RESEARCH

AP® Potential Predicted by PSAT/NMSQT® Scores Using Logistic Regression

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Introduction

AP Potential™ is an educational guidance tool that uses PSAT/NMSQT® scores to identify students who have the potential to do well on one or more Advanced Placement® (AP®) Exams. Students identified as having AP potential, perhaps students who would not have been otherwise identified, should consider enrolling in the corresponding AP course if they have the interest and motivation to do so. To date, several studies have been conducted to evaluate the validity of using PSAT/NMSQT scores to predict success on AP Exams (Camara & Millsap, 1998; Ewing, Camara, & Millsap, 2006; Ewing, Camara, Millsap & Milewski, 2007). Results have shown that PSAT/NMSQT scores were moderately to strongly correlated with scores on most AP Exams and that self-reported high school grade point average (HSGPA), grades in related subjects, and total years of study in related subjects accounted for very little additional variance in AP Exam performance once PSAT/NMSQT performance was taken into account.

The methodology used to develop prior versions of AP Potential was empirical; that is, it involved pooling test data across schools and computing expectancy tables showing the percentage of test-takers earning passing scores on AP Exams at various levels of PSAT/NMSQT performance. The purpose of the current research is two-fold. The first is to switch from the empirical approach of building expectancy tables to the use of logistic regression models. Logistic regression models allow for more flexibility should, for example, there be a desire to evaluate and incorporate additional variables that may be important to consider when predicting AP Exam performance. In addition, logistic regression models can be used to determine the PSAT/NMSQT score associated with a particular probability of success (e.g., 50%, 70%), which is in contrast to the previously used empirical approach that yielded the raw percentage of students achieving success on a particular AP Exam for each PSAT/NMSQT score category. The second purpose of this research is to update AP Potential predictions based on more current PSAT/NMSQT and AP score data, which is necessary to do periodically as test-taking populations change over time.

Sample

Drawn from 6,091,075 high school sophomores and juniors who took the PSAT/NMSQT in 2007 and 2008, the sample included 1,835,806 students who took the PSAT/NMSQT in October 2007 and October 2008 and then completed one or more AP Exams 19 months later in May 2009 and May 2010, respectively. The sample comprised approximately 30% of the sophomore and junior PSAT/NMSQT examinee population (over 6 million) in these two years, greater than the proportion of PSAT/NMSQT examinees in 2000 and 2001 completing AP Exams in 2002 and 2003 (24% as reported in Ewing et al., 2006). Overall, there were more junior PSAT/NMSQT examinees completing AP Exams as seniors (> 1 million) than sophomore PSAT/NMSQT examinees completing AP Exams as juniors (about 0.78 million). Table 1 provides PSAT/NMSQT means and standard deviations for the sample, and for all sophomore and junior PSAT/NMSQT examinees in 2007 and 2008. As can be seen, the sample is more highly able than the population of PSAT/NMSQT examinees. A subset of AP students who also completed the SAT Questionnaire were also used to further analyze the relationship between HSGPA, grades in relevant subject areas, and AP Exam scores. Students complete the SAT Questionnaire when they register for the SAT.

Data Analyses

Two sets of analyses were conducted in order to update AP Potential. First, correlations were calculated between students' scores on the 33 AP Exams and several PSAT/NMSQT scores including (1) Critical Reading (CR), (2) Math (M), (3) Writing (W) (4) CR + M, (5) CR + W, (6) M + W, and (7) CR + M + W. Based on the correlational analyses, one of these seven PSAT/NMSQT scores was retained for use in a logistic regression model, which was computed for each AP Exam and used as the basis for building the expectancy tables. AP Exam scores are reported on a 5-point scale ranging from 1 (no recommendation) to 5 (extremely well qualified) and are interpreted in relation to a student's readiness for placement into higher-level college courses. The three PSAT/NMSQT scores (Critical Reading, Math, and Writing) are reported on a 20–80 scale. For purposes of this study, the three individual PSAT/NMSQT scores were also summed to create four composite scores (i.e., CR +M, CR +W, M + W, and CR + M + W).

Second, logistic regression models were conducted to predict success on a given AP Exam based on the retained PSAT/NMSQT score. Two binary outcome variables, with different definitions of success, were examined. In the first scenario, scoring a 3 or better on the AP Exam was defined as success; whereas, in the second scenario, scoring a 4 or better was defined as success. For each definition of success, two models were examined. For Model 1, the retained PSAT/NMSQT score was included as a single predictor. For Model 2, in addition to PSAT/NMSQT score, grade level at the time of the PSAT/NMSQT (i.e., sophomore or junior) was added. If grade level at the time of the PSAT/NMSQT significantly improved model fit, it would indicate that different relationships were present between AP Exam scores and PSAT/NMSQT scores for sophomores and juniors, and separate expectancy tables should be provided. For 10 high-volume AP Exams, sequential logistic regressions[1] were also conducted to investigate the pseudo R-squared increment that PSAT/NMSQT scores contributed above and beyond self-reported cumulative HSGPA and grades in high school courses that were believed to be associated with AP Exam performance. The pseudo R-squared increment was further examined among subgroups by gender and ethnicity.

Results

Correlations and PSAT/NMSQT® Predictor Selection

Correlations between AP and PSAT/NMSQT scores are reported in Table 2 and the summary statistics of AP and PSAT/NMSQT performance overall and by grade level are presented in Table 3. Of the 33 AP Exams, seven were found to have a correlation less than the minimum value of .40[2] required for using PSAT/NMSQT scores to predict AP potential, including Chinese Language and Culture, German Language and Culture, Japanese Language and Culture, Spanish Language, Studio Art: 2-D Design, Studio Art: 3-D Design, and Studio Art: Drawing (see Table 2). Among the 26 AP Exams that were moderately to highly correlated with PSAT/NMSQT scores, four additional exams were removed from further analysis. Latin Vergil was removed because this exam is being replaced with a new course and exam called Latin. French Language and Culture and Spanish Literature and Culture were excluded to be consistent with not reporting AP Potential for AP world language exams. Finally, Calculus BC will be officially removed from the AP Potential tool in December of 2014 and, therefore, is not analyzed further in this report. Calculus BC is being removed because prior work has shown that PSAT/NMSQT cut scores for Calculus BC were systematically lower across the range of PSAT/NMSQT scores than were PSAT/NMSQT cut scores for Calculus AB, making their use in this context difficult to explain given that Calculus BC is considered to cover more advanced topics than Calculus AB[3].

