

Preliminary Findings on the Relationship between SAT Scores, High School GPA, Socioeconomic Status, and UCSC Freshman GPA

Julian Fernald, Assistant Director
Institutional Research and Policy Studies
University of California – Santa Cruz

Last year when UC President Atkinson proposed discontinuing UC's use of the SAT I examination as an admissions requirement in favor of the SAT II, UCOP released several papers describing a series of studies assessing the relative predictive validity of SAT I and SAT II test scores and high school GPA on UC freshman GPA. The mediating effect of socioeconomic status (SES) was also considered. These studies were based on regression analyses of the aggregated pool of students who first applied and were admitted to the University of California from Fall 1996 through Fall 1999. In brief, the findings suggested that: 1) SAT II scores are better predictors of freshman GPA than SAT I scores, 2) SAT I scores are more sensitive to students' socioeconomic status than are SAT II scores, and 3) when socioeconomic status is held constant the predictive power of the SAT I to predict freshman GPA is substantially diminished, while the predictive power of the SAT II remains strong.^[1]

Because traditional grades were optional for UCSC students during 1996-1999, UCSC was the only one of the eight undergraduate UC campuses to be excluded from the UCOP studies. With the institution of the mandatory grading policy last year, new freshmen who first matriculated in fall 2001 comprise the first cohort of UCSC students for whom comparable freshman GPA data are available. The decision that was ultimately reached last year by President Atkinson and the system-wide academic senate to substitute the traditional SAT I exam with a revised "curriculum-based" SAT I obviates the need to replicate the UCOP study for UCSC students in order to facilitate an SAT I decision. However, as UCSC moves toward selectivity and comprehensive review the need to understand the relationship between a variety of criteria and UCSC success is critical. This analysis examined the relative predictive power of high school GPA, SAT I, and SAT II scores on UCSC freshman GPA, and the impact of SES variables on the predictive validity of these variables.

Methodology

In Fall 2001 3,057 new first time, first-year undergraduates (freshmen^[2]) enrolled at UCSC. Of those, 2,812 (92%) were still enrolled at the end of the spring term. The preliminary findings presented here are based on regression analyses of 2001 new UCSC freshmen in who were still enrolled at UCSC at the end of Spring 2002, and for whom complete data was available (N=2,105^[3]). The criterion was students' cumulative UCSC GPA at the end

of Spring 2002 (freshman GPA), and the three main predictor variables were: 1) honors-weighted, uncapped, cumulative high school GPA (HSGPA), 2) composite scores on SAT I math and verbal tests (SAT I), and 3) composite scores on SAT II writing and math plus third subject test (SAT II). The mediating effects of SES were then considered by including as predictors, the logarithm of family income as self-reported on the application for admission^[4] (INCOME), and the highest level of education for the highest educated parent in educational categories^[5] (EDUCATION).

Freshman GPA has been widely criticized as too narrow a measure of college success, and many have argued for the use of other criteria, such as college graduation rates. In response to these criticisms UCOP is examining the relationship between SAT scores, high school GPA, and persistence and graduation rates and intends to make those results available at a later date. For the purpose of this analysis, however, freshman GPA was employed as the criterion, because it is, according to Geiser and Studley^[6] “the most commonly employed measure of ‘success’ in studies of the predictive validity of college admissions tests and because use of the SAT is most often justified on this basis.” In addition, using freshman GPA allows a comparison of the UCSC results to the results from the system-wide study.

Correlations between Predictor Variables and UCSC GPA

Table 1 (next page) presents the Pearson correlation matrix of each of the three main predictor variables and UCSC GPA. As indicated in Table 1:

- Of the three predictor variables, HSGPA was most strongly associated with UCSC GPA ($r = .345$), followed by SAT II ($r = .306$) and SAT I ($r = .290$).
- HSGPA was more strongly related to SAT II ($r = .220$) than SAT I ($r = .159$).
- SAT I and SAT II scores were highly correlated with each other ($r = .816$).

