DOCUMENT RESUME

ED 466 269 JC 020 476

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TITLE	Student Average Academic Preparation: The Development of a College-Level Summary Measure of Student Preparedness for Academic Coursework.
INSTITUTION	California Community Colleges, Sacramento. Office of the Chancellor.
PUB DATE	2002-05-03
NOTE	12p.; Paper presented at the Annual Meeting of the Research and Planning Group for California Community Colleges (40th, Pacific Grove, CA, May 1-3, 2002).
AVAILABLE FROM	For full text: http://www.cccco.edu/divisions/tris/rp/rp_doc/rp2002_saap.pdf.
PUB TYPE	Reports - Evaluative (142) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*College Outcomes Assessment; *College Preparation; *Community Colleges; Comparative Analysis; Educational Environment; *Performance Based Assessment; Research Methodology; Two Year Colleges
IDENTIFIERS	*California Community Colleges; Stanford Achievement Tests

ABSTRACT

The Board of Governors of California's Community College System, in executing California's Partnership for Excellence (PFE) Program, has recognized that the colleges operate within remarkably disparate social and economic environments, and that these differences include variation in factors that are likely to affect the performance of colleges on the predetermined outcome measures. The attempt to compensate for such disparities has resulted in an adjustment modeling process. Adjustment models are statistically derived equations that "adjust" for observed relationships between external variables and each of the PFE outcomes. This document describes the process the Chancellor's Office used to match college enrollment records against standard test results without the use of social security numbers or other unique identifiers. The subsequent Student Average Academic Preparation (SAAP) measure proved to be a significant and positive adjustment factor in three of the five PFE adjustment models, including basic skills improvement, course completion, and transfer. According to the paper, the SAAP represents a substantial step forward in the systemwide efforts to account for the disparate conditions affecting the performance of each of California's community colleges. (EMH)

Student Average Academic Preparation: The Development of a College-Level Summary Measure of Student Preparedness for Academic Coursework*

by

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*Presented at the Annual Meeting of the Research and Planning Group of California Community Colleges (May 3, 2002). I am grateful to Willard Hom and Shuqin Guo for their respective suggestions for improving this paper. All correspondence should be directed to the author at pbahr@cccco.edu.

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ABSTRACT

California's community college performance based funding strategy - the Partnership for Excellence program - includes, as an aspect of the outcome assessment component of the program, a mechanism to "level the playing field" between colleges. This function is accomplished through adjustment models: statistically derived equations that "adjust" for observed relationships between exogenous variables and college-level outcomes of interest. The development of adjustment models for each of the several outcomes has relied upon an exploratory process to derive a parsimonious set of exogenous variables with nonzero (statistically significant) relationships to the outcome of interest. One previously unmeasured adjustment variable has received considerable interest in discussions of the adjustment model developmental process, namely the academic preparedness of entering students at each college. This paper addresses the recent work of the California Community College's Chancellor's Office to develop a measure of student average academic preparation for use in the "leveling the playing field" aspect of community college outcome measurement and accountability.

Student Average Academic Preparation: The Development of a College-Level Summary Measure of Student Preparedness for Academic Coursework

BACKGROUND

The Board of Governors of California's Community College system, in executing California's Partnership for Excellence (PFE) program, has recognized formally that the colleges operate within remarkably disparate social and economic environments, and that these differences include variation in factors that are likely to affect the performance of colleges on the predetermined outcome measures. The recognition of, and attempt to correct for, such disparities has taken the form of the implementation of an "adjustment modeling" process. Adjustment models are statistically derived equations that "adjust" for observed relationships between exogenous variables (factors that are not within the purview of control of the individual colleges and districts) and each of the PFE outcomes.

THE PROBLEM

While the exploratory process of selecting a parsimonious set of adjustment variables has drawn on numerous data sources and examined a variety of possible adjustment factors, considerable attention has been focused on one important adjustment factor for which data were unavailable. This factor, dubbed *student average academic preparation* (SAAP), would represent the relative academic preparedness of entering students at each college. The academic preparedness of the incoming student population was expected to be a predominant factor affecting the performance of each college on accountability measures derived from student outcomes.