[1] Sequential logistic regression refers to the stages in which the variables were entered into the models with HSGPA and grades entered in stage one, and PSAT/NMSQT scores entered in stage two.

[2] Typically, a correlation of approximately 0.1 is considered low, a correlation of 0.3 is considered moderate, and a correlation of 0.5 or higher is considered strong. For reporting in AP Potential, we require the correlation between AP Exam scores and PSAT/NMSQT scores to be in the moderate to strong range (i.e., equal to or above .40).

[3] Although AP Potential will no longer report Calculus BC as of December 2014, students who have strong perquisite experience in courses leading up to Calculus and those who perform well in Calculus AB may consider taking Calculus BC. When making final course placement decisions, it is important to consider factors such as prior course work, student interest, and motivation.

The PSAT/NMSQT scores chosen as the predictor were selected based on correlation patterns as well as based on ensuring consistency across AP Exams of similar content area. Generally, the PSAT/NMSQT scores that were selected were the ones that had the highest correlation with AP scores and, if not, the second highest correlation. For example, Chemistry, Computer Science A, and Physics C: Electricity/Magnetism had the highest correlations with CR + M. Physics B and Physics C: Mechanics had the highest correlation with Math (.584 and .567, respectively), and the second highest correlation with CR + M (.583 and .566, respectively). The differences were so small that CR + M was determined as the PSAT/NMSQT predictor for Physics B and Physics C: Mechanics so that consistent PSAT/NMSQT scores were selected for all science exams. For the 22 AP Exams for which PSAT/NMSQT scores can be used to predict potential, the correlation coefficients between AP scores and the retained PSAT/NMSQT scores ranged from .47 to .76 and the average correlation coefficient was about .62.

The correlation patterns for sophomore and junior PSAT/NMSQT examinees are reported in Table 4, which shows that the correlations were all reasonably high for both grade levels. The correlations between AP Exam scores and PSAT/NMSQT scores were also computed on subgroups by gender and ethnicity using 10 high-volume AP Exams. The results were similar to the previous study by Ewing et al., (2006).

Strength of Relationship between AP Exam Scores and High School Grades

The correlations between AP Exam scores and HSGPA ranged from .22 for Calculus AB to .39 for Psychology, with an average correlation of .33 (see Table 5). The correlations between AP Exam scores and average grades in relevant courses ranged from .12 for Music Theory to .38 for U.S. History with an average correlation of .29. Similar to previous findings, the average relationships between AP Exam scores and HSGPA and relevant courses were much lower than the relationships between the scores on the same AP Exams and PSAT/NMSQT scores (.62 on average).

Logistic Regression Modeling

Logistic regression models were fitted for each AP Exam by including the corresponding PSAT/NMSQT score first (Model 1) and then grade level (Model 2) to predict the probability of achieving an AP score of 3 or better and 4 or better. The score statistics (see Table 6 and 7) showed that the results for Model 1 for all 22 AP Exams were significantly different from the null hypothesis ($p < .0001$) indicating that the PSAT/NMSQT scores were meaningfully associated with AP Exam performance. The classification accuracies as indicated by c ranged from 69.9% for AP Spanish Literature and 89.6% for English Language and Composition. In other words, for Spanish Literature, the logistic regression model could accurately predict achieving a 3, 4, or 5 versus a 1 or 2 69.9% of the time and, for English Language, the logistic regression model could accurately predict achieving a 3, 4, or 5 versus a 1 or 2 89.6% of the time. For models predicting probability of achieving AP score ≥ 4, the classification accuracy rates ranged from 71.9% for Spanish Literature to 88.9% for English Language.

Improvement in model fit for Model 2, when grade level at time of PSAT/NMSQT was added as an additional predictor was statistically significant, but the practical significance was relatively small. With the inclusion of grade level, the increases in Cox and Snell's (1989) pseudo R-squared ranged only from 0.2% to 2.6% and classification accuracy was only improved by 0.1% to 1.6%. Therefore, the simpler Model 1, where PSAT/NMSQT scores were used as the single predictor of AP Exam success, was finally retained for updating AP Potential expectancy tables.

Incremental Validity of PSAT/NMSQT Scores

Sequential logistic regressions were conducted on 10 high-volume AP Exams to understand the incremental validity that PSAT/NMSQT scores provided over and above HSGPA and grades in relevant courses. Pseudo R-squared increment contributed by PSAT/NMSQT score ranged from 17.1% for Psychology to 30.1% for English Literature and Composition. The variability accounted by PSAT/NMSQT scores substantially exceeded the contributions by cumulative HSGPA and grades in related courses (see Table 8).

In the previous report by Ewing, Camara and Millsap (2006), R-squared was computed based on multiple linear regression and the R-squared increment ranged from 19.2% to 43.4%. However, for the present study, the magnitude of the pseudo R-squared increment appeared to be slightly smaller, ranging from 12.0% to 30.1% for the same AP subjects. This is not surprising because pseudo R-squared calculated within logistic regression is typically smaller than that based on multiple regression because of the way it is calculated. Nonetheless, explanation of pseudo R-squared is similar to R-squared in linear regression, indicating how much variability in the outcome variable can be accounted for by logistic regression model. Pseudo R-squared increments for PSAT/NMSQT scores were also calculated by gender and ethnicity. Although the values have different levels of magnitude, the pseudo R-squared increments for subgroups exhibited similar patterns as in the previous report using multiple linear regression.

The findings from sequential multiple logistic regression indicated that PSAT/NMSQT scores serve as a better predictor of AP Exam performance than other indicators of high school academic performance including cumulative HSGPA and average grades in relevant courses.

