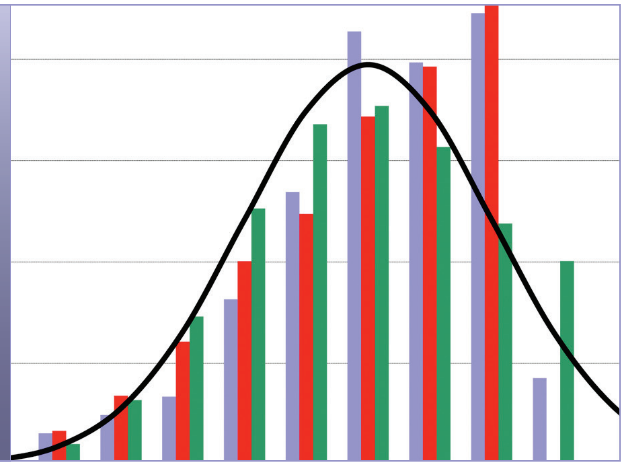
ACT Research Report Series

2012 (5)



Predicting Long-Term College Success through Degree Completion Using ACT® Composite Score, ACT Benchmarks, and High School Grade Point Average

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August 2012

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Abstract

This study compared the effectiveness of ACT® Composite score and high school grade point average (HSGPA) for predicting long-term college success. Outcomes included annual progress towards a degree (based on cumulative credit-bearing hours earned), degree completion, and cumulative grade point average (GPA) at 150% of normal time to degree completion (year 6 and year 3 for four- and two-year institutions, respectively). The utility of the individual ACT College Readiness Benchmarks for predicting long-term college success was also evaluated.

Data for this study included over 190,000 ACT-tested students who enrolled in college as first-time entering students in fall, 2000 through 2006. Over 100 total two- and four-year institutions were represented. Hierarchical logistic models were used to estimate institution-specific probabilities of college success based on ACT scores and HSGPA. First-year college GPA was also included as a predictor in the path analysis models. Accuracy and success rates were calculated using the distributions of ACT scores and HSGPA for each institution's approximate applicant pool; rates were then summarized across institutions. Direct and indirect effects of ACT score, HSGPA, and first-year academic performance on subsequent college outcomes were also examined. Results were disaggregated by institution type.

Both ACT Composite score and HSGPA were effective for predicting long-term college success at both four- and two-year institutions. Across the outcomes, test scores increased prediction accuracy over that for HSGPA alone. ACT scores and HSGPA were primarily indirectly related to subsequent college outcomes (through first-year college GPA). The ACT Benchmarks were also found to be useful for predicting long-term college success, providing further validity evidence for using them as measures of college readiness.

Acknowledgments

The authors thank Jeff Allen, Jill Crouse, and Richard Sawyer for their helpful comments and suggestions on an earlier draft of this report.

Predicting Long-Term College Success through Degree Completion Using ACT Composite Score, ACT Benchmarks, and High School Grade Point Average

Introduction

There are several student measures that are typically considered in the admissions process, largely because they have been found to identify accurately students who are ready for college and to predict students' eventual success in college. The top four measures identified by four-year postsecondary institutions (Clinedinst, Hurley, & Hawkins, 2011) are academically related and include grades in college preparatory courses, strength of high school curriculum, standardized test scores (ACT or SAT), and high school grade point average (HSGPA). But, many institutions also use other non-academic measures (e.g., extra-curricular activities and demonstrated interest in the institution) in making admission decisions. They do this to meet other goals that are not directly related to academic success but that closely align with their educational mission, such as maintaining equal opportunity and diversity in student enrollments. While most two-year institutions currently practice open admissions, about one-fifth of them use standardized test scores or HSGPA as part of their admission process (Breland, Maxey, Gernand, Cumming, & Trapani, 2002).

In this report, we focus on the use of pre-enrollment achievement measures to identify students who are likely to be successful in college, recognizing that this addresses only one aspect of the admission process. In order to evaluate the effectiveness of these measures, the outcome(s) of interest need to be identified. For making admission decisions, one outcome that is commonly used is first-year academic performance, as measured by first-year college grade point average (GPA). But, as pressure for increased accountability in higher education and higher graduation rates continues, institutions are considering outcomes beyond the first year of college, including persistence, academic performance, and degree completion. For example, a recent report from the Higher Education Research Institute (2011) refers institutions to a degree completion calculator available on their website that calculates expected degree completion rates based on student characteristics of their incoming freshman class. Another study (Saupe & Curs, 2008) discussed a procedure for developing four enrollment management scores, one of which was a graduation score intended to predict whether a student would graduate within six years of enrolling.

Two-year institutions also feel the pressure to increase graduation rates. Due to the reduced resources available to them, some are having to prioritize access; restrict enrollment; eliminate lower-level, remedial courses; and identify students who are likely to graduate or transfer to a four-year institution (González, 2012). In addition, they are being encouraged to evaluate intermediate outcomes that measure progress towards degree completion to help determine the reasons why so many students are not completing degrees (Moore, Shulock, & Offenstein, 2009).

Historically, numerous studies have consistently demonstrated that ACT scores and HSGPA are valid measures of early college success, defined as first-year college GPA and/or first to second year retention (Allen & Robbins, 2010; Allen, Robbins, Casillas, & Oh, 2008; Noble & Radunzel, 2007; Robbins, Allen, Casillas, Peterson, & Le, 2006). In a recent study of 50 four-year institutions, Westrick, Le, Robbins, Radunzel, and Schmidt (2012) found that the estimated mean correlation with first-year college GPA across institutions was 0.51 for ACT Composite (ACTC) score and 0.58 for HSGPA, after adjusting for range restriction. Sackett, Kuncel, Arneson, Cooper, & Waters (2009) found a similar correlation between SAT scores and first-year college GPA, after controlling for socioeconomic status. Sawyer (2010) reported that the multiple correlations of high school subject-area grade averages and ACT scores with first-year college GPA were higher when scores and grades were used jointly than when they were used separately.

Several studies have gone beyond examining correlations to evaluate the estimated effects of using these two measures for making admission decisions, with first-year college GPA as the outcome under consideration. For example, two studies (Sawyer, 2010; Noble & Sawyer, 2002) found that HSGPA was slightly more accurate (as measured by the estimated percentage of correct classifications) for predicting first-year success at GPA thresholds of 2.00, 2.50, and 3.00, and the ACTC score was slightly more accurate for predicting success at thresholds of 3.50 and 3.75. Across the different college GPA thresholds, using ACTC score and HSGPA in combination resulted in greater prediction accuracy, and was more effective for identifying successful students among those who would be expected to be successful, relative to using them separately. This latter finding demonstrates the incremental validity of test scores for predicting first-year academic performance. Sawyer (2010) also pointed out that HSGPA was a much stronger predictor of first-year GPA among students with higher ACTC scores than among those with lower scores. A similar result also held for ACTC score among students with higher HSGPAs.

The ACT College Readiness Benchmarks (in English, mathematics, reading, and science) have also been shown to be predictive of early college success. The Benchmarks are the minimum ACT test scores required for students to have a high probability of success in first-year, credit-bearing college courses—English Composition, College Algebra, social sciences courses, and Biology (Allen & Sconing, 2005), and provide an empirical definition for college readiness. Students who meet the Benchmark have approximately a 50% chance of earning a B or better and approximately a 75% chance of earning a C or better in the corresponding college course or courses (ACT, 2010a). The Benchmarks were identified as the typical scores across both two- and four-year postsecondary institutions that maximized the accuracy for predicting success (defined as earning a grade of a B or higher) in the corresponding courses. Meeting the Benchmarks has also been shown to be positively associated with early college outcomes, such as immediately enrolling in college the fall following high school graduation, persisting to the second year at the same institution, and achieving a 2.00 or higher, or 3.00 or higher, first-year college GPA (ACT, 2010b). Students who meet the Benchmarks are also less likely than those who do not meet the Benchmarks to take remedial coursework in English or mathematics.

A recent study (Radunzel & Noble, 2012) found that students who met the individual ACT Benchmarks were substantially more likely than those who did not meet the Benchmarks to persist in college through degree completion and to earn a degree in a timely manner. Moreover, as the number of ACT Benchmarks met increased, students' likelihood of achieving these outcomes also increased. The study also found that students with higher ACTC scores had higher success rates than those with lower scores; a similar result held for HSGPA. These findings were seen for students attending four-year institutions, as well as for those attending two-year institutions.

In a review of the literature, Moore and Shulock (2009) cited several studies documenting that first-year college GPA is also predictive of degree completion. These studies suggested that pre-college measures, such as standardized test scores and HSGPA, appear to influence degree completion primarily by virtue of their effect on first-year college academic performance.

In this study, we extend prior research on the topic of using ACT scores and HSGPA for making admission decisions by focusing on long-term college outcomes through degree completion and applying the same methodology used in Sawyer (2010) and Noble and Sawyer (2002). In particular, in this study we investigate

- the maximum accuracy of ACTC score and HSGPA used alone and jointly for predicting long-term college success. We also estimate the percentages of students who would be successful from among those who are expected to be successful (selected).
- the usefulness of the ACT College Readiness Benchmarks in each of the subject areas for predicting long-term college success, thus providing further validity evidence for using them as measures of college readiness. The percentages of successful students based on those with scores at or above the Benchmarks are compared to those associated with ACTC or HSGPA values that maximize the percentage of correct classifications.
- the utility of ACTC score and/or HSGPA for predicting long-term college success, given first-year college GPA. For this objective, we estimate the direct, indirect, and total effects of ACTC score, HSGPA, and first-year academic performance on subsequent college outcomes.