THE ANSWER

The Chancellor's Office of the California Community College system, in an effort to adjust for the effects of differences in student preparedness on the performance of each college, forged a data sharing alliance with the California Department of Education (CDE). In 1998, CDE implemented statewide testing of public school students using the Stanford 9 test battery as one component of California's Standardized Testing and Reporting (STAR) program. The Stanford 9 test includes five subject areas (mathematics, reading, language, history/social science, and science) and is one measure employed by CDE to assign an Academic Performance Index (API) score to each public school in California.

CDE agreed to share with the Chancellor's Office the Stanford 9 test results for public high school juniors for the two terms for which data were available at the time of the initiation of the data sharing: spring semester 1998 and spring semester 1999. The intention of the Chancellor's Office was to cross reference the Stanford 9 test results with the Fall 2000 cohort of incoming first-time freshmen at each college, and, by calculating the mean of each cohort's Stanford 9 test

results, develop an index of the average academic preparation of incoming freshmen at each college.

A PLOT TWIST

Unfortunately, CDE does not have social security numbers or other relevant unique identifiers for student's Stanford 9 test results, precluding a unique match against Chancellor's Office records. Thus, a simple match against college enrollment records was not possible

A "FUZZY" SOLUTION

To remedy this problem, the Chancellor's Office developed a "fuzzy match" process to connect student records with the CDE Stanford 9 test results. The fuzzy match relied upon the combined uniqueness of multiple student-level descriptive variables to connect student records across the two datasets. The four variables selected for the fuzzy match were gender, birth date, race/ethnicity, and high school of origin (in the case of the Stanford 9 data, high school of enrollment at the time of test administration).

Further complicating the situation, the Stanford 9 data includes both a primary race/ethnicity variable and a secondary variable indicating one or more additional racial/ethnic identifications, while the Chancellor's Office data includes only a single racial/ethnic identification variable. A fuzzy match employing only the primary race/ethnicity variable in both datasets would have been a reasonable method of matching records. However, with the goal of using all available information to maximize the percentage of matched records across the two datasets, the Chancellor's Office expanded the matching process to capitalize on the data contained within this secondary race/ethnicity variable.

In simple terms, the matching process involved five stages:

1. First-time freshmen from the Fall semester/quarter of 2000 were identified.
2. This first-time freshmen cohort was screened to eliminate all students who were younger than 17 years of age at first enrollment, older than 22 years of age at first enrollment, or who did not specify a valid California high school as their high school of origin.
3. The student records of this reduced cohort were then matched against the Stanford 9 test data (1998 and 1999 combined) using the combination of four variables mentioned above: birth date, high school, gender and primary race/ethnicity.
4. The matched records from the previous step were set aside, and the remaining unmatched first-time freshmen were matched against the Stanford 9 test data using the same four variables with the exception that the secondary race/ethnicity variable in the Stanford 9 data was used instead of the primary race/ethnicity variable. However, this step of the matching process included only Stanford 9 records with a single racial/ethnic identification in the secondary race/ethnicity variable. In other words, Stanford 9 test takers had the option of coding multiple racial/ethnic identifications in the secondary

race/ethnicity variable, and all students who did so were eliminated from the matching process accomplished in this step.

5. The matched students records from steps 3 and 4 were combined.

DEDUPLICATING MULTIPLY-MATCHED STUDENT RECORDS

Despite the relatively unique combination of birth date, high school, gender, and race/ethnicity, a number of duplicate observations were generated during the matching process. Duplicate observations constitute a single community college student for whom multiple Stanford 9 records were matched on the basis of the four variables discussed above. One would expect that duplicate observations would be particularly problematic in colleges that draw students from relatively few high schools containing populations that are relatively homogenous with regard to race/ethnicity.

Because the Stanford 9 test data lacks a unique identifier, it is impossible to determine which of the several Stanford 9 records were matched correctly to a given freshmen college student. Duplicate matches must be either eliminated entirely (dropping all students for whom multiple matches occurred) or eliminated at random such that only a single test score match remains. The Chancellor's Office elected for the latter of these two options – eliminating all but the first occurrence of multiply-matched student records – in order to maximize the match rate for each college. Furthermore, because the original CDE data were *not* sorted by test score prior to the matching process, the elimination of all but the first match of multiply matched student records (as opposed to eliminating all but the second match, etc.) is not believed to result in any systematic change, by college, in average Stanford 9 test scores.