Expectancy Tables

After the logistic regression models were computed, the PSAT/NMSQT scores associated with specific probabilities of success on each AP Exam were computed based on the parameter estimates from the model. Specifically, the expectancy tables show the PSAT/NMSQT score associated with achieving success on AP Exams at various probability levels ranging from 10% to 90% in 10% increments (See Tables 9 and 10)[4].

To use the expectancy tables to identify students for AP courses, educators would first locate the cut score associated with a level of probability (or threshold) they are comfortable with for achieving an AP score of 3 or better, or 4 or better. For example, if a school chooses the 70% threshold for success on the Calculus AB Exam, the expectancy tables indicate that a student should have a minimum PSAT/NMSQT Math score of 63 for achieving a 3 or better, and a minimum PSAT/NMSQT Math score of 69 for achieving a 4 or better. Similar to the empirical method employed in previous versions of the AP Potential tool, users should keep in mind that the logistic regression models on which the expectancy tables are built involve measurement errors and classification rates will never reach 100%. PSAT/NMSQT scores do not account for all of the variability in AP Exam performance, and some uncertainty about the probability of succeeding on AP Exams remains. The actual chance of success might be lower than the probability criteria utilized, given many other unknown factors. The expectancy tables only provide one piece of information and other factors such as motivation and interests in the subject content, previous prerequisite courses taken, and other academic performance indicators should still be taken into consideration when identifying students for potential success on AP Exams.

Discussion

PSAT/NMSQT scores were found once again to be moderately to strongly correlate with scores on AP Exams with the exception of AP world language and AP Studio Art exams. Using logistic regression models, the PSAT/NMSQT cut scores associated with different probabilities of success on each AP Exam were updated. Users can easily locate the minimum PSAT/NMSQT score for an individual student given an expected chance of success on a particular AP Exam, or derive the chance of success on different AP Exams given a student's specific PSAT/NMSQT scores. As was the case previously, the AP Potential tool can be utilized to help schools identify the needs for offering AP courses based on the number of students exceeding the cut scores corresponding to the desired chance of success on AP Exams. When using the expectancy tables, keep in mind that the sample on which the expectancy tables are based may not be representative of the entire PSAT/NMSQT examinee population in terms of academic performance. The students in our samples were

[4] Although the changes discussed in this report were implemented in December 2012, periodically, changes to the expectancy tables need to be made on a subject-by-subject basis. Thus, the most up-to-date expectancy tables can be found here: http://www.collegeboard.com/counselors/app/expectancy.html

relatively higher achieving students as indicated by PSAT/NMSQT performance. Thus, the AP Potential tool should be used cautiously and other factors, beyond PSAT/NMSQT scores, should be considered when making final course placement decisions.

References

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Table 1. PSAT/NMSQT Performance for 2007-08 Sophomore and Junior Examinees

Sample	PSAT/NMSQT Scale	All			Sophomore			Junior		
		N	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*
All sophomore & junior PSAT/NMSQT examinees 2007–2008	CR	6,091,075	44.33	11.58	2,936,528	41.74	11.25	3,154,547	46.74	11.36
	M		46.14	11.67		43.60	11.23		48.50	11.57
	W		43.56	11.25		41.08	10.76		45.87	11.21
PSAT/NMSQT examinees completing one or more of 33 AP Exams	CR	1,835,806	52.23	9.98	777,594	50.25	9.63	1,058,212	53.69	9.98
	M		54.26	10.26		52.11	9.97		55.84	10.17
	W		51.29	10.15		49.20	9.73		52.83	10.19

Table 2. Correlations of PSAT/NMSQT Scores with AP Exam Scores

AP Exam	N	CR	M	W	CR + M	CR + W	M + W	CR + M + W
Art History	27,679	.555	.417	.510	.537	**.563**	.511	.554
Biology	205,036	.580	.589	.533	**.647**	.590	.619	.638
Calculus AB	341,698	.393	**.539**	.379	.523	.412	.513	.498
Calculus BC	116,291	.350	**.497**	.347	.478	.373	.472	.454
Chemistry	139,600	.487	.607	.470	**.611**	.508	.598	.590
Chinese Language and Culture	4,684	-.126	**.110**	-.099	-.028	-.116	-.008	-.056
Computer Science A	21,607	.488	.585	.467	**.594**	.505	.578	.575
English Language	445,235	.741	.597	.694	.736	**.762**	.712	.761
English Literature	500,972	.735	.562	.688	.711	**.754**	.686	.739
Environmental Science	109,290	.618	.586	.536	**.668**	.613	.623	.656
European History	61,658	**.604**	.469	.523	.598	.599	.552	.604
French Language and Culture	28,198	.425	.345	.436	.424	**.456**	.430	.451
German Language and Culture	6,516	.329	.245	.355	.321	**.364**	.335	.352
Government & Politics: Comparative	22,037	.589	.479	.513	.595	.586	.553	**.598**
Government & Politics: U.S.	271,899	.629	.543	.560	.646	.630	.608	**.648**
Human Geography	25,017	.630	.533	.553	.642	.628	.601	**.644**
Japanese Language and Culture	2,296	-.063	**.119**	-.006	.025	-.037	.059	.014
Latin Vergil	8,723	.462	.380	.448	.478	.489	.470	**.499**
Macroeconomics	112,839	.513	.562	.474	**.595**	.523	.571	.580
Microeconomics	68,095	.531	.611	.502	**.633**	.548	.614	.617
Music Theory	19,842	.411	.516	.456	.512	.460	**.536**	.518
Physics B	90,807	.458	**.584**	.429	.583	.471	.562	.555
Physics C: Elect/Mag	21,847	.367	.452	.353	**.465**	.385	.451	.448
Physics C: Mechanics	48,928	.440	**.567**	.414	.566	.455	.544	.538
Psychology	212,402	.581	.522	.546	.608	.599	.589	**.618**
Spanish Language	120,396	**.060**	-.003	.050	.030	.057	.025	.038
Spanish Literature and Culture	19,643	.404	.344	.388	.395	**.409**	.386	.404
Statistics	171,871	.527	.639	.512	**.651**	.552	.640	.634
Studio Art: 2-D Design	23,695	.169	.194	.174	.201	.182	**.203**	.201
Studio Art: 3-D Design	3,811	.143	**.203**	.130	.192	.145	.184	.179
Studio Art: Drawing	18,023	.223	.250	.231	.262	.239	**.265**	.263
U.S. History	419,099	.644	.536	.576	.653	.648	.617	**.661**
World History	28,774	.624	.544	.552	**.643**	.621	.604	.642

Note: The numbers in bold represent the PSAT/NMSQT score with the highest correlation with AP Exam scores. The highlighted numbers refer to the final PSAT/NMSQT score used for estimating performance on AP Exams.