Table 1
Correlation Matrix of UCSC GPA and Predictor Variables

		UCSC GPA	SAT I	SAT II	HSGPA
UCSC GPA	Pearson Correlation	1.000	0.290	0.306	0.345
	Sig. (2-tailed)	.	0.000	0.000	0.000
SAT I	Pearson Correlation	0.290	1.000	0.816	0.159
	Sig. (2-tailed)	0.000	.	0.000	0.000
SAT II	Pearson Correlation	0.306	0.816	1.000	0.220
	Sig. (2-tailed)	0.000	0.000	.	0.000
HSGPA	Pearson Correlation	0.345	0.159	0.220	1.000
	Sig. (2-tailed)	0.000	0.000	0.000	.

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).
a Listwise N=2105

Percentage of Explained Variance in UCSC GPA

The percentage of variance explained by each of the three main predictor variables, both singly and in combination are presented in Table 2. The proportion of explained variance, also known as the *coefficient of determination*, or R^2 , represents the proportion of the total variance in an outcome variable, in this case UCSC GPA, that can be accounted for by a predictor variable, in this case HSGPA, SAT I and SAT II scores. R^2 can also be expressed as a percentage, as in Table 2.

	UCSC 2001 N=2,105	UC 1996-1999 N=63,462
Prediction Equations:		
SAT I	8.4%	13.3%
SAT II	9.4%	16.0%
HSGPA	11.9%	15.4%
SAT I + SAT II	9.8%	16.0%
SAT I + HSGPA	17.5%	20.8%
SAT II + HSGPA	17.4%	22.2%
SAT I + SAT II + HSGPA	18.1%	22.3%

Table 2 indicates that:

- First, among UCSC 2001 freshmen, the single best predictor of first-year GPA was HSGPA, accounting for 11.9% of the variance, followed by SAT II scores and SAT I scores, which explained 9.4% and 8.4% of the variance respectively. Among the 1996-1999 UC system-wide sample, SAT II and HSGPA accounted for the most variance, explaining 16.0% and 15.4% respectively, followed by SAT I, which accounted for 13.3%.
- Second, in both the UCSC and system-wide samples, the combination of all three of the predictor variables explained more of the variance in freshman GPA than any of the variables taken alone. Together they accounted for 18.1% of the UCSC variance, and to 22.2% of the UC variance.
- Third, among the UC sample, SAT I added very little, if any, predictive power after HSGPA and SAT II were taken into account, whereas, adding UCSC students' SAT I scores to their HSGPA and SAT II scores in the regression equation improved the predictive power

by a small, but significant amount (17.4% compared to 18.1%).

- Fourth and finally, overall the predictor variables did a better job of predicting freshman GPA in the system-wide sample than in the UCSC sample. The relative importance of each of the three variables was also somewhat different for UC and UCSC students. Among all UC students excluding UCSC, SAT II scores and HSGPA were the two best predictors followed by SAT I scores. Among UCSC students HSGPA was the single best predictor followed by SAT I and SAT II scores.

Standardized Regression Coefficients by Campus

Another indicator of the relative strength of predictor variables on a criterion are the standardized regression coefficients, or “beta weights,” associated with each variable. Beta weights indicate the average change in an outcome variable (in this case freshman GPA) in standard deviation units associated with each one standard deviation unit increase in a single predictor variable when all other predictor variables are held constant. The standardized regression coefficients associated with HSGPA, SAT I, and SAT II scores within a combined regression equation (freshman GPA = HSGPA + SAT I + SAT II) for each campus are shown in Table 3 (next page).

The pattern of beta weights in the UCSC data was similar to the pattern of explained variance described above. HSGPA had, by far, the most predictive power, followed by SAT I and SAT II, which were similar in their ability to predict UCSC GPA when other variables were held constant.

At the most selective campuses, Berkeley and UCLA, SAT II was the strongest predictor, followed by HSGPA, and SAT I as a distant third. At other more moderately selective campuses, Davis, Irvine, San Diego, and Santa Barbara, HSGPA was the best predictor, followed by SAT II, and finally SAT I. At the least selective campuses, Santa Cruz and Riverside, both of which admitted all UC eligible students during the years represented by these data, HSGPA was also the best predictor, followed by SAT I and SAT II. In 2001 UCSC admitted only “clearly eligible” students, as opposed to soliciting “potentially eligibles,” making UCSC somewhat more selective than Riverside. Among UCSC students SAT I and SAT II scores did about equally well predicting UCSC GPA.