Because a majority of two-year institutions have open admissions policies, prior studies of this nature have included the results for four-year institutions only. But, in light of the growing concerns for open access remaining the norm at two-year institutions (González, 2012), this research topic is relevant and timely. Therefore, as an initial look, we also examine these issues for two-year institutions. Though some of the long-term outcomes differ between the two types of institutions (e.g., degree types), we compare their results at common achievement levels to evaluate the utility of ACTC score, HSGPA, and the ACT Benchmarks as college readiness indicators and for predicting long-term college success for all students, regardless of whether they initially apply to a two- or four-year institution.

Data

Data for this study included approximately 194,000 ACT-tested students who enrolled in college as first-time entering students in fall, 2000 through 2006. Over 100 institutions were represented, including all public institutions from two state systems. Four-year institutions included in the study were required to have at least six years of follow-up data available on their students so that six-year bachelor's degree completion rates could be evaluated for a given cohort. Two-year institutions were required to have at least three years of follow-up data available so that three-year associate's degree completion rates could be evaluated for a given cohort.

Postsecondary institutions make admission decisions about applicants. Therefore, to study the usefulness of using ACTC score, HSGPA, and the ACT Benchmark scores for informing college admission decisions, we also included over 505,000 students who sent their ACT scores to study institutions during the same time frame but did not enroll there.[1] Nonenrolled students who sent scores to an institution, plus those who actually enrolled in an institution, comprised the "applicant pool" for that institution. The applicant pools for the institutions in this study approximate actual applicant pools. Students may send their ACT scores to any number of institutions, but actually apply to only a subset of them. Conversely, some students may apply to some institutions without submitting official ACT score reports. The analyses in this report are based on data from all score senders; they are considered to be proxies for "applicants."

College outcomes included annual progress to degree (based on cumulative hours earned), degree completion, and cumulative GPA at 150% of normal time to degree completion

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[1] Nonenrolled students were identified from the 2000 to 2006 ACT-tested high school graduate histories. These students requested that their ACT scores be sent to at least one of the 104 institutions included in this study during the same time period as that for enrolled students.

(at the end of year 6 for four-year institutions and the end of year 3 for two-year institutions). Analyses were done separately by institution type, where type was defined at time of initial enrollment. However, some institutions provided data for some but not all of the outcomes. As a result, the number of institutions and enrolled students with available data differed by college outcome (Table 1). Multiple freshman cohorts of students from an institution were combined together in the analyses (cohorts 2000 to 2003 for four-year institutions and cohorts 2000 to 2006 for two-year institutions).

Table 1

Sample Sizes for Total Group of Students and Enrolled Students with Available College Outcomes by Type of Institution

Outcome variable	Two-year institutions	Four-year institutions
Total		
Number of institutions	43	61
Number of enrolled students	67,816	125,911
Number of nonenrolled students	84,407	420,629
Number of students in applicant pool	152,223	546,540
Cumulative hours earned		
Number of institutions	42	50
Number of enrolled students	62,407	111,691
Cumulative GPA[a]		
Number of institutions	42	57
Number of enrolled students	28,868	68,662
Degree completion		
Number of institutions	43	61
Number of enrolled students	67,816	125,911
Degree completion plus transfer		
Number of institutions	40	NA
Number of enrolled students	66,129	

Note. Sample sizes by college outcome are for enrolled students with available data on the outcome and provide counts of the numbers of students used to estimate the hierarchical logistic models. Slight fluctuations in the numbers of enrolled students and numbers of institutions by outcome are due to missing data for individual students or entire institutions.
[a] Cumulative GPA was evaluated at year 3 for two-year institutions and at year 6 for four-year institutions.

Progress to degree was based on cumulative credit-bearing hours earned at the end of each spring term, and measured whether the student was making progress towards degree completion. For dropouts and stopouts, the last value for cumulative hours earned was carried forward. For four-year institutions, end-of-year cumulative hours thresholds were 24, 48, 72, and 96 earned credit hours for years 1, 2, 3, and 4, respectively, approximating bachelor's degree completion in about five years. For two-year institutions, end-of-year cumulative hours thresholds were 18, 36, and 54 credit hours earned for years 1, 2, and 3, respectively, approximating associate's degree completion in slightly over three years.

For degree completion, we evaluated earning a bachelor's degree within six years of initial enrollment at a four-year institution and earning an associate's degree within three years at a two-year institution. In addition, for two-year institutions from two state systems, we evaluated associate's degree completion or transfer to an in-state four-year institution within three years of initially enrolling in college. Given the data sources available for this study, we focused on degree completion from the initial institution.

Cumulative GPA was evaluated at the end of year 6 for four-year institutions and at the end of year 3 for two-year institutions (referred to in this report as the year 6/year 3 cumulative GPA). Cumulative GPAs at degree completion were included in these analyses for students graduating before the end of year 6 for four-year institutions or year 3 for two-year institutions. Cumulative GPAs were initially evaluated at the following levels: 2.50 or higher, 3.00 or higher, 3.25 or higher, 3.50 or higher, and 3.75 or higher. However, results for the 2.50 or higher college criterion were not included in this report because very few students had year 6/year 3 cumulative GPAs below 2.50.

The sample for the study does not represent students or institutions nationally. A large majority of both the two- and four-year institutions came from the North Central accrediting region (Table 2). Moreover, most of the four-year institutions and all of the two-year institutions were public institutions.[2] The four-year institutions varied in admissions selectivity, though the majority (75%) had traditional or selective admissions policies.

Table 2

Percent of Two- and Four-Year Institutions by Institutional Characteristic

Institutional characteristic	Two-year institutions (n = 43)	Four-year institutions (n = 61)
Affiliation		
Public	95	74
Private	5	26
Selectivity		
Selective/highly selective	0	26
Traditional	5	57
Liberal/open	95	11
Unknown	0	5
Accrediting region		
North Central	95	80
Southern	0	16
Northwestern	0	3
Middle States	2	0
Unknown	2	0
Locale		
Urban	9	23
Suburban	14	18
Small city	16	39
Small town	60	20

Note. Percentages may not sum to 100 percent due to rounding.

The pre-enrollment measures used in this study included ACTC score, HSGPA, and the ACT College Readiness Benchmarks. The ACT Composite score is the rounded arithmetic

[2] In fall 2003, approximately three-fourths and nearly one-half of four- and two-year institutions in the United States, respectively, were private institutions (Knapp, Kelly-Reid, Whitmore, Wu, Gallego, Cong, Berzofsky, Huh, Levine, & Broyles, 2005).

average of the four subject area scores (English, Mathematics, Reading, and Science). Test scores are reported on a scale of 1 to 36. If students took the ACT more than once, only the most recent results were used. HSGPA was based on student's self-reported coursework taken in 23 specific courses in English, mathematics, social studies, and science and the grades earned in these courses. The ACT College Readiness Benchmarks correspond to scores of 18, 22, 21, and 24 on the ACT English, Mathematics, Reading, and Science tests, respectively (Allen & Sconing, 2005).

Method

For each institution, mean ACTC scores and HSGPAs, as well as the corresponding standard deviations (SDs) were computed for enrolled students and the entire applicant pool. Mean cumulative GPAs and success rates were calculated by institution for enrolled students. Distributions of the means and rates of these variables were then summarized across institutions using minimum, median, and maximum values.

Hierarchical logistic models estimated progress to degree, cumulative GPA, and degree completion rates for enrolled students from the pre-enrollment measures. Hierarchical models account for students clustered within institutions and allow the estimated college outcome success rates to vary across institutions. Separate models were developed by year for each relevant outcome and by institution type (two- vs. four-year). In all cases, we estimated random slope and intercept models.

Models were estimated for predicting college success based on (a) ACTC score, (b) HSGPA, (c) ACTC score and HSGPA used jointly, and (d) individual ACT subject area scores. The ACTC score and HSGPA joint model was evaluated with and without the interaction between these two measures. Nearly all of the interaction terms were statistically significant at the 0.01 level.

Clearly, a student's likelihood of being successful in college is based on multiple predictors, including cognitive and non-cognitive factors, as well as sociodemographic factors (Allen & Robbins, 2010). ACT does not advocate making college success predictions solely on the basis of a single measure, such as a test score. The use in this paper of one or two predictors is a mathematical simplification. The methods used here, such as those used with the ACTC and HSGPA joint model, could be generalized to multiple measures. The usefulness of these two measures for predicting long-term success is evaluated from the perspective of accurately distinguishing students who are likely to be successful from those who are not. In particular, the methodology used here is based on statistical decision theory (Sawyer, 1996) for validating educational selection decisions; the method frames validity evidence in terms of probable outcomes, given the ACT score or HSGPA and the outcome criteria used. The methodology used is the same as that used by ACT for helping institutions make course placement decisions.

For each predictor (or predictor combination) at institution-specific values we estimated three decision-based statistics for making admission decisions:

1. the maximum percentage of correct classifications (maximum accuracy rate (maxAR)),
2. the percentage of successful students among those who would be expected to be successful (success rate (SR)), and
3. the increase in the percentage of correct classifications over expecting all applicants to be successful (increase in accuracy rate (ΔAR)).

The latter two statistics were evaluated at the institution-specific predictor value that maximized the percentage of correct classifications. In this report, we refer to the predictor value associated with the maxAR as the "selection value."

Correct classifications include students at or above a given predictor (selection) value who were successful and students below the value who would have not been successful. For predictors that are positively related to success, it can be shown that the predictor value that maximizes the percentage of correct classifications corresponds to a 0.50 probability of success for a given model. For the two-predictor model, multiple combinations of ACTC score and HSGPA corresponding to a probability of success of 0.50 were identified. Probability distributions that cross 0.50 will yield accuracy rate distributions that increase to a maximum and then decrease. If the probability distribution for an institution does not cross 0.50, the maxAR is generally not interpretable, and the model is therefore considered a "nonviable model" for an institution. Models for institutions with probability curves crossing 0.50 are referred to here as "viable models."