Table 3. Means and Standard Deviations of AP Exam Scores for Students Taking Each AP Exam and their PSAT/NMSQT Scores, Overall and by Grade Level

	All			Sophomore			Junior		
AP Exam	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*	*N*	*Mean*	*SD*
AP Art History	27,679	2.90	1.31	9,103	2.80	1.31	18,576	2.94	1.30
PSAT/NMSQT Critical Reading		55.07	10.11		51.94	9.43		56.61	10.08
PSAT/NMSQT Math		54.81	10.03		52.24	9.42		56.07	10.08
PSAT/NMSQT Writing		53.95	10.31		50.59	9.61		55.60	10.25
AP Biology	205,036	2.76	1.54	77,634	2.89	1.57	127,402	2.68	1.52
PSAT/NMSQT Critical Reading		54.37	9.75		52.79	9.35		55.34	9.86
PSAT/NMSQT Math		56.61	9.76		55.27	9.38		57.43	9.90
PSAT/NMSQT Writing		53.32	10.03		51.69	9.60		54.32	10.16
AP Calculus AB	341,698	2.92	1.52	62,588	3.37	1.51	279,110	2.82	1.51
PSAT/NMSQT Critical Reading		54.79	9.39		54.18	9.41		54.93	9.38
PSAT/NMSQT Math		59.72	7.99		60.28	7.92		59.60	8.00
PSAT/NMSQT Writing		54.10	9.62		53.31	9.50		54.28	9.64
AP Calculus BC	116,291	3.80	1.38	23,916	4.12	1.25	92,375	3.71	1.40
PSAT/NMSQT Critical Reading		59.61	9.62		58.72	9.44		59.84	9.65
PSAT/NMSQT Math		65.98	7.38		66.24	7.35		65.92	7.38
PSAT/NMSQT Writing		59.04	9.72		57.91	9.54		59.34	9.75
AP Chemistry	139,600	2.82	1.48	74,736	2.92	1.48	64,864	2.70	1.48
PSAT/NMSQT Critical Reading		55.27	9.89		54.16	9.47		56.54	10.21
PSAT/NMSQT Math		59.81	9.28		58.82	9.00		60.95	9.46
PSAT/NMSQT Writing		54.22	10.05		53.10	9.63		55.51	10.36
AP Chinese Language and Culture	4,684	4.47	0.97	2,092	4.71	0.67	2,592	4.27	1.12
PSAT/NMSQT Critical Reading		51.13	14.32		50.57	13.15		51.58	15.18
PSAT/NMSQT Math		61.64	10.71		61.16	10.30		62.04	11.01
PSAT/NMSQT Writing		50.79	13.78		50.01	12.65		51.42	14.61
AP Computer Science A	21,607	3.05	1.57	9,267	3.14	1.55	12,340	2.98	1.57
PSAT/NMSQT Critical Reading		55.78	10.43		54.24	9.94		56.94	10.64
PSAT/NMSQT Math		61.41	9.65		60.25	9.39		62.28	9.76
PSAT/NMSQT Writing		54.14	10.58		52.41	10.00		55.44	10.82
AP English Language	445,235	2.99	1.18	379,727	2.96	1.17	65,508	3.13	1.19
PSAT/NMSQT Critical Reading		51.56	9.59		51.00	9.41		54.80	10.01
PSAT/NMSQT Math		52.66	9.95		52.11	9.78		55.82	10.27
PSAT/NMSQT Writing		50.66	9.75		50.07	9.55		54.10	10.17
AP English Literature	500,972	2.95	1.10	38,518	2.94	1.11	462,454	2.96	1.10
PSAT/NMSQT Critical Reading		55.55	9.87		53.27	9.95		55.74	9.83
PSAT/NMSQT Math		55.90	10.12		53.82	9.97		56.07	10.12
PSAT/NMSQT Writing		54.72	10.07		52.14	10.09		54.93	10.04
AP Environmental Science	109,290	2.69	1.39	37,150	2.63	1.38	72,140	2.72	1.40
PSAT/NMSQT Critical Reading		52.75	9.60		50.40	9.00		53.97	9.67