Table 3 Standardized Regression Coefficients for HSGPA, SAT I and SAT II Scores by UC Campus			
Regression equation: Freshman GPA = HSGPA + SAT I + SAT II			
	HSGPA	SAT I	SAT II
1996-1999:			
Berkeley	.21	-.02	.27
Davis	.30	.04	.27
Irvine	.25	.09	.21
Los Angeles	.23	.05	.26
Riverside	.31	.16	.10
San Diego	.27	.03*	.25
Santa Barbara	.36	.11	.15
2001:			
Santa Cruz	.29	.14	.13
1996-1999:			
UC System	.27	.07	.23
* Not statistically significant at p<.01 level			

Differences in the relative predictive power of SAT I scores and SAT II scores were largest at Berkeley, UCLA, and San Diego, suggesting that the superiority of SAT II over SAT I may be greater in a more selective admissions context. It seems likely that that the range of SAT I scores is more compressed at more selective campuses, resulting in a greater proportion of the variability in freshman GPA attributable to other variables. Interestingly, on less selective campuses, where there is likely to be a greater range of SAT I scores, HSGPA, which like SAT II purports to measure “achievement” rather than “aptitude,” was a better predictor of freshman GPA than either SAT I or SAT II scores. Further research is needed to investigate the role of the restricted range in campus differences.

Mediating Effects of Socioeconomic Status on the Predictive Validity of HSGPA and SAT Scores

In order to examine the impact of socioeconomic factors on the relative predictive validity of SAT scores and HSGPA regression analyses were conducted using two indicators of socioeconomic status in the regression equation: 1) the logarithm of family income as reported on the UC application, and 2) education level of the highest educated parent. Table 4 presents the standardized regression coefficients for HSGPA and SAT I and SAT II scores before and after including SES variables in the equation for both the 2001 UCSC sample and the 1996-1999 UC system-wide sample. In both samples the predictive power of SAT II and HS GPA increased slightly when SES was held constant. On the other hand, the predictive power of SAT I dropped sharply.

Predictor Variables:	Before SES Considered (Equation 1)		After SES Considered (Equation 2)	
	UCSC	UC	UCSC	UC
SAT I	.14	.07	.07	.02
SAT II	.13	.23	.15	.24
HSGPA	.29	.27	.30	.28
EDUCATION	x	x	.11	.03
INCOME	x	x	.01	.06

These data suggest that much of the apparent relationship between SAT I scores and freshman GPA is mediated by SES, whereas the two measures of achievement, SAT II and HSGPA are not. It should not be surprising that that SES is only weakly associated with HSGPA since grading standards vary widely across high schools. The differences between the Sat I and SAT II exams in terms of their sensitivity to SES on the other hand may be surprising. Quoting Geiser and

Studley,^[7] the SAT II is “a ‘fairer’ test for use in UC admissions insofar as it is demonstrably less sensitive to differences in students’ socioeconomic backgrounds.”

Relative Predictive Validity of SAT Component Scores by Discipline

The standardized regression weights for HSGPA and SAT component scores for both UCSC and the system-wide UC data are presented in Table 5. For both the UCSC and the UC samples, when component scores were entered into the regression equation separately, HSGPA was the single best predictor, followed by the SAT II writing test. Although the contribution of most of the other component test scores were statistically significant, all contributed to a substantially smaller proportion of the variance in freshman GPA than either HSGPA or SAT II Writing.

	UCSC	UC
HSGPA	.29	.27
SAT I Math	.07*	.01*
SAT I Verbal	.09	.05
SAT II Math	-.05*	.02
SAT II Writing	.17	.18
SAT II 3rd Subject	.05	.09

* Not statistically significant at $p < .01$ level

A more nuanced picture emerges when examining the pattern of beta weights within different disciplines. Table 6 (next page) presents the standardized regression weights for HSGPA and all five SAT component scores across broad disciplinary areas. HSGPA had the greatest predictive weight across disciplines, however the relative weight of the individual component tests varied

by discipline. SAT II Writing was the most predictive for undeclared majors and for students intending to major in something other than math, the natural sciences, or engineering. The SAT 3rd subject was the best predictor after HSGPA for students intending to major in the natural sciences or engineering. Further research is needed to determine the predictive value of any of the component tests on success in the upper level courses of any discipline.

