematics course, so it is not surprising that these students have both higher HSGPAs and FYGPAs.

Limitations

There are a few limitations of this research worth noting. First, as the focus of this study is on four-year colleges only, the course work taken by students at two-year colleges is likely to be different and is worthy of future cross-institutional analysis. Also, because the content area categories are not mutually exclusive, and the same students can be included in multiple content areas, it is somewhat difficult to make definitive conclusions about the descriptive statistics related to the students in each content area. That is to say, the students who have only taken a calculus course in the first-year of college may be different from the students who have taken a calculus, differential equations, and discrete/finite math course, yet they are all included in the same calculus content area category. Similarly, there may be substantial overlap between the specific content areas. For example, students who took differential equations, are likely to have also taken linear algebra. Therefore, comparisons between these two subsets of students, particularly on student-level measures like HSGPA and FYGPA, should be made with caution. It would be interesting to analyze patterns of courses taken in the first year in relation to college readiness in future research.

Conclusion

This analysis of first-year college couse work across 110 four-year institutions both confirms and challenges our previously understood schema of the most commonly taken courses in English, mathematics, and science. As in previous research, composition is the most commonly taken English course. However, calculus was more popular than algebra within mathematics, and chemistry was more popular than biology within the natural sciences. Both the English and math findings were different from those of previous analyses of first-year college course work in those content areas. These differences could either be due to the nature of the sample or could be related to changes in college requirements, student majors offered, and/or evolving student interests. The study highlights the fact that the actual course work that students are taking in the first year of college is integral to the discussion of college readiness and standards for success in various content areas. Because the first year of college is crucial to later success in college and graduation, it should remain a part of the national conversation on common core standards and our consideration of college preparation and success.

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Table 1

Percentage of Institutions by Key Variables: Comparison of Population to Sample

	Variable	*Population*	*Sample*
Region of U.S.	Midwest	28%	15%
	Mid-Atlantic	21%	24%
	New England	10%	22%
	South	22%	11%
	Southwest	7%	11%
	West	13%	17%
Selectivity	Admits under 50%	17%	24%
	Admits 50% to 75%	45%	54%
	Admits over 75%	38%	23%
Size	Small	43%	20%
	Medium	36%	39%
	Large	12%	21%
	Very large	9%	20%
Control	Public	37%	43%
	Private	63%	57%

Note: The target population was the 1,169 four-year public and private (nonproprietary) institutions in the U.S. that provided complete data to the 2006 College Board Annual Survey of Colleges. Percentages may not sum to 100 due to rounding. With regard to institution size, small = 750 to 1,999 undergraduates; medium = 2,000 to 7,499 undergraduates; large = 7,500 to 14,999 undergraduates; and very large = 15,000 or more undergraduates.

Table 2

Descriptive Statistics for Students Enrolled in at Least One Course, by Content Area

Content Area	*n*	*%*	*HSGPA*		*FYGPA*		*College Course Grade*	
			Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Social Sciences	133,906	81%	3.60	0.50	2.99	0.69	2.96	0.87
English	117,950	72%	3.56	0.50	2.97	0.68	3.16	0.80
Mathematics	117,499	72%	3.62	0.50	2.99	0.68	2.74	1.05
Natural Sciences	106,501	65%	3.67	0.48	3.01	0.68	2.78	0.93
Arts and Music	62,495	38%	3.59	0.50	3.03	0.67	3.27	0.86
History	57,801	35%	3.55	0.51	2.92	0.71	2.84	0.96
Humanities	57,548	35%	3.62	0.49	3.06	0.64	3.10	0.86
Business and Communications	53,859	33%	3.55	0.51	2.98	0.68	3.08	0.86
Foreign and Classical Languages	48,093	29%	3.68	0.47	3.16	0.61	3.29	0.78
Physical Education and Health	33,432	20%	3.58	0.51	2.97	0.69	3.39	0.87
Freshman Experience	26,024	16%	3.50	0.54	2.93	0.71	3.57	0.78
Computer Sciences	23,932	15%	3.56	0.52	2.96	0.69	2.95	1.04
Engineering	18,097	11%	3.76	0.45	2.95	0.70	3.17	0.83
Military	1,954	1%	3.58	0.49	2.80	0.68	3.69	0.63
Other	22,326	14%	3.55	0.52	2.95	0.73	3.39	0.86
Total	164,331	100%	3.61	0.50	2.98	0.71	2.98	0.71

Note: This table is based on the 164,331 unique students with self-reported high school GPA and first-year college GPA. The content area categories are not mutually exclusive — as students take courses in multiple areas — and therefore percentages do not sum to 100. Where students took multiple courses in a single area, their mean course grade was computed and then the mean across all students within that category was computed. Courses that could not be categorized into one of the above categories are labeled "Other." Courses categorized as "Other" include: Facing Fear, Clothing Construction, and Phlebotomy.

