SAT® Subject Area Readiness Indicators: Reading, Writing, and STEM

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Introduction

In 2011, the College Board developed the SAT® College and Career Readiness Benchmark to assist educators and policymakers in their efforts to better evaluate the college readiness of their students[1]. This benchmark was designed to identify the point on the SAT score scale that is indicative of students' having a high likelihood of success in college, with "success" being defined as a 65% probability of obtaining a first-year GPA (FYGPA) of 2.67 (B-) or higher. This criterion was informed by a panel of expert educators and policymakers convened by the College Board in 2007 (Kobrin, Patterson, Wiley, & Mattern, 2012).

There are several advantages to using FYGPA as an outcome variable to measure college readiness. FYGPA encompasses all of the courses a student completes during his or her first term and often represents approximately 25% of the courses a student will complete during college. In addition, courses taken during a student's first year are typically more uniform than those taken during subsequent years, making it a more appropriate measure of general preparedness (Wiley, Wyatt, & Camara, 2010). Research has established a strong correlation between FYGPA and retention, and the likelihood of continuing college for four years increases substantially for students with higher FYGPAs (Allen, 1999; Murtaugh, Burns, & Schuster, 1999).

The College and Career Readiness Benchmark is 1550, a composite score for the three sections of the SAT combined — critical reading (SAT-CR), mathematics (SAT-M), and writing (SAT-W). In addition, the College Board has provided subject-level readiness indicators for each section of the exam. The indicator score for each section is 500, and like the overall SAT College and Career Readiness Benchmark, each is based on a 65% probability of obtaining an FYGPA of a B- or higher (Wyatt, Kobrin, Wiley, Camara, & Proestler, 2011).

One limitation of this approach is that is the subject-level readiness indicators are linked to overall first-year grades, not to content-specific performance and may include a different range of subjects for different students. However, establishing a content-related SAT section score benchmark based on a single specific course (e.g., SAT-M to college algebra) would exclude a large percentage of freshman students who did not take that particular course (Shaw & Patterson, 2010). One way to address this limitation is to develop a benchmark that corresponds to performance in several freshman courses within a content area. Accordingly, the College Board has calculated benchmarks that link SAT section scores to performance in multiple related freshman college courses. Critical reading section scores (SAT-CR) were linked to performance in courses that likely require extensive reading assignments, mathematics section scores (SAT-M) were linked to performance in math and related courses, and writing section scores (SAT-W) were linked to performance in courses that typically require writing.

Data and Methodology

The data were obtained from a sample of 199,366 SAT takers who self-reported their HSGPA, graduated from high school in 2009, and attended one of the 131 four-year colleges and universities that participated in the College Board's validity study. These institutions provided information on first-year course titles, grades, and credit hours earned. Course titles were used to identify courses utilizing reading and writing skills, as well as courses in math and related subjects (see Table 1).The decision to link SAT-CR to all courses likely to have extensive reading requirements rather than solely English courses was driven both by content considerations and empirical evidence. From a content perspective, both the Common Core State Standards and the National Assessment of Educational Progress (NAEP) framework emphasize the use of informational text[2] that prepares students for reading material in a variety of areas, including social science, history, science, and technical areas (Camara & Quenemoen, 2012; Common Core State Standards, n.d.).

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1. See Wyatt, Kobrin, Wiley, Camara, and Proestler (2011) for more information.
2. The NAEP framework recommends that 12th-graders' reading material be made up of 70% informational text.

From an empirical perspective, performance on AP Exams in English, history, and the social sciences is moderately to strongly correlated with both PSAT/NMSQT® critical reading section scores and PSAT/NMSQT writing section scores (Ewing, Camara, & Millsap, 2006). This suggests that reading and writing skills are related to success in entry-level college courses in these subjects.

Thus, SAT section scores were linked to college-level performance in course work in the subject areas as described in Table 1. Additionally, section scores were linked to content-specific FYGPAs rather than to individual course grades to provide a more complete picture of student performance than would individual course grades alone.