PSAT/NMSQT Math		54.86	9.60		52.86	9.08		55.88	9.69
PSAT/NMSQT Writing		51.73	9.86		49.21	9.21		53.02	9.93
AP European History	61,658	3.16	1.30	17,313	3.20	1.28	44,345	3.15	1.30
PSAT/NMSQT Critical Reading		57.42	9.63		55.16	9.33		58.31	9.61
PSAT/NMSQT Math		56.98	9.64		55.30	9.48		57.64	9.62
PSAT/NMSQT Writing		55.53	9.99		53.28	9.61		56.41	9.99
AP French Language and Culture	28,198	2.57	1.22	7,039	2.87	1.28	21,159	2.48	1.18
PSAT/NMSQT Critical Reading		58.68	10.09		56.58	10.31		59.38	9.92
PSAT/NMSQT Math		59.09	9.88		57.52	10.04		59.61	9.77
PSAT/NMSQT Writing		58.48	10.20		56.27	10.38		59.22	10.03
AP German Language and Culture	6,516	3.07	1.26	1,140	3.39	1.34	5,376	3.01	1.23
PSAT/NMSQT Critical Reading		58.24	9.78		55.46	10.19		58.83	9.59
PSAT/NMSQT Math		59.71	9.57		56.80	10.35		60.33	9.28
PSAT/NMSQT Writing		57.09	9.86		54.50	10.35		57.64	9.66
AP Government & Politics: Comparative	22,037	3.17	1.36	3,539	3.18	1.36	18,498	3.16	1.36
PSAT/NMSQT Critical Reading		58.54	9.66		55.49	9.28		59.12	9.62
PSAT/NMSQT Math		58.83	9.73		56.46	9.69		59.29	9.67
PSAT/NMSQT Writing		56.70	9.85		53.74	9.51		57.27	9.81
AP Government & Politics: U.S.	271,899	2.83	1.32	24,562	2.96	1.33	247,337	2.82	1.32
PSAT/NMSQT Critical Reading		55.34	9.81		52.97	9.38		55.57	9.82
PSAT/NMSQT Math		56.58	10.01		54.02	9.56		56.83	10.02
PSAT/NMSQT Writing		54.13	10.05		51.38	9.65		54.41	10.05
AP Human Geography	25,017	2.96	1.39	8,843	2.93	1.38	16,174	2.98	1.40
PSAT/NMSQT Critical Reading		52.76	9.87		50.33	9.31		54.09	9.91
PSAT/NMSQT Math		54.19	9.95		52.16	9.55		55.30	9.99
PSAT/NMSQT Writing		51.53	9.99		48.95	9.43		52.95	10.01
AP Japanese Language and Culture	2,296	3.41	1.43	621	4.01	1.33	1,675	3.19	1.41
PSAT/NMSQT Critical Reading		55.48	11.39		50.60	11.47		57.29	10.82
PSAT/NMSQT Math		60.82	10.20		57.76	10.57		61.96	9.82
PSAT/NMSQT Writing		54.54	11.26		49.50	10.73		56.41	10.88
AP Latin Vergil	8,723	3.06	1.38	2,896	3.38	1.33	5,827	2.90	1.38
PSAT/NMSQT Critical Reading		61.54	9.21		59.87	8.83		62.37	9.28
PSAT/NMSQT Math		62.01	8.81		60.61	8.52		62.70	8.88
PSAT/NMSQT Writing		60.64	9.41		58.84	8.96		61.54	9.51
AP Macroeconomics	112,839	2.88	1.44	10,563	3.31	1.41	102,276	2.84	1.44
PSAT/NMSQT Critical Reading		56.41	10.02		54.61	9.69		56.59	10.04
PSAT/NMSQT Math		59.39	10.07		58.12	9.82		59.52	10.08
PSAT/NMSQT Writing		55.27	10.21		53.00	9.78		55.51	10.22
AP Microeconomics	68,095	3.08	1.38	8,202	3.42	1.35	59,893	3.03	1.38
PSAT/NMSQT Critical Reading		56.80	10.05		54.71	9.94		57.09	10.03

PSAT/NMSQT Math		60.21	10.10		58.77	10.14		60.41	10.07
PSAT/NMSQT Writing		55.62	10.26		53.28	10.04		55.94	10.25
AP Music Theory	19,842	3.07	1.29	6,955	3.03	1.29	12,887	3.10	1.29
PSAT/NMSQT Critical Reading		54.99	10.00		52.72	9.80		56.21	9.89
PSAT/NMSQT Math		57.22	10.09		55.53	9.99		58.12	10.03
PSAT/NMSQT Writing		54.57	10.25		52.09	10.07		55.91	10.10
AP Physics B	90,807	2.87	1.32	30,802	2.96	1.35	60,005	2.82	1.31
PSAT/NMSQT Critical Reading		56.08	9.82		54.61	9.45		56.84	9.92
PSAT/NMSQT Math		61.31	8.76		60.05	8.65		61.96	8.74
PSAT/NMSQT Writing		54.89	10.05		53.36	9.67		55.68	10.15
AP Physics C: Electricity and Magnetism	21,847	3.49	1.39	2,014	3.99	1.25	19,833	3.44	1.40
PSAT/NMSQT Critical Reading		62.63	9.60		61.88	9.67		62.71	9.59
PSAT/NMSQT Math		69.04	7.12		70.31	6.97		68.91	7.12
PSAT/NMSQT Writing		61.35	9.69		60.26	9.72		61.46	9.68
AP Physics C: Mechanics	48,928	3.37	1.35	5,484	3.63	1.35	43,444	3.33	1.35
PSAT/NMSQT Critical Reading		60.58	9.77		59.32	9.87		60.74	9.75
PSAT/NMSQT Math		66.71	7.92		66.48	8.31		66.74	7.86
PSAT/NMSQT Writing		59.41	9.94		57.94	9.86		59.59	9.93
AP Psychology	212,402	3.26	1.41	73,121	3.18	1.42	139,281	3.30	1.40
PSAT/NMSQT Critical Reading		52.74	9.51		50.30	8.94		54.02	9.55
PSAT/NMSQT Math		54.22	9.94		51.99	9.39		55.40	10.02
PSAT/NMSQT Writing		51.75	9.80		49.12	9.13		53.13	9.85
AP Spanish Language	120,396	3.26	1.40	47,914	3.49	1.36	72,482	3.10	1.40
PSAT/NMSQT Critical Reading		51.12	12.53		46.95	12.28		53.88	11.92
PSAT/NMSQT Math		52.85	12.39		48.97	12.26		55.42	11.80
PSAT/NMSQT Writing		51.20	12.61		46.93	12.17		54.03	12.09
AP Spanish Literature and Culture	19,643	2.92	1.34	5,800	2.91	1.34	13,843	2.93	1.34
PSAT/NMSQT Critical Reading		48.28	12.87		43.42	10.96		50.32	13.06
PSAT/NMSQT Math		49.59	12.43		45.22	10.57		51.42	12.69
PSAT/NMSQT Writing		48.33	12.95		43.49	10.72		50.36	13.26
AP Statistics	171,871	2.89	1.33	28,920	3.12	1.36	142,951	2.85	1.32
PSAT/NMSQT Critical Reading		54.81	9.72		52.42	9.36		55.29	9.72
PSAT/NMSQT Math		59.10	9.27		58.28	8.97		59.27	9.32
PSAT/NMSQT Writing		54.06	9.96		51.45	9.56		54.58	9.95
AP Studio Art: 2-D Design	23,695	3.20	1.06	4,169	3.18	1.09	19,526	3.20	1.05
PSAT/NMSQT Critical Reading		51.43	9.87		48.97	9.87		51.96	9.79
PSAT/NMSQT Math		51.83	9.90		49.65	9.78		52.30	9.87
PSAT/NMSQT Writing		50.42	10.14		47.76	9.85		50.99	10.11
AP Studio Art: 3-D Design	3,811	2.95	1.06	528	2.92	1.15	3,283	2.96	1.05
PSAT/NMSQT Critical Reading		51.53	10.11		48.79	10.27		51.97	10.02
PSAT/NMSQT Math		53.18	10.03		49.73	9.90		53.74	9.94