Table 3

Students Enrolled in at Least One Course, by Discipline and Institutional Acceptance Rate

	2006 Undergraduate Acceptance Rate					
	Less than 50% of Applicants		*50% to 75% of Applicants*		*More than 75% of Applicants*	
Content Area	*n*	*%*	*n*	*%*	*n*	*%*
Social Sciences	24,159	82%	34,277	80%	75,470	82%
English	21,383	72%	30,832	72%	65,735	72%
Mathematics	20,360	69%	30,701	71%	66,438	72%
Natural Sciences	18,793	63%	29,720	69%	57,988	63%
Arts and Music	11,112	38%	15,956	37%	35,427	39%
History	8,152	28%	16,534	38%	33,115	36%
Humanities	13,952	47%	9,538	22%	34,058	37%
Business and Communications	6,821	23%	18,587	43%	28,451	31%
Foreign and Classical Languages	13,245	45%	10,403	24%	24,445	27%
Physical Education and Health	4,761	16%	10,101	24%	18,570	20%
Freshman Experience	4,656	16%	7,797	18%	13,571	15%
Computer Sciences	3,101	10%	7,041	16%	13,790	15%
Engineering	3,563	12%	5,349	12%	9,185	10%
Military	174	1%	932	2%	848	1%
Other	1,814	6%	8,838	21%	11,674	13%
Total	29,604	100%	42,967	100%	91,760	100%

Note: This table is based on the 164,331 unique students with self-reported high school GPA and first-year college GPA. The content area categories are not mutually exclusive — as students take courses in multiple areas — and therefore percentages do not sum to 100. Courses that could not be categorized into one of the above categories are labeled "Other." Courses categorized as "Other" include: Facing Fear, Clothing Construction, and Phlebotomy.

Table 4

Descriptive Statistics for Students Enrolled in at Least One English Course, by English Content Area

English Content Area	*n*	*%*	*HSGPA*		*FYGPA*		*Course Grade*	
			Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Composition	100,312	85%	3.55	0.50	2.95	0.68	3.15	0.81
Literature	22,633	19%	3.65	0.48	3.16	0.60	3.26	0.77
Reading and Composition	4,297	4%	3.34	0.55	2.88	0.69	3.01	0.80
ESL	1,659	1%	3.35	0.55	2.74	0.79	3.00	1.11
Creative Writing	1,512	1%	3.65	0.47	3.26	0.55	3.52	0.63
Poetry	1,311	1%	3.67	0.49	3.18	0.61	3.40	0.71
Film	1,070	1%	3.51	0.55	3.02	0.65	3.08	0.87
Journalism	1,070	1%	3.68	0.46	3.19	0.58	3.20	0.78
Communication	882	1%	3.29	0.51	3.01	0.60	3.21	0.69
Reading	864	1%	3.27	0.54	2.72	0.63	3.11	0.80
Drama	488	0%	3.61	0.51	3.13	0.64	3.23	0.78
Other	1,102	1%	3.56	0.48	3.15	0.56	3.29	0.68
English Overall	117,950	100%	3.56	0.50	2.97	0.68	3.16	0.80

Note: This table is based on the 117,950 unique students with self-reported high school GPA and first-year college GPA who took at least one English course. Where students took multiple courses in a single area, their mean course grade was computed and then the mean across all students within that category was computed. Courses categorized as "Other" include: What It Means to Be Human, Ethics of Embodiment, and Evolution of the English Language.