Table 1: Course Content Areas that Constitute Content Area FYGPAs

Content Area FYGPA:	Reading	Writing	Math	Math and Science	STEM
Included Course Work	- Business and Communications - English (excluding writing) - History - Humanities - Social Science	- Business and Communications - English - History - Humanities - Social Science	-Math	- Math - Science	- Math - Science - Computer Science - Engineering

Data Analyses

Logistic regression was used to compute the SAT content benchmarks. Logistic regression is a statistical method that uses one or more predictor variables (in this case, an SAT section score) to predict a binary outcome (e.g., achieving a content FYGPA of 2.67 or higher). A series of separate logistic regression equations were estimated for each of the five content areas (see Table 1) using the SAT section score as the predictor variable and the dichotomized content-area FYGPA (e.g., 0 if below 2.67 and 1 if 2.67 or higher) as the outcome variable.

SAT section benchmarks were established for each of the 131 institutions participating in the College Board validity study. Any out-of-range institution-level benchmark (e.g., lower than 200 or higher than 800) was excluded,[3] and the remaining institution-level benchmarks were averaged, weighted by the institution-level sample sizes. A total of 18 benchmarks were computed for each content area using six probability levels (from 50% to 75%) and three content area FYGPAs (i.e., 2.00, 2.67, and 3.00).

Results

Table 2 includes the results for each of the logistic regressions. This table contains the maximum number of institutions (*k*) and the sample size (*n*) for each subject-area analysis, the *k* and *n* used to create each of the 18 benchmarks,[4] and the SAT content benchmark score. The content benchmark scores associated with a 65% probability of obtaining a 2.67 or higher are highlighted. These parameters were recommended by the College Board's panel of educators and policymakers, although it should be noted that these recommendations were made based on overall FYGPA and not content-specific FYGPAs.[5] The content benchmark scores associated with a 65% probability of obtaining a content FYGPA of 2.67 or higher were 500 on SAT-CR (to "reading" course FYGPAs[6]); 470 on SAT-W (to "writing" course FYGPAs); and, 610–630 on SAT-M, depending on the college course composition. The benchmark SAT-M score associated with a FYGPA composed strictly of math courses was 630; the SAT-M benchmark score associated with a combined math/science FYGPA was 620; and the SAT-M benchmark score associated with a STEM FYGPA was 610.

The benchmarks associated with subject area performance in critical reading and writing were considerably lower than those in math. However, this is expected given that mean college course grades in business and communications, English, history, humanities, and social science, tend to be higher than those in math and science[7] (Shaw & Patterson, 2010). Table 3 shows the percent of SAT takers who obtained each of the subject area readiness indicators associated with a 65% probability of obtaining a content related GPA of a B-

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3. The number of institutions that were excluded because of out-of-range SAT values can be calculated from Table 2 by subtracting *K* from 131.
4. Schools whose benchmark score falls below 200 or above 800 were dropped, and the number of valid institutions can differ between benchmarks. More schools had "out of range" benchmark scores when 2.00 was used as the content GPA outcome (rather than 2.67 or 3.00), as there was less variability associated with achieving this outcome.
5. For more information, see http://research.collegeboard.org/rr2010-3.
6. See Table 1 for the course categorizations.
7. Mean college course grades were higher in engineering and computer science than in math and science. However, a smaller percentage of students took these courses.

or higher. Roughly half of SAT takers obtained the critical reading and writing benchmarks (49.1% and 55.6%, respectively) while less than one-quarter of SAT takers obtained the math, math and science, or STEM benchmarks.

The College Board now has a suite of college readiness benchmarks that provide information for a variety of purposes and objectives. The SAT College and Career Readiness Benchmark of 1550 provides an indicator of overall student readiness, while the SAT content benchmarks provide a measure of student readiness within specific content areas.

Table 2: SAT Scores Associated with a Given Probability of Obtaining First-Year Course Content GPA