If there were no selection procedure (i.e., if all students were selected, regardless of their ACTC score and/or HSGPA), a certain percentage of them would be successful. This percentage is referred to as the "baseline" accuracy rate. The arithmetic difference between the maxAR and the baseline accuracy rate represents the increase in accuracy rate (ΔAR) that results from using test scores or HSGPA. Large ΔARs correspond to a greater contribution by the pre-enrollment measures in increasing the percentage of correct classifications.

MaxARs, SRs, and ΔARs were calculated for each institution with a viable model. These statistics were generated using the institution-specific parameter estimates from the hierarchical models and the distributions of ACT scores and HSGPA for each institution's applicant pool.[3]

[3] The institution-specific estimated conditional probabilities of success for nonenrolled students were assumed to be the same as those for enrolled students.

Distributions of these statistics were then summarized across institutions using minimum, median, and maximum values. Results across institutions with viable models for each individual predictor/outcome combination are presented in this paper.[4] Results across institutions with viable models for both predictors were similar to these. For comparison purposes, the median percentages of students with scores below the selection values associated with the maxAR were also reported. (Note: 100 minus this percentage gives the percentage of students in the applicant pool at or above the selection value). For a more complete description of the methodology used (including the assumptions being made) to evaluate the usefulness of pre-enrollment measures in the admissions process, see the full ACT research report by Sawyer (2010).

To study the utility of the ACT College Readiness Benchmark scores for predicting long-term college success, SRs were estimated at the Benchmark scores for each institution, regardless of whether or not the probability curve for the institution crossed 0.50. Increases in SRs (denoted by ΔSRs) were also estimated to evaluate the usefulness of the predictor variable for increasing SRs over baseline success rates. Distributions of SRs and ΔSRs were summarized across institutions using minimum, median, and maximum values. Median SRs at each ACT Benchmark were compared to those at the institution-specific ACTC or HSGPA values associated with the maxAR (the latter based on institutions with viable models only).

Path analysis was used to estimate the effects of ACTC score, HSGPA, and first-year college GPA jointly on subsequent college outcomes for enrolled students. First-year GPA was the cumulative GPA from the end of the spring term of the student's first year of college. Figure 1 shows the hypothesized path model for each college outcome.

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[4] Across college outcomes, median decision-based statistics were comparable for the joint models with and without the interaction. Therefore, median statistics based on the model with the interaction are presented in this report.

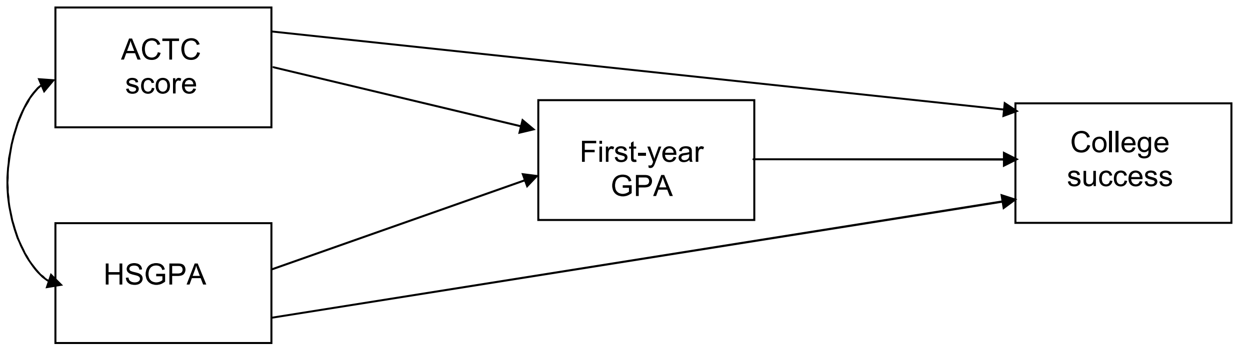

Figure 1. Path model evaluated. ACTC = ACT Composite; HSGPA = high school grade point average; GPA = grade point average.

The path model included two regression models, as well as the correlation between ACTC score and HSGPA. The first model regressed first-year college GPA on ACTC score and HSGPA. The second model regressed the college outcome of interest (e.g., degree completion) on ACTC score, HSGPA, and first-year GPA. Hierarchical linear regression was used to estimate the models for continuous outcomes and hierarchical logistic regression was used for binary outcomes (the only college outcome that was not binary in these analyses was year 6/year 3 cumulative GPA). The fixed effects coefficients from the hierarchical models were standardized for comparative purposes. The method described by MacKinnon and Dwyer (1993) and Jasti, Dudley, and Goldwater (2008) for standardizing coefficients was applied when the outcome variable was binary.

An indirect effect for a specific path is found by taking the product of the standardized coefficients from each of the regressions that comprise the path. The total indirect effect of a predictor is found by summing all indirect effects across the various possible paths. Paths connecting two correlated variables are included as indirect paths. Adding the total indirect effect and the direct effect gives the total effect of the predictor.

Some students omitted responses to high school coursework and grade items when they completed the ACT registration materials. Multiple imputation was used to estimate missing values; 12% of enrolled students and 11% of nonenrolled students had missing HSGPA. Five data sets were imputed. Models were developed for all five imputed data sets; no differences in parameter estimates (including standard errors) of practical significance were found across the data sets. The results reported here for all analyses involving HSGPA are those based on the initial imputed data set.

Results

Effectiveness of ACTC Score and HSGPA for Predicting Long-Term College Success

In this section, we describe the incremental benefit of using ACTC score and HSGPA jointly for predicting college success through degree completion. We first present descriptive statistics for ACTC scores and HSGPAs for enrolled students and the entire applicant pool, as well as for college outcomes over time for enrolled students. Next, we present probability distributions for the various college outcomes as functions of ACTC scores and HSGPAs. Following this, we present maxARs, ΔARs, and SRs for ACTC score and HSGPA used separately and jointly to predict long-term college success.

Descriptive statistics. At four-year institutions, mean ACTC scores and HSGPAs were typically higher among enrolled students than among students in the entire applicant pool (Table 3). The corresponding standard deviations were slightly smaller for enrolled students. The typical mean ACTC score across four-year institutions in this study (21.5) was lower than the mean score (22.6) of first-year ACT-tested college students nationally who enrolled in four-year institutions in 2003 (ACT, 2004).

Table 3

Distributions of Means and Standard Deviations of ACTC Scores, HSGPAs, College Success Rates, and College GPAs by Applicant/Enrollment Status across Four-Year Institutions

Enrollment status	Predictor/outcome variable	Number of students		Mean		SD	
		Med	Min/Max	Med	Min/Max	Med	Min/Max
Applicant pool	ACTC score	6,692	159/41,628	20.4	16.3/23.0	4.1	3.1/4.7
	HSGPA	6,692	159/41,628	3.21	2.81/3.50	0.58	0.45/0.64
Enrolled students	ACTC score	1,287	50/9,824	21.5	16.1/25.3	3.9	3.1/4.7
	HSGPA	1,287	50/9,824	3.32	2.82/3.73	0.53	0.29/0.64
	Progress year 1	1,541	50/9,824	68	27/89		
	Progress year 2	1,541	50/9,824	54	21/83		
	Progress year 3	1,529	49/9,824	46	18/79		
	Progress year 4	1,526	49/9,824	44	17/79		
	Bachelor's degree	1,287	50/9,824	42	17/79		
	First-year GPA	1,170	44/9,225	2.80	2.35/3.18	0.81	0.54/0.96
	Year 6 cum GPA[a]	612	24/6,286	3.12	2.77/3.47	0.52	0.38/0.75

Note. SD = standard deviation; Med = median; Min = minimum; Max = maximum; ACTC = ACT Composite; HSGPA = high school grade point average.
[a] Student's cumulative GPAs at degree completion were included in year 6 GPA analyses for students who graduated with a bachelor's degree before the end of year 6.

Among enrolled students, the typical six-year bachelor's degree completion rate across four-year institutions was 42% and ranged from 17% to 79%. Median progress to degree rates declined over time from 68% by the end of year 1 (24 or more cumulative hours earned) to 44% by the end of year 4 (96 or more cumulative hours earned). The typical year 6 college cumulative GPA was above 3.00 (median = 3.12).

At two-year institutions, mean ACTC scores and HSGPAs were comparable between enrolled students and the applicant pool (Table 4). The typical mean ACTC score of students enrolled in two-year institutions in this study (18.3) was slightly lower than the mean score (18.8) of first-year ACT-tested college students nationally who enrolled in two-year institutions in 2003 (ACT, 2004).

Table 4

Distributions of Means and Standard Deviations of ACTC Scores, HSGPAs, College Success Rates, and College GPAs by Applicant/Enrollment Status across Two-Year Institutions

Enrollment status	Predictor/outcome variable	Number of students		Mean		SD	
		Med	Min/Max	Med	Min/Max	Med	Min/Max
Applicant pool	ACTC score	2,137	120/16,472	18.3	16.7/20.2	3.6	3.2/4.1
	HSGPA	2,137	120/16,472	3.04	2.81/3.21	0.59	0.51/0.62
Enrolled students	ACTC score	834	95/9,551	18.3	16.9/20.6	3.5	3.0/4.0
	HSGPA	834	95/9,551	3.02	2.79/3.25	0.58	0.49/0.62
	Progress year 1	832	79/8,804	50	18/77		
	Progress year 2	831	95/8,866	40	8/61		
	Progress year 3	830	95/8,808	34	4/54		
	Associate's degree	834	95/9,551	14	4/34		
	Associate's degree or transfer	1,053	157/9,551	23	7/41		
	First-year GPA	385	65/7,321	2.63	2.18/3.01	0.90	0.76/1.10
	Year 3 cum GPA[a]	343	25/4,729	2.81	2.55/3.08	0.71	0.53/1.00

Note. SD = standard deviation; Med = median; Min = minimum; Max = maximum; ACTC = ACT Composite; HSGPA = high school grade point average.