Table 5

Descriptive Statistics for Students Enrolled in at Least One Mathematics Course, by Mathematics Content Area

Mathematics Content Area	*n*	*%*	*HSGPA*		*FYGPA*		*College Course Grade*	
			Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Calculus	52,034	44%	3.76	0.43	3.11	0.62	2.83	1.00
Algebra	20,883	18%	3.36	0.51	2.72	0.75	2.52	1.15
Statistics	13,422	11%	3.70	0.46	3.20	0.58	3.06	0.96
Precalculus	10,651	9%	3.56	0.47	2.87	0.67	2.63	1.10
Discrete/Finite Math	4,424	4%	3.47	0.53	3.00	0.63	2.82	1.03
Algebra & Trigonometry	3,628	3%	3.46	0.48	2.76	0.73	2.55	1.11
Probability/Statistics	3,022	3%	3.63	0.46	3.14	0.60	2.88	1.07
Geometry	3,018	3%	3.89	0.39	3.23	0.65	3.67	0.71
Basic Mathematics	2,607	2%	3.32	0.55	2.83	0.79	2.69	1.15
Contemporary Mathematics	2,578	2%	3.56	0.51	2.95	0.67	2.66	1.16
Analysis	2,543	2%	3.65	0.45	3.01	0.73	2.75	1.12
Mathematical Reasoning/Thought	2,299	2%	3.42	0.50	2.91	0.68	2.71	1.09
Linear Algebra	2,147	2%	3.89	0.37	3.36	0.52	3.11	0.92
Differential Equations	1,977	2%	3.91	0.37	3.39	0.47	3.16	0.90
College/University Math	1,970	2%	3.42	0.48	2.95	0.62	2.96	0.94
Elementary Functions	1,854	2%	3.70	0.44	2.93	0.59	2.78	0.95
Trigonometry	1,578	1%	3.64	0.47	2.70	0.72	2.20	1.29
Mathematical Models	1,221	1%	3.54	0.53	2.96	0.62	2.85	1.01
Mathematics Education	1,212	1%	3.47	0.49	3.11	0.61	2.98	0.92
Probability	1,041	1%	3.74	0.42	3.25	0.52	3.16	0.89
Other	15,453	13%	3.62	0.50	2.96	0.66	2.71	1.13
Mathematics Overall	117,499	100%	3.62	0.50	2.99	0.68	2.74	1.05

Note: This table is based on the 117,499 unique students with self-reported high school GPA and first-year college GPA who took at least one mathematics course. Where students took multiple courses in a single area, their mean course grade was computed and then the mean across all students within that category was computed. Courses categorized as "Other" include: Introduction to Cryptography, Theory of Equations, and Women in Mathematics.

Table 6

Descriptive Statistics for Students Enrolled in at Least One Natural Science Course, by Natural Science Content Area

Natural Science Content Area	*n*	*%*	*HSGPA*		*FYGPA*		*College Course Grade*	
			Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Chemistry	49,618	47%	3.76	0.44	3.01	0.67	2.72	0.95
Biology	36,777	35%	3.69	0.48	3.02	0.68	2.77	0.99
Physics	21,299	20%	3.78	0.44	3.07	0.65	2.88	0.98
Geology	15,689	15%	3.58	0.49	2.98	0.66	2.88	0.93
Astronomy	9,297	9%	3.64	0.48	3.05	0.66	2.95	0.93
Environmental Science	5,195	5%	3.60	0.47	3.02	0.65	3.04	0.90
Anatomy and Physiology	4,216	4%	3.63	0.48	3.08	0.64	2.66	1.04
Plant Science	2,855	3%	3.60	0.49	2.94	0.72	2.79	1.09
Oceanography	1,976	2%	3.65	0.47	3.01	0.61	2.93	0.91
Ecology	1,956	2%	3.85	0.42	3.14	0.59	2.96	0.91
Microbiology	1,924	2%	3.74	0.43	3.16	0.59	2.95	0.87
General Science	1,485	1%	3.75	0.47	3.20	0.62	3.40	0.74
Pharmacology	1,370	1%	3.41	0.55	2.55	0.79	2.85	1.02
Physical Science	1,360	1%	3.65	0.48	3.09	0.56	3.03	0.92
Animal Science	1,342	1%	3.70	0.48	2.91	0.73	2.97	1.02
Atmospheric Science	1,129	1%	3.62	0.45	3.01	0.64	2.84	0.94
Meteorology	1,119	1%	3.68	0.49	3.19	0.55	3.14	0.78
Biodiversity	1,069	1%	3.64	0.50	2.96	0.72	2.73	0.96
Geography	1,006	1%	3.55	0.52	2.99	0.63	2.73	0.96
Zoology	920	1%	3.67	0.50	2.92	0.67	2.54	1.09
Climatology	857	1%	3.78	0.40	3.21	0.51	3.04	0.80
Biochemistry	751	1%	3.80	0.40	3.12	0.60	3.20	0.89
Entomology	494	0%	3.71	0.44	2.99	0.71	3.23	1.01
Neuroscience	396	0%	3.81	0.42	3.30	0.54	3.12	0.82
Agriculture	383	0%	3.66	0.44	3.09	0.64	3.74	0.66
Forensic Science	313	0%	3.45	0.49	2.88	0.75	2.74	0.85
Forestry	236	0%	3.45	0.54	2.90	0.72	3.20	0.92
Other	510	0%	3.96	0.36	3.31	0.63	3.70	0.60
Natural Science Overall	106,501	100%	3.67	0.48	3.01	0.68	2.78	0.93