Course	Probability	Course Grade								
		2.00			2.67			3.00		
		k	n	SAT	k	n	SAT	k	n	SAT
SAT-CR	50%	55	78,156	260	126	184,526	410	130	186,061	480
To	55%	65	95,963	280	129	185,899	440	131	186,282	510
"Reading" Courses	60%	75	106,630	300	129	185,899	470	131	186,282	540
(K = 131)	65%	83	125,284	310	130	186,061	500	131	186,282	570
(N = 186,282)	70%	94	143,432	340	131	186,282	530	130	185,051	590
	75%	98	147,238	370	131	186,282	560	130	185,051	630
SAT-W	50%	56	79,531	250	124	185,286	400	131	193,974	470
To	55%	67	95,671	270	128	191,975	420	131	193,974	490
"Writing" Courses	60%	72	106,630	290	130	193,285	440	131	193,974	520
(K = 131)	65%	83	122,802	300	131	193,974	470	131	193,974	540
(N = 193,974)	70%	93	141,746	320	131	193,974	500	131	193,974	570
	75%	104	156,964	350	131	193,974	530	131	193,974	600
SAT-M	50%	108	120,463	350	129	142,609	520	131	143,665	570
To	55%	115	129,834	370	130	142,864	560	131	143,665	600
All Math Courses	60%	121	134,553	400	130	142,864	590	131	143,665	640
(K = 131)	65%	124	141,195	430	130	142,864	630	128	139,892	670
(N = 143,665)	70%	126	141,728	470	129	140,977	660	122	131,485	700
	75%	129	142,509	510	122	133,765	700	109	110,658	720
SAT-M	50%	114	161,190	350	130	175,439	530	130	175,496	600
To	55%	117	163,215	380	130	175,439	560	128	173,633	620
Math/Science Courses	60%	120	163,996	410	129	174,229	590	128	173,633	650
(K = 131)	65%	128	173,875	430	129	174,229	620	127	171,387	680
(N = 175,654)	70%	131	175,654	460	128	173,633	650	124	163,256	710
	75%	130	174,387	500	127	171,387	680	109	142,646	730
SAT-M	50%	115	165,538	350	130	178,540	520	129	177,323	590
To	55%	115	165,538	380	130	178,540	550	129	177,323	620
STEM Courses	60%	122	168,330	400	129	177,323	580	128	176,705	650
(K = 131)	65%	125	170,317	430	129	177,323	610	125	173,753	670
(N = 178,755)	70%	129	177,337	460	128	176,705	640	123	169,840	700
	75%	129	177,100	500	126	173,921	670	112	152,925	730

Table 3: Percentage of SAT Takers Graduating in 2012 Who Obtained the Subject Area Readiness Benchmarks[8]

Subject	Section	Criteria	Benchmark	Percent Attaining
Reading	SAT-CR	65% of B-	500	49.1
Writing	SAT-W	65% of B-	470	55.6
Math	SAT-M	65% of B-	630	18.4
Math/Science	SAT-M	65% of B-	620	20.4
STEM	SAT-M	65% of B-	610	22.5

Note: The criteria are based on a first-year GPA in relevant courses as described in Table 1.

8. See Table 2.

References

Allen, D. (1999). Desire to finish college: An empirical link between motivation and persistence. *Research in Higher Education, 40,* 461–485.

Camara, W. J., & Quenemoen, R. (2012). *Defining and measuring college and career readiness and informing the development of performance level descriptors (PLDs).* Commissioned white paper for PARCC. Available at http://www.parcconline.org/sites/parcc/files/PARCC%20CCR%20paper%20v14%201-8-12.pdf.

Common Core State Standards Initiative. (n.d.). Retrieved from http://www.corestandards.org/ELA-Literacy/introduction/key-design-consideration

Ewing, M., Camara, W. J., & Millsap, R. E. (2006). *The relationship between PSAT/NMSQT scores and AP Examination grades: A follow-up study* (College Board Research Report No. 2006-1). New York: The College Board. Retrieved from http://research.collegeboard.org/rr2006-1

Kobrin, J. L., Patterson, B. F., Wiley, A., & Mattern, K. D. (2012). *A standard-setting study to establish college success criteria to inform the SAT college and career readiness benchmark* (College Board Research Report No. 2012-3). New York: The College Board. Retrieved from: http://research.collegeboard.org/rr2012-3

Murtaugh, P. A., Burns, L. D., & Schuster, J. (1999). Predicting the retention of university students. *Research in Higher Education, 40,* 355–371.

Shaw, E. J., & Patterson, B. F. (2010). *What should students be ready for in college? A look at first-year course work in four-year postsecondary institutions in the U.S.* (College Board Research Report 2010-1). Retrieved from http://research.collegeboard.org/rr2010-1

Wiley, A., Wyatt, J., & Camara, W. J. (2010). *The development of a multidimensional college readiness index* (College Board Research Report No. 2010-3). New York: The College Board. Retrieved from http://research.collegeboard.org/rr2010-3

Wyatt, J., Kobrin, J., Wiley, A., Camara, W. J., & Proestler, N. (2011) *SAT benchmarks: Development of a college readiness benchmark and its relationship to secondary and postsecondary school performance* (College Board Research Report No. 2011-5). New York: The College Board. Retrieved from http://research.collegeboard.org/rr2011-5