Table 6
Percent of Variance Explained and Standardized Regression Coefficients
for HSGPA, SAT I, and SAT II component test scores
by Intended Major Discipline

UCSC Freshman GPA = HSGPA + SAT I M + SAT I V + SAT II M + SAT II E + SAT II 3rd

	Overall	Math/Science	Other	Undeclared
HSGPA	.287	.309	.299	.296
SAT I Math	.066*	.089*	-.004*	.127
SAT I Verbal	.091	.036*	.088**	.078
SAT II Math	-.045*	.014*	.027*	-.052*
SAT II English	.168	.071*	.160	.180
SAT II 3rd Subject	.048	.102	.029	.009*
R² for model	.192	.172	.197	.213
N	2,671	615	1,051	1,005

* Not statistically significant at $p < .05$

Summary

Comparisons between the UCSC and UC system-wide data should be made cautiously. The UC analyses were based on students who first were admitted and enrolled between 1996 and 1999, while the UCSC data is from students who first enrolled in 2001. Furthermore the UC data included four years compared to only a single year of UCSC data. The enormous difference in the size of the two samples means that the margin of error in the UCSC data is considerably larger.

Although there were some differences in the patterns of relative importance of the predictor variables between UCSC and some other campuses, some important consistencies also emerged. Perhaps most striking is that on campuses for which SAT II was the best predictor of freshman

GPA, SAT I scores added very little, if any, power to predict freshman GPA. On the other hand, on the campuses where SAT I contributed nearly as much or more than SAT II to the prediction of first-year GPA, HSGPA was a considerably better predictor than either of the SAT scores. Taken together these findings strongly suggest that high school “achievement,” whether measured by SAT II or HSGPA is a better indicator of future UC success, at least in the first year, than is “aptitude,” at least as measured by the SAT I. Furthermore, across campuses SAT I scores were more sensitive to students’ socioeconomic backgrounds than either of the measures of high school achievement.

Author’s Note: This paper relied heavily on the work of Saul Geiser and Roger Studley, both for the results and interpretation of the results of the system-wide studies conducted by UCOP. The analyses of the UCSC data were replications of the UCOP studies.

[1] See S. Geiser & R. Studley (July 2001). Preliminary Findings on the Relationship between SAT Scores, Socioeconomic Status, and UC Freshman GPA. UCOP; and S. Geiser with R. Studley (October 2001). UC and the SAT: Predictive Validity and Differential Impact of the SAT I and SAT II at the University of California, UCOP.

[2] For the sake of brevity the term “freshmen” is used throughout this report despite the fact that some first-time, first-year, direct from high school students first enrolled with enough AP/IB units to be classified as sophomores. It should also be noted that some transfer students are still freshmen at the time of entry, and they were excluded from these analyses.

[3] A small percentage of new freshmen do not submit SAT I or SAT II scores, or a high school GPA. A somewhat larger minority do not complete the parental education or family income questions on the application.

[4] According to S. Geiser & R. Studley (July 2001), “The logarithm of family income is used ... to take into account the diminishing marginal effects of income on UCGPA and other variables. That is, a \$10,000 increase in income is likely to have a larger effect for a student whose family earns \$35,000 annually than for a student whose family earns \$135,000. Use of the log of income is standard practice in economic research.”

[5] e.g., 1=some high school, 2=high school graduate, 3=some college, etc.

[6] S. Geiser with R. Studley (October 2001). UC and the SAT: Predictive Validity and Differential Impact of the SAT I and SAT II at the University of California, UCOP.

[7] S. Geiser & R. Studley (July 2001). Preliminary Findings on the Relationship between SAT Scores, Socioeconomic Status, and UC Freshman GPA. UCOP