[a] Student's cumulative GPAs at degree completion were included in year 3 GPA analyses for students who graduated with an associate's degree before the end of year 3.

Among enrolled students, the typical three-year associate's degree completion rate for two-year institutions was relatively low at 14% and ranged from 4% to 34% across institutions. The typical rate for completing an associate's degree or transferring to an in-state four-year institution by year 3 was higher at 23% and ranged from 7% to 41% across institutions. Progress to degree rates for two-year institutions also declined over time from 50% by the end of year 1 (18 or more cumulative hours earned) to 34% by the end of year 3 (54 or more cumulative hours earned). The typical year 3 college cumulative GPA was less than 3.00 (median = 2.81).

Hierarchical logistic regression results. Figures A-1 to A-10 in Appendix A provide estimated probabilities of completing a degree, progressing towards a degree, or achieving different levels of year6/year3 cumulative GPA as a function of ACTC score or HSGPA. The probabilities in the figures were estimated using the fixed effects parameter estimates from the hierarchical logistic models. Across college outcomes, as ACTC score or HSGPA increased, the estimated probabilities of success at either a typical two- or four-year institution increased.

Degree completion. At four-year institutions, the probability of earning a bachelor's degree by year 6 for students with an ACTC score of 25 (the maximum average ACTC score across institutions) was substantially higher than that for students with an ACTC score of 16 (the minimum average ACTC score across institutions; 0.54 vs. 0.31, see Figure A-1). At two-year institutions, the chances of earning an associate's degree or transferring to an in-state four-year institution by year 3 were greater than those of earning an associate's degree by year 3 by at least 10 percentage points for students with ACTC scores of 19 or higher or HSGPAs of 3.3 or higher (Figures A-1 and A-2). Regardless of the student's HSGPA, the probabilities of degree completion at two-year institutions (including or not including transfer) were less than 0.50.

Progress to degree. The estimated probabilities of progressing towards a degree associated with a given ACTC score or HSGPA decreased over time with the largest decline in probabilities occurring between years 1 and 2 (Figures A-3 and A-4 for four-year institutions and Figures A-5 and A-6 for two-year institutions). For example, at a typical four-year institution, the estimated probability of progressing towards a degree for a student with an ACTC score of 21 was 0.68 at the end of year 1 (earned 24 or more hours), and decreased to 0.54 (48 or more hours), 0.48 (72 or more hours), and 0.45 (96 or more hours) by the end of years 2, 3, and 4, respectively (Figure A-3).[5] The corresponding probabilities for a student with a HSGPA of 3.20 were estimated to be 0.64, 0.50, 0.44, and 0.41, respectively (Figure A-4). Estimated progress-to-degree probabilities also declined over time for two-year institutions (Figures A-5 and A-6).

Year 6 cumulative GPA at four-year institutions. The chances of earning a 3.75 or higher year 6 cumulative GPA were at least 30 percentage points lower than the chances of earning a 3.00 or higher GPA for students with ACTC scores of 16 to 32 (Figure A-7) or HSGPAs of 2.80 or higher (Figure A-8). For example, an ACTC score of 21 corresponded to a 0.58 estimated probability of earning a 3.00 or higher year 6 cumulative GPA at a typical four-year institution (Figure A-7). The corresponding probabilities for the other criterion levels were 0.38 (3.25), 0.20 (3.50), and 0.07 (3.75), respectively.

A HSGPA of 3.20 was associated with a 0.52 estimated probability of achieving a 3.00 or higher year 6 cumulative GPA at a typical four-year institution (Figure A-8). The corresponding probabilities for the other criterion levels were 0.30 (3.25), 0.13 (3.50), and 0.03 (3.75), respectively. For the 3.75 criterion, a HSGPA of 4.00 corresponded to a typical probability of success of only 0.33.

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[5] ACTC score of 21 and HSGPA of 3.20 correspond to the approximate median average ACTC score and HSGPA across four-year institutions.

Year 3 cumulative GPA at two-year institutions. Probability curves for two-year institutions were comparable to those for four-year institutions. An ACTC score of 18 corresponded to a 0.42 estimated probability of earning a 3.00 or higher year 3 cumulative GPA at a typical two-year institution (Figure A-9).[6] The corresponding probabilities for the other criterion levels were 0.26 (3.25), 0.14 (3.50), and 0.05 (3.75), respectively.

A HSGPA of 3.00 was associated with an estimated probability of 0.39 of achieving a 3.00 or higher year 3 cumulative GPA at a two-year institution (Figure A-10). The corresponding probabilities for the other criterion levels were 0.24 (3.25), 0.12 (3.50), and 0.04 (3.75), respectively. For the criterion levels of 3.50 or higher and 3.75 or higher, a HSGPA of 4.00 corresponded to a typical probability of success of less than 0.50 at two-year institutions (0.45 and 0.26, respectively).

Accuracy and success rates for ACTC score and HSGPA. In this section, we summarize median maxARs, ΔARs, and SRs across institutions with viable models using ACTC score or HSGPA as predictors of long-term college outcomes.[7] Minimum and maximum values for these statistics are provided in Appendix B, Tables B-1 to B-4. Results for progress to degree outcomes are also provided in the tables in Appendix B.

Degree completion. For four-year institutions, 58 of the 61 institutions had viable ACTC models and 56 had viable HSGPA models for predicting degree completion (Table 5).

[6] ACTC score of 18 and HSGPA of 3.00 correspond to the approximate median average ACTC score and HSGPA across two-year institutions.
[7] For a viable model, the probability distribution must cross 0.50.

Table 5

Median Results for Predicting Degree Completion

Predictor variable	Number of institutions	Maximum accuracy rate (maxAR)	Increase in accuracy rate (ΔAR)	Success rate (SR)
Bachelor's degree completion by year 6 -- four-year institutions (n = 61)				
ACTC	58	64	24	57
HSGPA	56	65	23	58
ACTC & HSGPA	61	67	26	60
Associate's degree completion by year 3 -- two-year institutions (n = 43)				
ACTC	25	81	63	55
HSGPA	5	72	43	52
ACTC & HSGPA	25	82	64	53
Associate's degree completion or transfer to four-year institution by year 3 -- two-year institutions (n = 40)				
ACTC	38	77	54	55
HSGPA	14	69	37	54
ACTC & HSGPA	38	77	54	55

Note. Results across institutions with viable models for both predictors were similar to those presented here. Statistics were evaluated at selection values associated with the maxAR. ACTC = ACT Composite; HSGPA = high school grade point average.

The three institutions with nonviable ACTC models had relatively high six-year bachelor's degree completion rates (66% to 79%). The five institutions with nonviable HSGPA models had relatively low six-year bachelor's degree completion rates (17% to 25%). Joint ACTC and HSGPA models were viable for all 61 four-year institutions included in this study.

The median ACTC and HSGPA selection values associated with the maxAR for predicting six-year bachelor's degree completion were relatively high (25 for ACTC and 3.57 for HSGPA; Appendix B, Table B-1), and these selection values varied substantially across institutions (ranging from 9 to 31 for ACTC and from 2.20 to 4.00 for HSGPA). Multiple combinations of ACTC score and HSGPA corresponded to a probability of 0.50 for the joint model and are therefore not listed in the tables in Appendix B. Median maxARs and SRs were comparable for ACTC and HSGPA (64% vs. 65% and 57% vs. 58%, respectively). The median maxAR and SR for the joint model were higher than those based on the single-predictor models (by 2 to 3 percentage points). The typical maxAR associated with using both ACTC score and HSGPA jointly for predicting bachelor's degree completion was 26 percentage points higher than the baseline AR. These findings demonstrate the incremental benefit of using ACTC score and HSGPA for predicting bachelor's degree completion by year 6.

To better understand the results based on the joint model and the incremental usefulness of ACTC score beyond HSGPA, Figure 2 provides the estimated probabilities of completing a bachelor's degree by year 6 associated with different values of HSGPA and ACTC scores. As both HSGPA and ACTC score increased, probabilities of success also increased. The ACTC score differential was larger for students with higher HSGPAs than those with lower HSGPAs. The same was true for the HSGPA differential when comparing students with higher and lower ACTC scores.

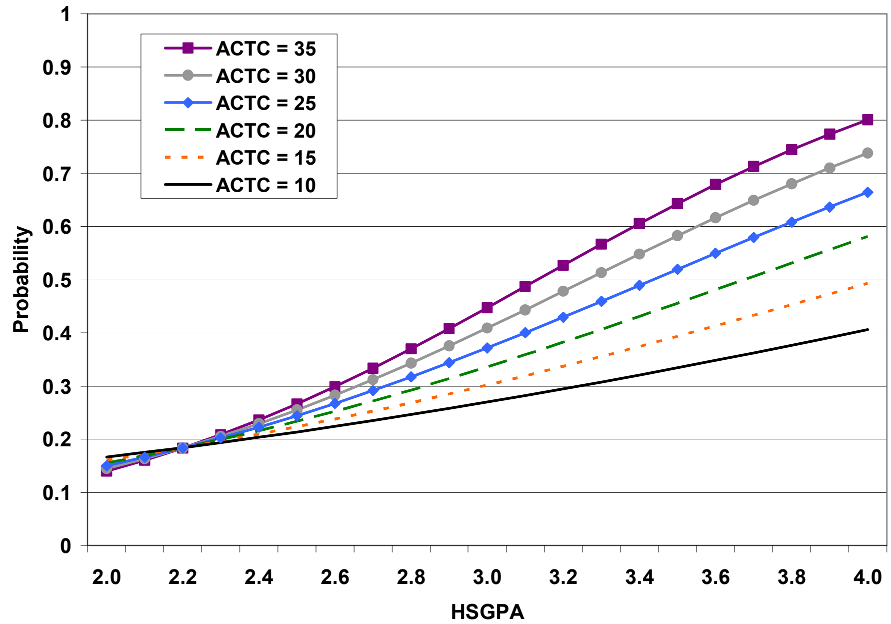

Figure 2. Estimated probabilities of bachelor's degree completion by year 6 based on HSGPA and ACTC score at four-year institutions.[8] HSGPA = high school grade point average; ACTC = ACT Composite.