Note: This table is based on the 106,501 unique students with self-reported high school GPA and first-year college GPA who took at least one natural science course. Where students took multiple courses in a single area, their mean course grade was computed and then the mean across all students within that category was computed. Courses categorized as "Other" include: Cholesterol: Good, Bad, Money; Informatics for Scientists; and Science of Contemporary Issues.

Appendix A

Descriptive Statistics for Students Enrolled in at Least One English Course, by Detailed English Content Area

Detailed English Content Area	*n*	*%*	*HSGPA*		*FYGPA*		*College Course Grade*	
			Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Composition	95,012	81%	3.55	0.50	2.94	0.68	3.15	0.82
Literature	15,683	13%	3.66	0.48	3.18	0.58	3.30	0.74
Composition — Literature	8,593	7%	3.55	0.51	3.10	0.55	3.29	0.72
Reading and Composition	4,297	4%	3.34	0.55	2.88	0.69	3.01	0.80
Literature — American	3,780	3%	3.61	0.48	3.11	0.63	3.23	0.81
Composition — Persuasive	2,989	3%	3.52	0.49	3.05	0.60	3.22	0.72
Literature — British	2,485	2%	3.72	0.47	3.25	0.61	3.26	0.80
Literature — World	1,992	2%	3.64	0.48	3.15	0.65	3.19	0.91
ESL	1,659	1%	3.35	0.55	2.74	0.79	3.00	1.11
Creative Writing	1,512	1%	3.65	0.47	3.26	0.55	3.52	0.63
Poetry	1,311	1%	3.67	0.49	3.18	0.61	3.40	0.71
Film	1,070	1%	3.51	0.55	3.02	0.65	3.08	0.87
Journalism	1,070	1%	3.68	0.46	3.19	0.58	3.20	0.78
Communication	882	1%	3.29	0.51	3.01	0.60	3.21	0.69
Reading	864	1%	3.27	0.54	2.72	0.63	3.11	0.80
Composition — Business/Technical	694	1%	3.63	0.47	3.00	0.69	3.25	0.85
Drama	488	0%	3.61	0.51	3.13	0.64	3.23	0.78
Literature — Women's	308	0%	3.69	0.45	3.13	0.64	3.15	0.87
Literature — Criticism	307	0%	3.63	0.47	3.24	0.57	3.34	0.74
Other	1,102	1%	3.56	0.48	3.15	0.56	3.29	0.68
English Overall	117,950	100%	3.56	0.50	2.97	0.68	3.16	0.80

Note. The content area categories are not mutually exclusive — as students take courses in multiple areas — and therefore students are included in the estimation of descriptive statistics for more than one content area. Where students took multiple courses in a single area, their mean course grade was computed and then the mean across all students within that category was computed. Courses categorized as "Other" include: What It Means to Be Human, Ethics of Embodiment, and Evolution of the English Language.

Appendix B

Descriptive Statistics for Students Enrolled in at Least One Mathematics Course, by Detailed Mathematics Content Area