PSAT/NMSQT Writing		50.40	10.11		47.34	10.35		50.89	9.98
AP Studio Art: Drawing	18,023	3.20	1.06	3,330	3.22	1.12	14,693	3.20	1.05
PSAT/NMSQT Critical Reading		52.03	10.35		49.29	10.39		52.65	10.24
PSAT/NMSQT Math		52.70	10.18		50.52	10.24		53.20	10.10
PSAT/NMSQT Writing		51.20	10.54		48.35	10.55		51.85	10.44
AP U.S. History	419,099	2.79	1.31	395,225	2.79	1.31	23,874	2.78	1.31
PSAT/NMSQT Critical Reading		51.70	9.51		51.52	9.43		54.61	10.27
PSAT/NMSQT Math		52.99	9.74		52.86	9.68		55.06	10.39
PSAT/NMSQT Writing		50.38	9.70		50.22	9.62		53.02	10.55
AP World History	28,774	2.95	1.34	18,653	2.88	1.33	10,121	3.08	1.34
PSAT/NMSQT Critical Reading		52.94	10.29		51.19	9.81		56.18	10.37
PSAT/NMSQT Math		53.79	10.35		52.58	10.18		56.04	10.27
PSAT/NMSQT Writing		51.47	10.35		49.94	9.97		54.31	10.43

Table 4. Correlations of PSAT/NMSQT Scores with AP Exam Scores, Overall and by Grade Level

				Sophomore		Junior		
AP Exam	PSAT/NMSQT Scale	N	Overall Corr	*n*	*Corr*	*n*	*Corr*	Absolute Corr Difference
Art History	CR + W	27,679	.563	9,103	.560	18,576	.571	0.010
Biology	CR + M	205,036	.647	77,634	.665	127,402	.661	0.004
Calculus AB	M	341,698	.539	62,588	.562	279,110	.535	0.027
Chemistry	CR + M	139,600	.611	74,736	.631	64,864	.624	0.007
Computer Science A	CR + M	21,607	.594	9,267	.620	12,340	.598	0.022
English Language	CR + W	445,235	.762	379,727	.765	65,508	.761	0.004
English Literature	CR + W	500,972	.754	38,518	.777	462,454	.754	0.024
Environmental Science	CR + M	109,290	.668	37,150	.679	72,140	.672	0.007
European History	CR + M + W	61,658	.604	17,313	.636	44,345	.605	0.031
Government & Politics: Comp.	CR + M + W	22,037	.598	3,539	.632	18,498	.601	0.031
Government & Politics: U.S.	CR + M + W	271,899	.648	24, 562	.661	247,337	.653	0.008
Human Geography	CR + M + W	25,017	.644	8,843	.641	16,174	.660	0.019
Macroeconomics	CR + M	112,839	.595	10,563	.601	102,276	.604	0.002
Microeconomics	CR + M	68,095	.633	8,202	.654	59,893	.643	0.012
Music Theory	M + W	19,842	.536	6,955	.570	12,887	.523	0.047
Physics B	CR + M	90,807	.583	30,802	.621	60,005	.580	0.042
Physics C: Elect/Mag	CR + M	21,847	.465	2,014	.438	19,833	.470	0.032
Physics C: Mechanics	CR + M	48,928	.566	5,484	.610	43,444	.564	0.046
Psychology	CR + M + W	212,402	.618	73,121	.617	139,281	.629	0.012
Statistics	CR + M	171,871	.651	28,920	.659	142,951	.662	0.003
U.S. History	CR + M + W	419,099	.661	395,225	.665	23,874	.641	0.024
World History	CR + M	28,774	.643	18,653	.656	10,121	.623	0.033
Minimum		19,842	.465	2,014	.438	10,121	.470	.002
Maximum		500,972	.762	395,225	.777	462,454	.761	047
Mean		153,011	0.617	61,827	0.633	92,878	0.620	0.020
Median		100,049	0.615	18,653	0.634	59,949	0.624	0.021

Table 5. Means and Correlations of AP Exam Scores with HSGPA and High School Course Grades