ASSESSING THE REPRESENTATIVENESS OF THE MATCHED GROUP

Prior to matching, the Chancellor's Office identified 103,929 unique student records meeting the criteria of: (1) first term of enrollment in Summer 2000 or Fall 2000, (2) originating from a California high school, and (3) age of no more than 22 years and no less than 17 years. After completing the fuzzy match process and deduplicating matched records, Stanford 9 test scores were matched to 58,565 students for an overall match rate of 56.35%. Of these, 53,955 students had valid test scores on all five tests, leading to practical match rate of 51.92%. Match rates by gender and race/ethnicity are provided below in Tables 1 and 2, respectively. The findings presented in these tables suggest reasonably equal match rates across categories of gender and predominant categories of race/ethnicity.

Match rates by college varied from a low of 6.57% to a high of 68.33%. Excluding the lowest match rate of 6.57%, the next lowest college match rate was 13.17%, followed by 25.00%. Descriptive statistics for match rate by college are provided in Table 3, and a histogram representing the distribution (proportion) of colleges by match rate is presented in Figure 1. While not equal across colleges, match rates appear to be sufficiently large at most of the colleges to warrant a reasonable degree of confidence in aggregate statistics derived from the match.

TABLE 1: Percent match by gender for all first-time freshmen, ages 17 to 22, originating in California high schools

Gender	N for all First-Time Freshmen Ages 17 to 22 Originating in California High Schools	Percent with Five Valid Test Scores
Male	50,418	51.57
Female	53,014	52.73
Nonreporting	497	0.00

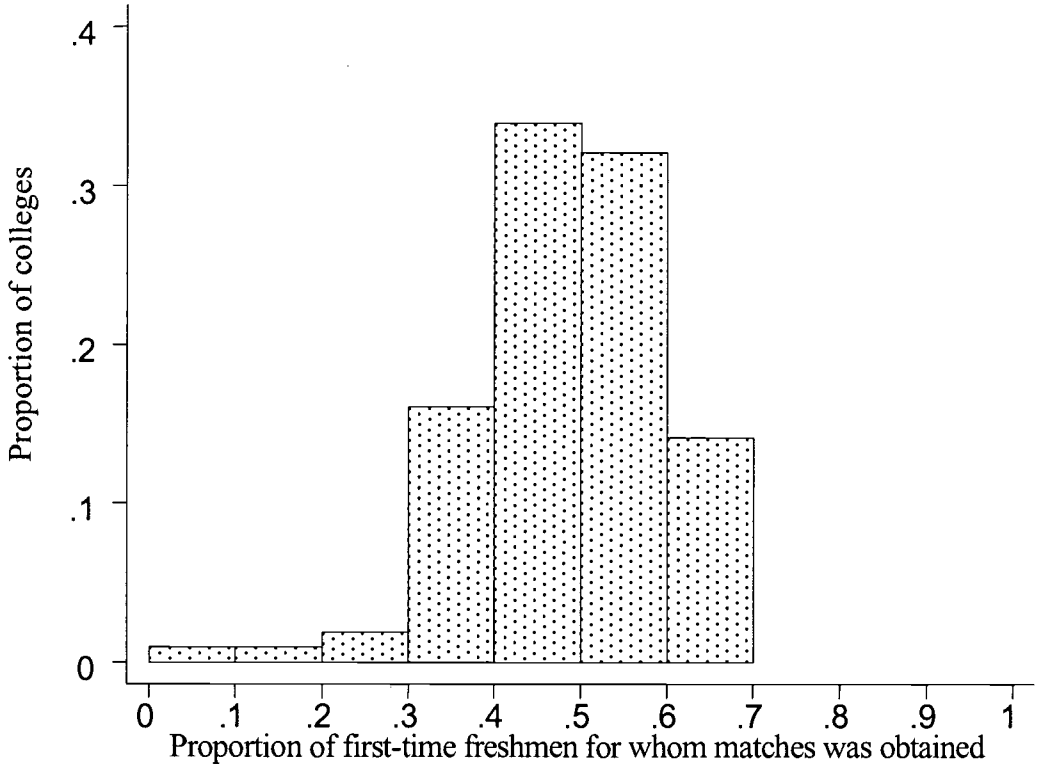
TABLE 2: Percent match by race/ethnicity for all first-time freshmen, ages 17 to 22, originating in California high schools