For associate's degree completion by year 3, 25 of the 43 two-year institutions had viable ACTC models and only five had viable HSGPA models (three-year associate's degree completion rates were relatively low). As a result, selection values associated with the maxAR were relatively high across the institutions with viable models (Appendix B, Table B-2); these values were higher than those for predicting bachelor's degree completion by year 6 at four-year institutions. Across the 25 institutions with viable models, the typical maxAR and SR associated with ACTC scores were relatively high (81% and 55%, respectively), while the percentages of students at or above the ACTC selection values were relatively low (ranged from about 1% to 8% across institutions; Appendix B, Table B-2).

[8] The probabilities in Figure 2 were estimated using the fixed effects parameter estimates from the hierarchical logistic model that included an interaction term between ACTC score and HSGPA.

When examining associate's degree completion or four-year transfer by year 3 as the outcome, 38 of 40 two-year institutions had viable ACTC models, but only 14 of the 40 institutions had viable HSGPA models (the typical probability of associate's degree completion or transfer by year 3 for students with a 4.00 HSGPA was less than 0.50; Figure A-2). The median selection values associated with the maxAR were slightly higher than those for bachelor's degree completion by year 6 at four-year institutions (27 vs. 25 for ACTC score and 3.75 vs. 3.57 for HSGPA). The median maxAR and ΔAR across two-year institutions based on ACTC score were both higher than those associated with predicting bachelor's degree completion across four-year institutions. The median SR, however, was comparable. The median maxAR for HSGPA viable models was considerably lower than that based on ACTC viable models. Median maxARs, ΔARs, and SRs for the ACTC and HSGPA joint models were comparable to those for the ACTC models, reflecting the negligible incremental benefit of HSGPA for predicting associate's degree completion by year 3 alone or in combination with transferring to an in-state four-year institution.

Progress to degree over time. Over 85% of the two- and four-year institutions with cumulative hours earned available had viable models for evaluating the progress to degree outcomes (44 out of 50 four-year institutions and 36 out of 42 two-year institutions; Appendix B, Tables B-1 and B2). Median selection values for predicting progress to degree from either ACTC or HSGPA increased over time (Appendix B, Tables B-1 and B-2). For example, for four-year institutions, the median ACTC score associated with the maxAR increased from 18 at year 1 to 24 at year 4, compared to a score of 25 for predicting completion of a bachelor's degree by year 6 (usually requiring 120 or more cumulative credit hours earned). For two-year institutions, the typical score associated with the maxAR for completing an associate's degree by year 3 was much higher than that for predicting progress to degree at year 3 (29 vs. 23; Table B-2).

Median maxARs, ΔARs, and SRs for HSGPA were slightly higher than those for ACTC for four-year institutions, but these median values were more comparable between these two predictors for two-year institutions. However, at both two- and four-year institutions, the median maxARs, ΔARs, and SRs based on the joint models were slightly higher than those based on the single-predictor models (by 1 to 3 percentage points). These findings are consistent with those seen for degree completion.

Year 6 cumulative GPA at four-year institutions. All but one of the 57 four-year institutions with cumulative GPA data available had viable ACTC models for predicting college GPA at year 6 for criterion levels at or above 3.00 (Table 6). In contrast, only 40 and 2 of the 57 institutions had viable models for HSGPA for the 3.50 and 3.75 criterion levels, respectively (the typical probability of a 3.75 or higher GPA for students with a 4.00 HSGPA was less than 0.50; Figure A-8). For predicting college GPA at year 6, median ACTC scores and HSGPAs associated with the maxAR increased across GPA criterion levels from 3.00 to 3.75 (Table B-3 of Appendix B). For example, the median ACTC selection value for a GPA level of 3.00 or higher was 20; the corresponding selection values for the other criterion levels were 24, 27, and 31, respectively. For both ACTC score and HSGPA, selection values associated with the maxAR varied substantially across institutions (see minimum and maximum values in Table B-3 of Appendix B).

Table 6

Median Results for Predicting Levels of Year 6 College Cumulative GPA at Four-Year Institutions

Predictor variable	Number of institutions	Maximum accuracy rate (maxAR)	Increase in accuracy rate (ΔAR)	Success rate (SR)
3.00 or higher college GPA				
ACTC	57	67	12	68
HSGPA	57	70	16	70
ACTC & HSGPA	57	71	18	71
3.25 or higher college GPA				
ACTC	57	70	33	64
HSGPA	57	73	35	63
ACTC & HSGPA	57	75	39	67
3.50 or higher college GPA				
ACTC	57	79	56	61
HSGPA	40	79	56	56
ACTC & HSGPA	57	83	62	63
3.75 or higher college GPA				
ACTC	56	91	82	58
HSGPA	2	84	67	50
ACTC & HSGPA	57	92	84	59

Note. Students' cumulative GPAs at degree completion were included in year 6 GPA analyses for students who graduated with a bachelor's degree before the end of year 6. Statistics were evaluated at selection values associated with the maxAR. GPA = grade point average; ACTC = ACT Composite; HSGPA = high school grade point average.

The HSGPA models were slightly more accurate than the ACTC models for criterion levels of 3.00 and 3.25 (based on the median maxARs and ΔARs), but the HSGPA and ACTC models were comparable for the criterion level of 3.50. For the GPA criterion level of 3.75, the typical maxAR and ΔAR were relatively high for ACTC score (91% and 82%, respectively). Across the GPA criterion levels (at or above 3.00), the median maxARs, ΔARs, and SRs for the ACTC and HSGPA joint model generally exceeded those for both single-predictor models. Figure 3 contains the estimated probabilities for achieving a year 6 cumulative GPA of 3.00 or higher at a typical four-year institution based on different values of HSGPA and ACTC score.

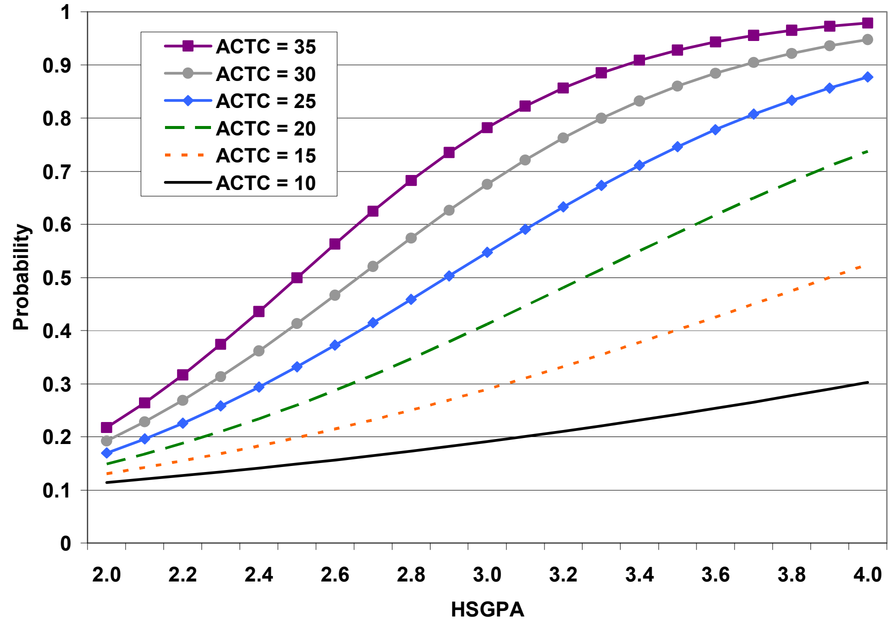

Figure 3. Estimated probabilities of achieving a year 6 college cumulative GPA of 3.00 or higher based on HSGPA and ACTC score at four-year institutions.[9] HSGPA = high school grade point average; ACTC = ACT Composite.

ACTC differentials in estimated probabilities were greater for students with higher HSGPAs than for those with lower HSGPAs. Larger HSGPA differentials were also seen for students with higher ACTC scores than for those with lower scores. Similar results held for the other GPA criterion levels.

Year 3 cumulative GPA at two-year institutions. Only 5 of the 42 two-year institutions had viable HSGPA models for predicting year 3 college GPA at the 3.50 criterion level, and none of the institutions had viable HSGPA models for the 3.75 criterion level (Table 7). In contrast, all but two of the institutions had viable ACTC models across GPA criterion levels.

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[9] The probabilities in Figure 3 were estimated using the fixed effects parameter estimates from the hierarchical logistic model that included an interaction between ACTC score and HSGPA.

Table 7

Median Results for Predicting Levels of Year 3 College Cumulative GPA at Two-Year Institutions

Predictor variable	Number of institutions	Maximum accuracy rate (maxAR)	Increase in accuracy rate (ΔAR)	Success rate (SR)
3.00 or higher college GPA				
ACTC	42	66	22	63
HSGPA	42	68	25	62
ACTC & HSGPA	42	70	27	66
3.25 or higher college GPA				
ACTC	42	74	46	62
HSGPA	42	75	48	56
ACTC & HSGPA	42	77	50	64
3.50 or higher college GPA				
ACTC	42	84	66	60
HSGPA	5	78	55	51
ACTC & HSGPA	42	85	68	61
3.75 or higher college GPA				
ACTC	40	92	84	58
HSGPA	0			
ACTC & HSGPA	41	93	85	58

Note. Students' cumulative GPAs at degree completion were included in year 3 GPA analyses for students who graduated with an associate's degree before the end of year 3. Statistics were evaluated at selection values associated with the maxAR. GPA = grade point average; ACTC = ACT Composite; HSGPA = high school grade point average.