AP Exam	*N*	Variable	*Mean*	*SD*	Correlation with AP
Art History	20,103	Art History	2.96	1.30	--
		HSGPA	9.90	1.45	.338
		Art and Music Grades	3.90	0.33	.158
Biology	153,247	Biology	2.84	1.55	--
		HSGPA	10.31	1.31	.350
		Natural Science Grades	3.71	0.50	.339
Calculus AB	254,877	Calculus AB	2.97	1.53	--
		HSGPA	10.44	1.22	.216
		Math Grades	3.74	0.48	.230
Chemistry	105,631	Chemistry	2.90	1.48	--
		HSGPA	10.58	1.20	.300
		Natural Science Grades	3.80	0.43	.305
Computer Science A	16,752	Computer Science A	3.08	1.57	--
		HSGPA	10.02	1.50	.347
		Math Grades	3.64	0.56	.344
English Language	330,828	English Language	3.07	1.16	--
		HSGPA	10.10	1.44	.383
		English Grades	3.68	0.52	.354
English Literature	368,781	English Literature	3.03	1.10	--
		HSGPA	10.21	1.38	.360
		English Grades	3.74	0.47	.310
Environmental Science	83,968	Environmental Science	2.74	1.40	--
		HSGPA	9.83	1.45	.352
		Natural Science Grades	3.55	0.57	.334
European History	45,973	European History	3.24	1.28	--
		HSGPA	10.17	1.36	.325
		Social Science & History Grades	3.78	0.44	.281
Government & Politics: Comp	16,708	Government & Politics: Comp	3.21	1.36	--
		HSGPA	10.13	1.40	.352
		Social Science & History Grades	3.75	0.46	.324
Government and Politics: U.S.	209,759	Government and Politics: U.S.	2.89	1.32	--
		HSGPA	10.17	1.39	.368
		Social Science & History Grades	3.71	0.50	.311
Human Geography	18,508	Human Geography	3.03	1.39	--
		HSGPA	9.77	1.51	.352
		Social Science & History Grades	3.64	0.54	.326
Macroeconomics	88,303	Macro-economics	2.91	1.44	--
		HSGPA	10.22	1.35	.332
		Social Science & History Grades	3.71	0.50	.263
Microeconomics	52,324	Microeconomics	3.11	1.38	--
		HSGPA	10.22	1.34	.346
		Social Science & History Grades	3.73	0.49	.250
Music Theory	14,688	Music Theory	3.13	1.28	--
		HSGPA	9.90	1.50	.316
		Art and Music Grades	3.97	0.18	.122
Physics B	70,783	Physics B	2.90	1.33	--
		HSGPA	10.47	1.25	.271
		Natural Science Grades	3.77	0.45	.283
Physics C: Elect/Mag	17,199	Physics C: Elect/Mag	3.51	1.39	--
		HSGPA	10.69	1.09	.230
		Natural Science Grades	3.88	0.34	.223
Physics C: Mechanics	38,423	Physics C: Mechanics	3.39	1.34	--
		HSGPA	10.62	1.15	.237
		Natural Science Grades	3.85	0.37	.246
Psychology	154,040	Psychology	3.30	1.40	--
		HSGPA	9.84	1.47	.385
		Social Science & History Grades	3.63	0.54	.297
Statistics	131,717	Statistics	2.93	1.33	--
		HSGPA	10.15	1.33	.366
		Math Grades	3.59	0.57	.365

U.S. History	317,572	U.S. History	2.88	1.30	--
		HSGPA	10.11	1.43	.369
		Social Science & History Grades	3.63	0.56	.383
World History	20,635	World History	3.06	1.33	--
		HSGPA	9.89	1.55	.361
		Social Science & History Grades	3.66	0.55	.375

Note: The cumulative HSGPA was on a 1 to 12 scale, originally with A+ coded as 1 and E/F coded as 12. For ease of explanation, the HSGPA scale was reversed to have 12 represent A and 1 represent E/F so that higher HSGPA corresponded to higher academic performance.

Table 6. Logistic Regression Models Predicting Success of Achieving AP Score ≥ 3

AP Exam	PSAT/NMSQT Explanatory Variable					Total *N*	AP ≥ 3 *n*	Score Statistics	Pseudo R-Squared[2]	Classification Accuracy (%)
	Math[1]	CR + M[1]	CR + W[1]	M + W[1]	CR + M + W[1]					
Calculus AB	1.164					341,698	199,723	75270	0.219	77.5
Biology		1.101				205,036	107,486	65519	0.320	83.4
Chemistry		1.090				139,600	79,306	38551	0.276	81.1
Computer Science A		1.082				21,607	13,473	5724	0.262	80.7
Environmental Science		1.107				109,290	57,398	35707	0.329	83.9
Macroeconomics		1.079				112,839	64,816	29599	0.259	80.0
Microeconomics		1.087				68,095	44,542	18928	0.273	81.8
Physics B		1.084				90,807	54,872	22154	0.242	79.2
Physics C: Elect/Mag		1.069				21,847	15,441	3381	0.149	74.2
Physics C: Mechanics		1.086				48,928	35,393	10736	0.211	79.4
Statistics		1.099				171,871	104,195	50243	0.293	82.5
World History		1.088				28,774	17,503	8377	0.291	82.3
Art History			1.067			27,679	17,067	6113	0.221	78.1
English Language			1.149			445,235	281,967	180267	0.418	89.6
English Literature			1.137			500,972	314,296	206012	0.414	89.3
Music Theory				1.064		19,842	12,409	3974	0.199	76.7
European History					1.058	61,658	45,790	14265	0.231	81.4
Government: Comp.					1.056	22,037	14,397	5632	0.252	80.6
Government: U.S.					1.063	271,899	155,252	83204	0.305	82.8
Human Geography					1.064	25,017	15,592	7381	0.298	83.0
Psychology					1.063	212,402	148,592	55283	0.266	82.5
U.S. History					1.068	419,099	230,479	131672	0.315	83.2

Note: [1]Entries are odds ratios associated with the corresponding explanatory PSAT/NMSQT score. The reported explanatory variables are all significant at $p<.0001$ as assessed through the Wald chi-square. Values >1 indicate the change in success probability per each PSAT/NMSQT one point score increment.

[2]Values are Cox and Snell's pseudo R-squared.