Race/Ethnicity	N for all First-Time Freshmen Ages 17 to 22 Originating in California High Schools	Percent with Five Valid Test Scores
White	40,977	58.85
Black	6,470	44.13
Hispanic	33,189	55.86
Asian	10,492	54.96
Pacific Islander	782	26.73
Filipino	3,975	49.96
Native American	960	22.60
Other	2,263	9.59
Nonreporting	4,821	1.10

TABLE 3: Descriptive statistics for percent match by college

Mean	48.65
Standard Deviation	11.16
Median	49.50
25th Percentile	42.69
75th Percentile	56.90
Minimum	6.57
Maximum	68.33
Skewness	-0.82
Kurtosis	4.34
N	106

FIGURE 1: Histogram of the distribution (proportion) of colleges by match rate (N=106)



CALCULATING THE COLLEGE-LEVEL SAAP SCORE

The SAAP score for each college is a simple, unweighted mean of the average of each student's five normal curve equivalent test scores. Stated briefly, CDE provided the nationally standardized normal curve equivalent score (a percentile) for each of the five tests for each student. The Chancellor's Office averaged these normal curve equivalent scores across each student, with equal weights given to each of the five tests. The averages of the five tests for the students were then collapsed (averaged) to the level of the college to give a summary mean of the means of the five tests for matched students. Descriptive statistics for the average of the five normal curve equivalent scores for all students are provided in Table 4, and descriptive statistics for the college-level SAAP score are provided in Table 5. The distribution (proportion) of colleges by SAAP score is presented in Figure 2.

A review of the Table 4, Table 5, and Figure 2 reveals a bell-shaped distribution for the aggregate SAAP score and fairly low degree of variation relative to the variation in student-level scores. For example, while the interquartile range (IQR) of student-level scores is 22.94, the aggregate SAAP has an IQR of only 7.94. A comparison of standard deviations reveals a similarly reduced level of variation in the SAAP (15.78 versus 5.12). Means and medians are similar both within and between the student-level and college-level measures.

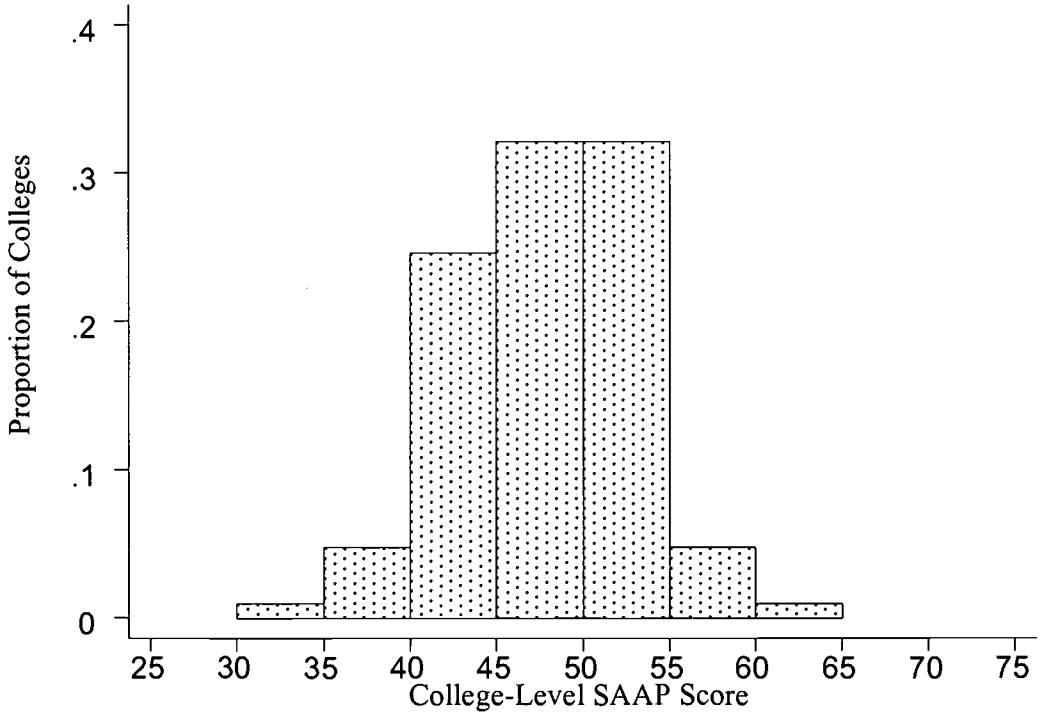
TABLE 4: Descriptive statistics for the average of the five Stanford 9 normal curve equivalent scores for all matched students