Detailed Mathematics Content Area	*n*	*%*	*HSGPA*		*FYGPA*		*College Course Grade*	
			Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Calculus	40,379	34%	3.77	0.43	3.12	0.62	2.84	1.02
Algebra	20,883	18%	3.36	0.51	2.72	0.75	2.52	1.15
Statistics	11,908	10%	3.68	0.46	3.18	0.59	3.02	0.98
Precalculus	10,651	9%	3.56	0.47	2.87	0.67	2.63	1.10
Calculus — Analytic Geometry	8,498	7%	3.79	0.42	3.07	0.61	2.81	0.94
Other — Business/Economics	4,739	4%	3.72	0.44	2.96	0.61	2.50	1.20
Discrete/Finite Math	4,424	4%	3.47	0.53	3.00	0.63	2.82	1.03
Algebra and Trigonometry	3,628	3%	3.46	0.48	2.76	0.73	2.55	1.11
Calculus — Business/Economics	3,484	3%	3.68	0.45	3.15	0.53	2.94	0.95
Probability/Statistics	3,022	3%	3.63	0.46	3.14	0.60	2.88	1.07
Geometry	3,018	3%	3.89	0.39	3.23	0.65	3.67	0.71
Basic Mathematics	2,607	2%	3.32	0.55	2.83	0.79	2.69	1.15
Contemporary Mathematics	2,578	2%	3.56	0.51	2.95	0.67	2.66	1.16
Analysis	2,543	2%	3.65	0.45	3.01	0.73	2.75	1.12
Mathematical Reasoning/Thought	2,299	2%	3.42	0.50	2.91	0.68	2.71	1.09
Linear Algebra	2,147	2%	3.89	0.37	3.36	0.52	3.11	0.92
Differential Equations	1,977	2%	3.91	0.37	3.39	0.47	3.16	0.90
College/University Math	1,970	2%	3.42	0.48	2.95	0.62	2.96	0.94
Other — Science/Engineering	1,967	2%	3.87	0.39	2.84	0.69	2.34	1.20
Elementary Functions	1,854	2%	3.70	0.44	2.93	0.59	2.78	0.95
Trigonometry	1,578	1%	3.64	0.47	2.70	0.72	2.20	1.29
Statistics — Business/Economics	1,546	1%	3.86	0.37	3.44	0.47	3.34	0.79
Calculus — Science/Engineering	1,445	1%	3.74	0.46	3.07	0.63	2.82	0.97
Mathematical Models	1,221	1%	3.54	0.53	2.96	0.62	2.85	1.01
Mathematics Education	1,212	1%	3.47	0.49	3.11	0.61	2.98	0.92
Probability	1,041	1%	3.74	0.42	3.25	0.52	3.16	0.89
Other	9,036	8%	3.52	0.51	2.98	0.67	2.90	1.05
Mathematics Overall	117,499	100%	3.62	0.50	2.99	0.68	2.74	1.05

Note: The content area categories are not mutually exclusive — as students take courses in multiple areas — and therefore students are included in the estimation of descriptive statistics for more than one content area. Where students took multiple courses in a single area, their mean course grade was computed and then the mean across all students within that category was computed. Courses categorized as "Other" include: Introduction to Cryptography, Theory of Equations, and Women in Mathematics.

Appendix C

Descriptive Statistics for Students Enrolled in at Least One Natural Science Course, by Detailed Natural Science Content Area

Detailed Natural Science Content Area	*n*	*%*	*HSGPA*		*FYGPA*		*College Course Grade*	
			Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Chemistry	48,218	45%	3.76	0.44	3.01	0.67	2.72	0.96
Biology	29,891	28%	3.69	0.47	3.00	0.69	2.74	1.00
Physics	14,634	14%	3.76	0.45	3.09	0.65	2.93	0.95
Geology	11,241	11%	3.59	0.48	2.98	0.66	2.90	0.93
Astronomy	6,747	6%	3.63	0.48	3.06	0.64	2.98	0.91
Physics — Mechanical	6,059	6%	3.83	0.40	3.02	0.65	2.83	1.07
Environmental Science	4,808	5%	3.60	0.47	3.03	0.63	3.04	0.90
Anatomy and Physiology	4,216	4%	3.63	0.48	3.08	0.64	2.66	1.04
Biology — Cellular and Molecular	3,315	3%	3.81	0.42	3.13	0.68	2.80	1.04
Plant Science	2,855	3%	3.60	0.49	2.94	0.72	2.79	1.09
Chemistry — Organic	2,257	2%	3.88	0.42	3.30	0.58	2.97	0.86
Physics — Electricity and Magnetism	2,062	2%	3.90	0.38	3.23	0.56	2.94	0.99
Biology — Organismal	2,023	2%	3.76	0.45	3.13	0.65	2.90	0.93
Oceanography	1,976	2%	3.65	0.47	3.01	0.61	2.93	0.91
Microbiology	1,924	2%	3.74	0.43	3.16	0.59	2.95	0.87
Biology — Genetics	1,652	2%	3.86	0.41	3.36	0.53	3.16	0.84
Geology — Earth Science	1,506	1%	3.51	0.50	2.99	0.67	2.84	0.99
General Science	1,485	1%	3.75	0.47	3.20	0.62	3.40	0.74
Geology — Environmental	1,381	1%	3.57	0.49	3.07	0.62	2.97	0.89
Astronomy — Solar System	1,379	1%	3.71	0.43	3.15	0.57	3.10	0.87
Pharmacology	1,370	1%	3.41	0.55	2.55	0.79	2.85	1.02
Physical Science	1,360	1%	3.65	0.48	3.09	0.56	3.03	0.92
Animal Science	1,342	1%	3.70	0.48	2.91	0.73	2.97	1.02
Geology — Physical	1,303	1%	3.61	0.45	2.97	0.69	2.88	0.90
Atmospheric Science	1,129	1%	3.62	0.45	3.01	0.64	2.84	0.94
Meteorology	1,119	1%	3.68	0.49	3.19	0.55	3.14	0.78
Biology — Human	1,115	1%	3.39	0.56	2.93	0.69	2.73	1.03
Chemistry — Inorganic	1,092	1%	3.84	0.41	3.19	0.58	2.88	0.98
Ecology	1,078	1%	3.82	0.43	3.16	0.57	3.02	0.89
Biodiversity	1,069	1%	3.64	0.50	2.96	0.72	2.73	0.96
Geography	1,006	1%	3.55	0.52	2.99	0.63	2.73	0.96
Geology — Evolution	987	1%	3.46	0.40	2.85	0.54	2.69	0.80