Table 7. Logistic Regression Models Predicting Success of Achieving AP Score ≥ 4

	PSAT/NMSQT Explanatory Variable									
AP Exam	Math[1]	CR + M[1]	CR + W[1]	M + W[1]	CR + M + W[1]	Total *N*	AP ≥ 4 *n*	Score Statistics	Pseudo R-Squared[2]	Classification Accuracy (%)
Calculus AB	1.165					341,698	137,231	70146	0.211	77.2
Biology		1.098				205,036	74,750	60828	0.299	83.3
Chemistry		1.091				139,600	51,371	36353	0.264	81.2
Computer Science A		1.083				21,607	10,477	5868	0.272	80.7
Environmental Science		1.105				109,290	37,374	33010	0.305	84.0
Macroeconomics		1.078				112,839	47,170	28062	0.250	79.6
Microeconomics		1.087				68,095	30,794	19154	0.284	81.4
Physics B		1.084				90,807	30,065	19683	0.223	79.1
Physics C: Elect/Mag		1.068				21,847	12,742	3539	0.159	73.4
Physics C: Mechanics		1.084				48,928	25,208	11303	0.231	78.0
Statistics		1.099				171,871	62,831	49777	0.291	82.8
World History		1.086				28,774	10,391	7984	0.279	82.2
Art History			1.066			27,679	10,027	6097	0.219	78.3
English Language			1.133			445,235	149,890	172017	0.388	88.9
English Literature			1.123			500,972	157,797	181520	0.368	88.3
Music Theory				1.063		19,842	7,370	3891	0.196	76.7
European History					1.055	61,658	24,904	15527	0.252	79.9
Government: Comp.					1.053	22,037	9,722	5492	0.249	79.5
Government: U.S.					1.059	271,899	84,479	69867	0.260	82.0
Human Geography					1.06	25,017	9,747	7180	0.286	82.1
Psychology					1.058	212,402	107,780	58466	0.275	80.8
U.S. History					1.064	419,099	136,139	116236	0.278	82.8

Note: [1]Entries are odds ratios associated with the corresponding explanatory PSAT/NMSQT score. The reported explanatory variables are all significant at $p<.0001$ as assessed through the Wald chi-square. Values >1 indicate the change in success probability per each PSAT/NMSQT one point score increment.

[2]Values are Cox and Snell's pseudo R-squared.

Table 8. Pseudo R-Squared and Pseudo R-Squared Increment for PSAT/NMSQT Scores Above and Beyond HSGPA and High School Course Grades

PSAT/NMSQT Scale	AP Exam	*N*	Pseudo R-Squared Step 0 (without PSAT/NMSQT score) [1]	Pseudo R-Squared Step 1 (with PSAT/NMSQT score) [1]	Pseudo R-Squared Increment[1]
M	Calculus AB	254,877	.048	.227	.179
CR + M	Biology	153,247	.120	.331	.211
CR + M	Chemistry	105,631	.092	.282	.190
CR + M	Macroeconomics	88,303	.088	.268	.180
CR + M	Statistics	131,717	.113	.315	.202
CR + W	English Language	330,828	.126	.415	.289
CR + W	English Literature	368,781	.111	.412	.301
CR + M +W	Government: U.S.	209,759	.112	.315	.203
CR + M +W	Psychology	154,040	.098	.269	.171
CR + M +W	U.S. History	317,572	.133	.324	.192

Note: [1]Values are Cox and Snell's pseudo R-squared.

Table 9. Expectancy Table for AP Score ≥ 3

PSAT/NMSQT Scale	AP Exam	PSAT/NMSQT Score Corresponding to Particular Probabilities of Scoring >= 3 on the Indicated AP Exam								
		10%	20%	30%	40%	50%	60%	70%	80%	90%
M	Calculus AB	43	48	51	54	57	60	63	66	71
CR + M	Biology	87	95	101	105	109	114	118	124	132
	Chemistry	85	95	101	106	111	115	121	127	136
	Computer Science A	81	91	98	104	109	114	119	126	136
	Environmental Science	84	92	98	102	106	110	114	120	128
	Macroeconomics	82	92	99	105	111	116	122	129	139
	Microeconomics	80	90	96	102	106	111	117	123	133
	Physics B	83	93	100	106	111	116	121	128	138
	Physics C: Elect/Mag	83	95	103	110	116	122	129	137	149
	Physics C: Mechanics	86	95	102	107	112	117	123	129	139
	Statistics	84	93	98	103	107	112	116	122	131
	World History	73	83	89	94	99	104	109	116	125
CR + W	Art History	65	78	86	93	99	106	112	121	133
	English Language	79	84	88	92	94	97	101	104	110
	English Literature	86	92	96	100	103	106	109	113	120
M + W	Music Theory	66	79	88	95	101	108	115	124	137
CR + M +W	European History	105	120	129	137	144	151	159	169	183
	Government: Comp.	118	133	143	151	158	166	174	184	199
	Government: U.S.	123	136	145	153	159	166	173	182	195
	Human Geography	111	124	133	140	146	153	160	169	182
	Psychology	103	116	125	132	139	145	152	161	174
	U.S. History	117	129	138	144	150	157	163	172	184

Table 10. Expectancy Table for AP Score ≥ 4

PSAT/NMSQT Scale	AP Exam	PSAT/NMSQT Score Corresponding to Particular Probabilities of Scoring >= 4 on the Indicated AP Exam								
		10%	20%	30%	40%	50%	60%	70%	80%	90%
M	Calculus AB	49	54	58	61	63	66	69	72	78
CR + M	Biology	96	105	111	115	120	124	129	135	143
	Chemistry	99	108	114	119	124	129	134	140	149
	Computer Science A	91	101	108	113	119	124	129	136	146
	Environmental Science	95	104	109	113	118	122	126	131	140
	Macroeconomics	93	103	111	117	122	127	133	141	151
	Microeconomics	94	104	110	116	121	125	131	137	147
	Physics B	102	112	119	124	129	134	140	146	156
	Physics C: Elect/Mag	92	105	113	120	126	132	139	147	159
	Physics C: Mechanics	99	109	116	122	127	132	137	144	154
	Statistics	99	108	113	118	122	127	131	137	146
	World History	90	100	106	112	117	122	127	133	143
CR + W	Art History	86	99	107	114	120	127	134	142	155
	English Language	94	101	105	108	112	115	118	123	129
	English Literature	103	110	115	119	122	126	129	134	141
M + W	Music Theory	87	100	109	116	123	129	136	145	158
CR + M +W	European History	139	154	164	172	180	188	196	206	221
	Government: Comp.	138	154	164	173	180	188	197	207	223
	Government: U.S.	147	162	171	179	186	193	201	210	224
	Human Geography	132	146	155	162	169	176	184	193	207
	Psychology	119	133	143	150	158	165	173	182	197
	U.S. History	137	150	158	166	172	179	186	194	207