Similar to the results seen for four-year institutions, median selection values associated with the maxAR increased across GPA criterion levels for two-year institutions (Appendix B, Table B-4). The ACTC selection scores for two-year institutions were generally within 2 score points of those for four-year institutions, and the HSGPA selection values for two-year institutions were generally higher than those for four-year institutions. Selection values associated with the maxAR also varied substantially across institutions (Appendix B, Table B-4). Median maxARs, ΔARs, and SRs for the ACTC and HSGPA joint models tended to be slightly higher than those for both single-predictor models for GPA criterion levels of 3.00 or higher. In general, typical SRs for two-year institutions were lower than those for four-year institutions for GPA criterion levels of 3.00 and 3.25.

Usefulness of ACT College Readiness Benchmarks for Predicting Long-Term College Success

In this section, we evaluate the effectiveness of the ACT College Readiness Benchmarks for predicting college success through degree completion. We first present descriptive statistics on ACT Benchmark attainment for enrolled students, as well as for the entire applicant pool. We also briefly describe the probability distributions for college success as functions of the individual ACT subject area scores. Following this, we present the typical probabilities of success, SRs, and ΔSRs associated with the ACT College Readiness Benchmark scores.

Descriptive statistics. At four-year institutions, the typical percentages of students meeting the ACT Benchmarks were higher among enrolled students than among students in the applicant pool (Table 8). In contrast, at two-year institutions, the typical Benchmark attainment percentages were comparable for these two student groups, and were lower than those for students from four-year institutions.

Table 8

Distributions of Percentages of Students Meeting ACT Benchmarks across Institutions by Applicant/Enrollment Status and Type of Institution

Institution type	ACT Benchmark	Applicant pool		Enrolled students	
		Med	Min/Max	Med	Min/Max
Four-year	English	70	31/84	78	31/96
	Mathematics	31	5/58	38	5/85
	Reading	51	16/69	59	15/83
	Science	21	3/44	26	3/56
Two-year	English	52	38/67	53	38/72
	Mathematics	14	7/38	13	5/38
	Reading	33	20/48	33	19/50
	Science	10	3/20	9	2/23

Note. For the typical numbers of students per institution see those reported in Tables 3 and 4. Med = median; Min = minimum; Max = maximum.

Across college outcomes for both institution types, as the ACT subject area score increased, the typical probabilities of college success also increased. This finding is illustrated in Figure 4 for six-year bachelor's degree completion at four-year institutions.

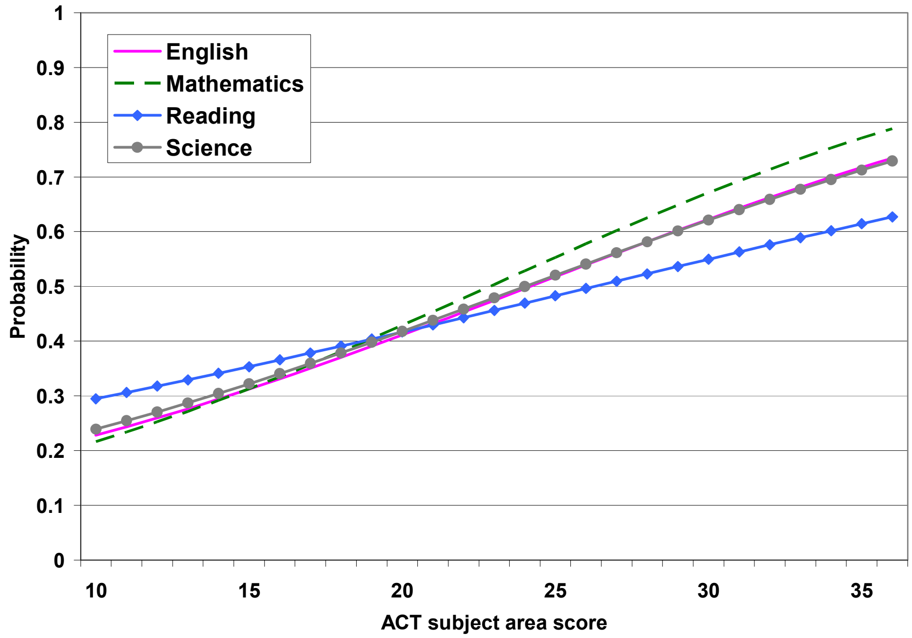

Figure 4. Probability of completing a bachelor's degree by year 6 as a function of ACT subject area score.[10]

The logistic curve associated with the ACT Mathematics score was steeper than those associated with the other subject area tests (that is, there were greater differences in the probabilities of completing a bachelor's degree by year 6 between students with higher and lower scores in mathematics than in the other subject areas). Across the outcomes, the typical probabilities of success at the ACT Mathematics (22) and Science (24) Benchmark scores were higher than those at the ACT English (18) and Reading (21) Benchmark scores. This finding is further illustrated in the next section where the typical probabilities of success (across institutions) at the Benchmark scores are provided.

Success rates for ACT College Readiness Benchmarks. Estimated SRs and ΔSRs associated with ACT Benchmark scores across all institutions with available outcome data were

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[10] The probabilities in Figure 4 are based on fixed effects parameter estimates from the hierarchical logistic models.

calculated. For these analyses, cumulative GPA was evaluated for only two criterion levels: 3.00 or higher and 3.50 or higher.

Degree completion. For four-year institutions, median probabilities of completing a bachelor's degree by year 6 ranged from 0.35 to 0.47 across the Benchmarks (Table 9). For two-year institutions, median probabilities of success ranged from 0.12 to 0.23 across the Benchmarks for predicting associate's degree completion, and ranged from 0.21 to 0.36 for predicting associate's degree completion or transfer to an in-state four-year institution by year 3.

Table 9

Median Results for Predicting Degree Completion by ACT College Readiness Benchmarks

Subject area	Probability of success at Benchmark	Success rate (SR)	Increase in success rate (ΔSR)
Bachelor's degree completion by year 6 (*n* = 61 four-year institutions)			
English	0.35	46	5
Mathematics	0.46	53	13
Reading	0.39	47	5
Science	0.47	52	11
Associate's degree completion by year 3 (*n* = 43 two-year institutions)			
English	0.12	18	4
Mathematics	0.22	28	14
Reading	0.15	19	5
Science	0.23	26	12
Associate's degree completion or transfer to four-year institution by year 3 (*n* = 40 two-year institutions)			
English	0.21	29	6
Mathematics	0.36	42	19
Reading	0.25	30	7
Science	0.35	38	16

Note. For the typical percentages of students at or above the ACT Benchmark scores, see Table 8.

The probabilities of degree completion for each Benchmark varied substantially across institutions (Appendix C, Tables C-1 and C-2). For example, the estimated probability of completing a bachelor's degree by year 6 at the ACT Mathematics Benchmark score ranged from 0.23 to 0.79 across institutions, further illustrating the high variability in institutional degree completion rates and admission requirements across institutions.

For both two- and four-year institutions, typical SRs associated with the ACT Benchmark scores were higher than baseline SRs as evidenced by the positive ΔSRs (ranging from 4 to 19 percentage points). Median SRs and ΔSRs associated with the ACT Mathematics and Science Benchmarks were higher than those associated with the ACT English and Reading Benchmarks (by as little as 5 percentage points to as much as 13 percentage points; larger differences were seen for two-year institutions). To help provide context for these SRs, median SRs for the Mathematics Benchmark score were only slightly lower than those corresponding to ACTC or HSGPA values that maximized prediction accuracy for bachelor's degree completion by year 6 for four-year institutions (within 4 to 5 percentage points; see Tables 5 and 9). A similar result was not seen for the two degree completion outcomes at two-year institutions: the typical SRs associated with the Mathematics Benchmark were considerably lower than those corresponding to ACTC scores that maximized prediction accuracy (by at least 13 percentage points).[11] This latter finding is a result of the institution-specific associate's degree completion rates being relatively low (ranged from 4% to 34% when transfers were not included and from 7% to 41% when transfers were included).

[11] The SRs corresponding to Benchmark scores were based on all 61 four-year institutions and 40 two-year institutions, while SRs based on institution-specific ACTC selection scores (those associated with the maxAR) were based on 58 four-year institutions and 25 or 38 two-year institutions with viable ACTC models. For ACTC score we also evaluated SRs across all institutions at specific scores. But, the conclusions were similar to those already noted for results based on the institution-specific selection scores.

Progress to degree over time. The typical probabilities of success and SRs associated with using the ACT Benchmarks to predict progress towards a degree decreased over time (Tables C-1 for four-year institutions and C-2 for two-year institutions). For example, for four-year institutions, the typical chances of completing 24 or more credit hours by the end of year 1 for students with an ACT Mathematics score of 22 was 73%. For students with the same ACT Mathematics score, the typical chances of completing 96 or more credit hours by the end of year 4 decreased to 51%. And, the corresponding median SRs decreased from 82% to 57% from year 1 to year 4. These findings agree with an earlier result where the median ACTC score and HSGPA values associated with the maxAR for predicting progress to degree increased over time (see Tables B-1 and B-2).

Across time points and types of institutions, the highest median SRs and ΔSRs for the progress to degree outcomes were generally associated with the ACT Mathematics Benchmark, but typical ΔSRs were positive for all of the Benchmarks demonstrating the incremental value of these indicators over baseline SRs. The median SRs for the ACT Mathematics and Science Benchmarks were higher than those corresponding to the institution-specific ACTC selection values for the first two years, and were comparable for later years (compare Table B-1 to Table C-1 and Table B-2 to Table C-2). Typical ΔSRs associated with the ACT Mathematics and Science Benchmark scores for predicting the progress to degree outcomes ranged from 12 to 16 percentage points at four-year institutions and from 19 to 27 percentage points at two-year institutions. The median SRs for the ACT English and Reading Benchmarks were comparable to those associated with the institution-specific ACTC selection values for earlier years, but were slightly lower for later years.