Mean	48.42
Standard Deviation	15.78
Median	47.70
25th Percentile	36.62
75th Percentile	59.56
Minimum	0.8
Maximum	99.0
Skewness	0.22
Kurtosis	2.55
N	53,955

TABLE 5: Descriptive statistics for the college-level *Student Average Academic Preparation* (SAAP) score

Mean	47.81
Standard Deviation	5.12
Median	48.51
25th Percentile	43.85
75th Percentile	51.79
Minimum	30.83
Maximum	61.34
Skewness	-0.36
Kurtosis	3.26
N	106

FIGURE 2: Histogram of the distribution (proportion) of colleges by *Student Average Academic Preparation* Score (N=106)



THE USE OF THE SAAP MEASURE IN ADJUSTMENT MODELS

The SAAP measure proved to be a statistically significant and positive adjustment factor in three of the five PFE adjustment models, including the basic skills improvement model, the course completion model, and the transfer model. Likewise, the measure was found to be statistically significant and positive in adjustment models developed by the Chancellor's Office for the Persistently Low Transfer College (PLTC) study. The measure was not found to be statistically significant in the degree/certificate completion PFE adjustment model or the vocational course completion PFE adjustment model, after accounting for other adjustment factors.

PROBLEMS AND FUTURE DIRECTIONS

A number of unresolved weaknesses in the SAAP measure are immediately evident. First, the measure addresses only the academic preparation of *recent high school students* and fails to address the impact that the academic preparedness of "nontraditional" students and early high school "dropouts" may have on the performance of a college. Second, the measure addresses only students of *California* high schools, which is particularly problematic for community colleges near the borders of California where the influx of nonresident students could be expected to be relatively high. Third, the measure addresses only *public* high school students, excluding students of private high schools and home schools. Fourth, at present the measure is calculated for only one year (Fall 2000), although this problem will be remedied as additional waves of Stanford 9 data are made available by CDE. Fifth, the year for which the SAAP measure is calculated is several years after the baseline years addressed by the PFE and PLTC adjustment models, the consequence of which is the unverified assumption of relative continuity in the academic preparation of incoming college freshmen at each college. Finally, the rules of administration for the Stanford 9 test precludes certain segments of the public high school population, most notably students who have been enrolled in a given school district for less than one year, suggesting that transient populations may be underrepresented in the Stanford 9 data and the SAAP measure.

Future work on the SAAP measure is expected to include an expansion in the number of first-time freshmen cohorts addressed by the measure, cross-year validation of the assumption of continuity in relative student average academic preparedness, and college-level validation of the representativeness of the match.

CONCLUSION

The SAAP measure developed by the Chancellor's Office represents a substantial step forward in the systemwide efforts to account for the disparate exogenous conditions affecting the performance of each of California's community colleges. While the measure is not without weaknesses, it still satisfies, at least in part, an essential and long-standing need voiced by numerous researchers and administrators in the California Community College system. Moreover, although the measure was constructed to meet the immediate requirements of adjustment modeling for the purpose of accountability, it has the potential to contribute to the

advancement of many future research efforts aimed at understanding the dynamics of education in community colleges. However, with due consideration given to the temporal and budgetary restrictions present at the time of development, it is recognized that the measure is in its infancy and that improvements and refinements on the measure should and will continue.

ABOUT THE AUTHOR

Peter Riley Bahr is employed as a researcher in the Research and Planning Unit of the Chancellor's Office of California Community Colleges. He is in the process of completing his doctorate in Sociology at the University of California – Davis, specializing in quantitative methodology, social psychology, and social stratification.

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EFF-089 (5/2002)