Appendix C ***(continued)***

Descriptive Statistics for Students Enrolled in at Least One Natural Science Course, by Detailed Natural Science Content Area

Detailed Natural Science Content Area	*n*	*%*	*HSGPA*		*FYGPA*		*College Course Grade*	
			Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Zoology	920	1%	3.67	0.50	2.92	0.67	2.54	1.09
Physics — Engineering	915	1%	3.92	0.38	3.20	0.64	3.06	0.92
Ecology — Evolution	880	1%	3.87	0.39	3.12	0.62	2.88	0.92
Biology — Evolution	875	1%	3.76	0.42	2.98	0.73	2.62	1.07
Astronomy — Descriptive	870	1%	3.56	0.52	2.81	0.90	2.66	1.16
Climatology	857	1%	3.78	0.40	3.21	0.51	3.04	0.80
Biology — Conservation	756	1%	3.44	0.55	2.77	0.80	3.00	1.10
Biochemistry	751	1%	3.80	0.40	3.12	0.60	3.20	0.89
Astronomy — Cosmology	725	1%	3.81	0.40	3.20	0.54	3.00	0.85
Biology — Marine	571	1%	3.65	0.47	3.06	0.62	3.11	0.85
Biology — Environmental	499	0%	3.66	0.45	3.19	0.60	3.34	0.81
Entomology	494	0%	3.71	0.44	2.99	0.71	3.23	1.01
Geology — Dinosaurs	453	0%	3.59	0.52	2.98	0.61	2.89	0.90
Neuroscience	396	0%	3.81	0.42	3.30	0.54	3.12	0.82
Agriculture	383	0%	3.66	0.44	3.09	0.64	3.74	0.66
Forensic Science	313	0%	3.45	0.49	2.88	0.75	2.74	0.85
Environmental Science — Wildlife	298	0%	3.56	0.52	2.82	0.78	3.15	1.00
Physics — Energy	288	0%	3.71	0.49	3.21	0.54	3.24	0.74
Physics — Thermal	285	0%	3.94	0.36	3.40	0.47	3.23	0.77
Chemistry — Physical	281	0%	3.98	0.32	3.35	0.43	2.99	0.87
Physics — Wave	279	0%	3.90	0.38	3.38	0.49	3.25	0.71
Geology — Earth History	266	0%	3.69	0.42	3.11	0.62	3.03	0.88
Physics — Sound and Music	266	0%	3.67	0.44	3.07	0.67	3.08	0.83
Forestry	236	0%	3.45	0.54	2.90	0.72	3.20	0.92
Physics — Astronomy	189	0%	3.79	0.38	3.20	0.52	3.08	0.78
Environmental Science — Water	142	0%	3.53	0.45	3.11	0.69	2.85	0.91
Geology — Historical	122	0%	3.64	0.48	2.81	0.71	2.58	1.15
Other	510	0%	3.96	0.36	3.31	0.63	3.70	0.60
Natural Science Overall	106,501	100%	3.67	0.48	3.01	0.68	2.78	0.93

Note: The content area categories are not mutually exclusive — as students take courses in multiple areas — and therefore students are included in the estimation of descriptive statistics for more than one content area. Where students took multiple courses in a single area, their mean course grade was computed and then the mean across all students within that category was computed. Courses categorized as "Other" include: Cholesterol: Good, Bad, Money; Informatics for Scientists; and Science of Contemporary Issues.

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