Year 6 cumulative GPA at four-year institutions. The typical probabilities of achieving a year 6 college GPA of 3.00 or higher ranged from 0.46 to 0.72 across the Benchmarks (Table 10). The corresponding probabilities for the 3.50 criterion ranged from 0.13 to 0.34. Probabilities of success varied substantially across institutions (Table C-3).

Table 10

Median Results for Predicting Levels of Year 6/Year 3 College Cumulative GPAs using ACT College Readiness Benchmarks, by Institution Type

	Four-year institutions			Two-year institutions		
ACT Benchmark	Probability of success at Benchmark	Success rate (SR)	Increase in success rate (ΔSR)	Probability of success at Benchmark	Success rate (SR)	Increase in success rate (ΔSR)
3.00 or higher college GPA						
English	0.46	65	10	0.42	55	13
Mathematics	0.66	76	19	0.63	70	26
Reading	0.59	69	12	0.50	60	16
Science	0.72	77	19	0.63	68	24
3.50 or higher college GPA						
English	0.13	29	7	0.14	25	8
Mathematics	0.28	40	18	0.30	39	23
Reading	0.22	34	10	0.21	29	12
Science	0.34	43	19	0.34	41	23

Note. ACT Benchmarks are 18 for English, 22 for Mathematics, 21 for Reading, and 24 for Science. Cumulative GPA was evaluated at year 6 for four-year institutions and at year 3 for two-year institutions. Students' cumulative GPAs at degree completion were included in GPA analyses for students at four-year institutions who graduated with a bachelor's degree before the end of year 6 or students at two-year institutions who graduated with an associate's degree before the end of year 3.

Median SRs were substantially higher and ΔSRs were slightly higher for the 3.00 or higher criterion than for the 3.50 or higher criterion. Typical probabilities of success, SRs, and ΔSRs associated with the ACT Mathematics and Science Benchmark scores were higher than those associated with the ACT English and Reading Benchmark scores at both GPA criterion levels. Median SRs for the Mathematics and Science Benchmarks were also slightly higher than those associated with the institution-specific ACTC and HSGPA selection values that maximized prediction accuracy for the 3.00 or higher criterion, but were substantial lower for the 3.50 or higher criterion (see Tables 6 and 10). The latter finding is due to the typical ACTC selection value being considerably higher than the ACT Benchmark scores (by at least 3 scale score points). Moreover, a relatively small percentage of students achieved a 3.50 or higher year 6 cumulative GPA (median across four-year institutions was 27%).

Year 3 cumulative GPA at two-year institutions. Findings noted for year 6 cumulative GPA at four-year institutions generally held true for year 3 cumulative GPA at two-year institutions. Typical probabilities of success associated with the ACT Benchmarks were lower for two-year institutions than for four-year institutions for the 3.00 or higher criterion, but were somewhat more comparable for the 3.50 or higher criterion (Table 10). Similar to those noted for four-year institutions, probabilities of success and SRs varied across the institutions (Table C-4). Median SRs were lower for two-year institutions than for four-year institutions, but the opposite was true for ΔSRs. Differences in typical SRs and ΔSRs between the two types of institutions were larger for the 3.00 or higher criterion than for the 3.50 or higher criterion.

Path Analysis

In this section we investigate the effects of ACTC score, HSGPA, and first-year college GPA jointly for predicting subsequent college outcomes. The indirect effects of ACTC scores and HSGPA on college outcomes mediated through first-year college GPA, as well as their direct effects on college outcomes, are estimated (see Figure 1). Only enrolled students with college GPAs at the end of the first year were included in the analyses (83% and 62% of the samples for four- and two-year institutions, respectively).

Degree completion at four-year institutions. The path model for bachelor's degree completion by year 6 for four-year institutions is shown in Figure 5.

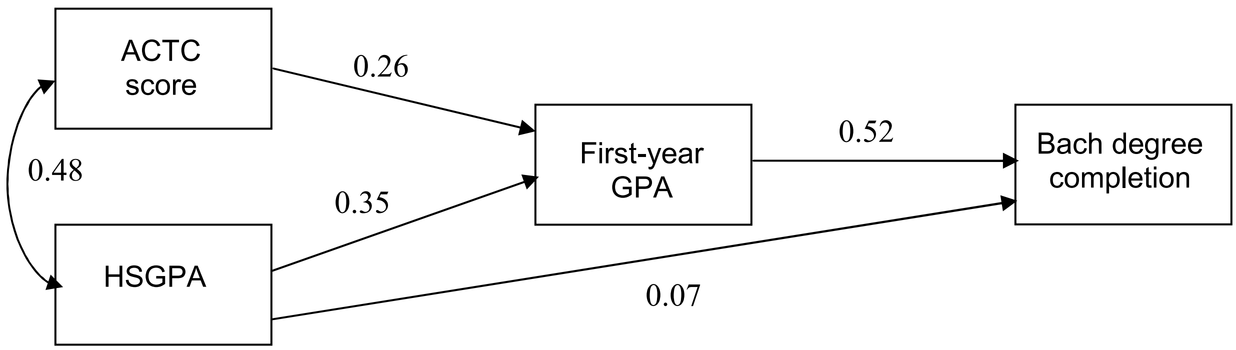

Figure 5. Path model for bachelor's degree completion by year 6 at four-year institutions. ACTC = ACT Composite; HSGPA = high school grade point average; GPA = grade point average; Bach = Bachelor's.

ACTC score was found to be only indirectly related to bachelor's degree completion; the direct path was not statistically significant at the 0.01 level. The direct effect of first-year GPA on bachelor's degree completion was over 7 times that for HSGPA. The paths from ACTC score and HSGPA on first-year GPA were both significant. The total effect of HSGPA on degree completion (direct and indirect) was slightly greater than that for ACTC score (0.31 vs. 0.26). The total effect on bachelor's degree completion for each of the pre-enrollment measures was lower than the direct/total effect of first-year GPA (Table D-1 from Appendix D).

Degree completion at two-year institutions. The path model for associate's degree completion by year 3 at two-year institutions is shown in Figure 6, and the path model for associate's degree completion or transfer to four-year institution by year 3 is shown in Figure 7.

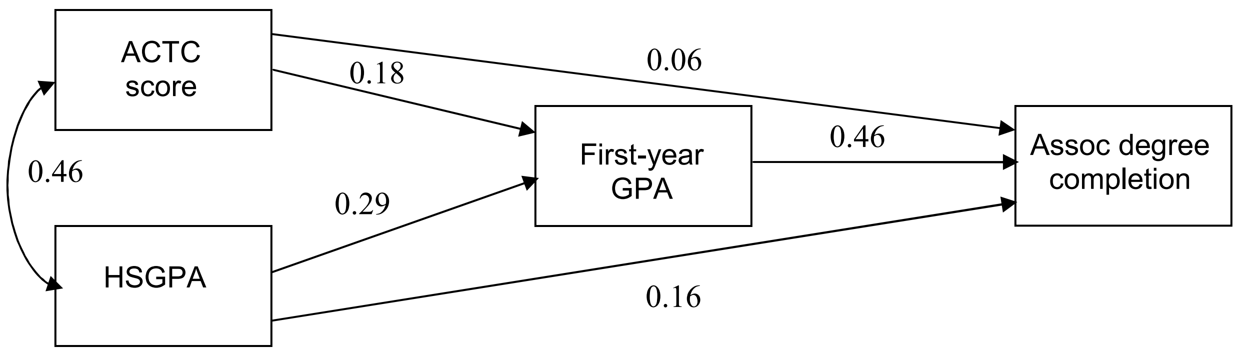

Figure 6. Path model for associate's degree completion by year 3 at two-year institutions. ACTC = ACT Composite; HSGPA = high school grade point average; GPA = grade point average; Assoc = Associate's.

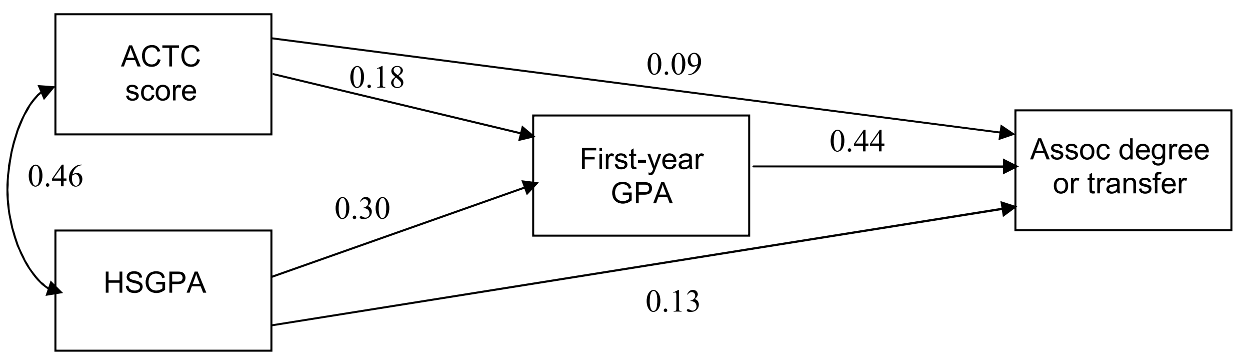

Figure 7. Path model for associate's degree completion or transfer to an in-state four-year institution by year 3 at two-year institutions. ACTC = ACT Composite; HSGPA = high school grade point average; GPA = grade point average; Assoc = Associate's.

The direct effect of first-year GPA on each outcome was greater than the direct effects of ACTC score or HSGPA. The total effect of HSGPA on degree completion was greater than that of ACTC score (0.27 vs. 0.36 when not including transfers and 0.29 vs. 0.34 when including transfers; Table D-2 from Appendix D). They were each smaller than the direct/total effect of first-year GPA on these two outcomes.

Progress to degree. For four-year institutions, similar to that seen for degree completion, ACTC score was only indirectly related to the progress to degree outcomes. The significant direct effects of HSGPA on these outcomes were relatively small in comparison to those for first-year GPA (0.07 vs. 0.58 to 0.62; see Table D-1 in Appendix D). For two-year institutions, the direct effects of ACTC score and HSGPA on the progress to degree outcomes were comparable and relatively small in comparison to those of first-year GPA on these outcomes (see Table D-2 in Appendix D). Across these outcomes over time, the total effects of each of the pre-enrollment measures (direct and indirect) were smaller than the direct/total effects of first-year GPA on the progress to degree outcomes.

Year 6 cumulative GPA at four-year institutions. The direct effects of ACTC score and HSGPA on year 6 cumulative GPA were somewhat comparable, but were substantially smaller than the direct effect of first-year GPA on the outcome (Figure 8).

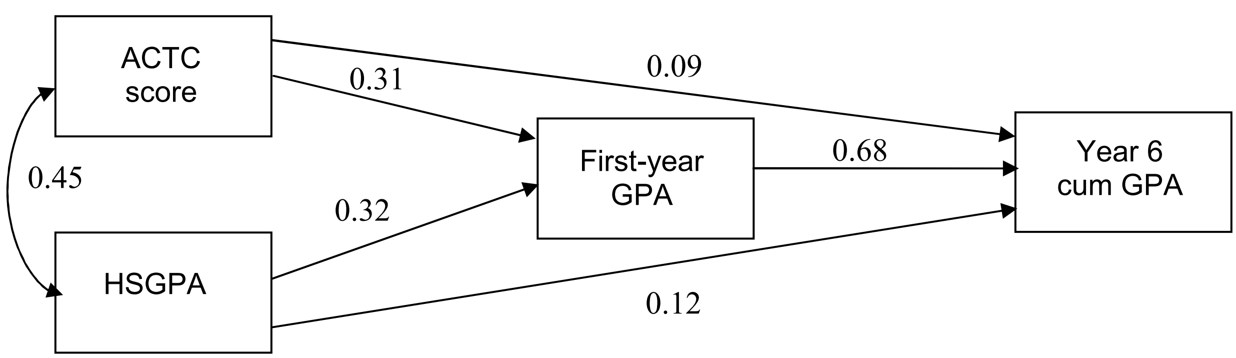

Figure 8. Path model for year 6 cumulative GPA at four-year institutions. Analyses included only those students who either graduated prior to year 6 or were still enrolled at the end of year 6. ACTC = ACT Composite; HSGPA = high school grade point average; GPA = grade point average; cum = cumulative.

For students who either graduated prior to year 6 or were still enrolled at year 6, the direct effects on first-year GPA, as well as the total effects on year 6 cumulative GPA, were comparable for ACTC score and HSGPA (Table D-1 in Appendix D). The total effects for both pre-enrollment measures were smaller than the direct/total effect of first-year GPA on this outcome.

Year 3 cumulative GPA at two-year institutions. Path model results for year 3 cumulative GPA at two-year institutions were similar to those for year 6 cumulative GPA at four-year institutions (Figure 9). The one exception was that the direct effect of HSGPA on first-year GPA was greater than the direct effect of ACTC score on the same outcome.

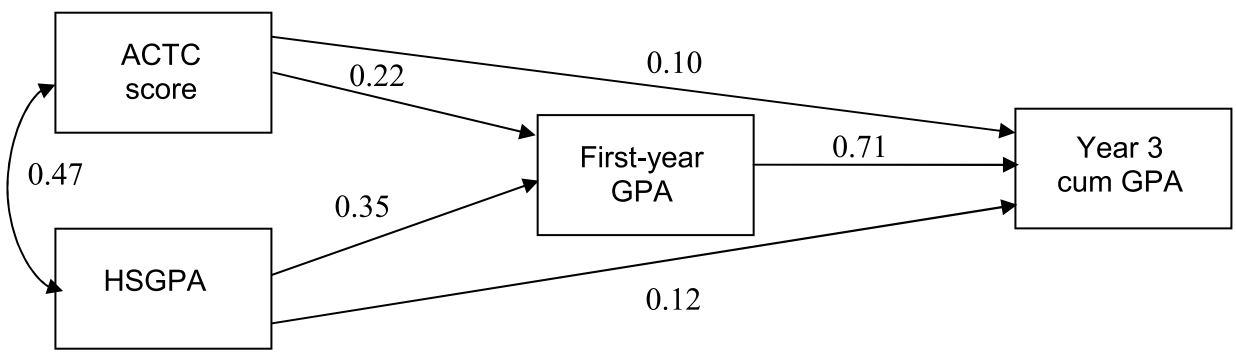

Figure 9. Path model for year 3 cumulative GPA at two-year institutions. Analyses included only those students who either graduated prior to year 3 or were still enrolled at the end of year 3. ACTC = ACT Composite; HSGPA = high school grade point average; GPA = grade point average; cum = cumulative.

Discussion

Long-term student success is clearly an important goal for all postsecondary institutions. And, in light of the increased pressure to improve degree completion rates, institutions may be more likely to admit students who have a reasonable chance of progressing towards and completing a degree. Four-year institutions often use multiple measures in making admission decisions. And, even though most two-year institutions have open admission policies, they often look at students' high school records and require students to take course placement exams to help determine which courses they will need to take. Most students also use test scores and HSGPA to help them identify institutions to which they want to apply for admissions (Sawyer, 2010).

In this study, for both four- and two-year institutions, we evaluated the utility of ACT scores and HSGPAs for identifying among possible applicants those who are likely to be successful in college beyond the first year. For each outcome, estimated decision-based statistics associated with ACTC score and HSGPA used alone and jointly were compared at values that maximized the percentage of correct classifications. The ACTC and HSGPA selection values (that maximized prediction accuracy) identified in this study were used for comparative purposes only. In general, institutions rarely use strict selection cutoffs in making their admission decisions.

Some researchers have suggested that standardized tests like the ACT are not useful and not predictive of long-term college success (Soares, 2012). However, results from this study refute that notion. For example, typical maximum accuracy rates for the progress to degree outcomes over time through degree completion were moderately high (64% to 71% at four-year institutions and 65% to 77% at two-year institutions). In general, typical maximum accuracy and corresponding success rates were slightly higher for HSGPA than for ACTC score at four-year institutions, but were comparable at two-year institutions. However, across college outcomes at both types of institutions, using both ACTC score and HSGPA was generally more beneficial for improving prediction accuracy and success rates over those based on single-predictor models, providing evidence of the incremental benefit of using both measures for predicting college success beyond the first year. Our estimate of the typical maximum accuracy rate based on the joint model for predicting six-year bachelor’s degree completion (67%) is in line with results from another study (Schmitt, Keeney, Oswald, Pleskac, Billington, Sinha, & Zorzie, 2009) that found that four-year bachelor's degree completion was successfully predicted by SAT/ACT scores and HSGPA jointly for 63% of students.

Results based on the ACTC and HSGPA joint model also suggest that the effect of HSGPA on long-term college success depends on the student's ACTC score. For example, for students with a HSGPA of 4.0, the typical chances of completing a bachelor's degree by year 6 from the same initial four-year institution were a little over 60% (Figure A-2). But, these chances were greater for students with higher ACTC scores and smaller for those with lower ACTC scores (ranging from 40% to 80%; Figure 2). The ACTC score differential was also found to be larger for students with higher HSGPAs. Two other independent studies (ACT, 2012) based on observed degree completion rates also found this to be the case. Allowing higher ACTC scores to compensate for lower HSGPAs and vice versa contributes to the increase in the percentage of correct classifications based on the joint model.

Another important finding from the first part of this study was the apparent inability of HSGPA to predict higher levels of later college GPA (at year 6 for four-year institutions and at year 3 for two-year institutions). For example, across four-year institutions, the typical chances of achieving higher levels of year 6 cumulative GPA associated with a HSGPA of 4.00 was less than 50% (for criterion level of 3.75; Figure A-8). On the other hand, the typical chances of achieving a year 6 cumulative GPA of 3.75 or higher were relatively high for students with higher ACTC scores (Figure A-7). Sawyer (2010) found a similar result for first-year college GPA. Moreover, the typical ACTC and HSGPA values that maximized prediction accuracy for achieving different levels of year 6 cumulative GPA were similar to those reported in Noble and Sawyer (2002) for predicting first-year college GPA levels. However, the typical maximum accuracy rates found in this study were slightly lower than those found for first-year college

GPA. As one would expect, this finding suggests that these two pre-enrollment measures are more strongly related to more proximal college outcomes than to the more distal ones.

The findings from the path models examined in this study highlight the importance of students being ready for college and performing well academically during their first year to improve their chances of progressing towards and completing a degree. Both ACTC score and HSGPA were primarily indirectly related to subsequent college outcomes (through first-year college GPA), but both contributed unique information towards predicting first-year academic performance. Across the outcomes, the total effect of each of the pre-enrollment measures (direct and indirect) was smaller than the direct/total effect of first-year GPA. One limitation of these analyses was that students who dropped out prior to the end of the first year were not included.

Another recent study (Allen & Robbins, 2010) also examined path models for predicting timely degree attainment (by year 4 for bachelor's degrees and by year 2 for associate's degrees). The study also found that first-year academic performance had the largest effect on degree completion. It also found that ACTC score and HSGPA were more predictive of first-year academic performance than other noncognitive and sociodemographic characteristics. Compared to our study, differences in their standardized path coefficients for predicting first-year academic performance between HSGPA and ACTC score were substantially smaller for four-year institutions, but they were considerably larger for two-year institutions. They adjusted for measurement error in their analyses; we did not account for range restriction or measurement error in our analyses.

Results from the path analysis also suggest that while ACTC score and HSGPA are correlated, there are differences in what they measure. ACT scores are reported on a score scale that maintains the same meaning across years and across high schools and are therefore not affected by differential grading standards as is the case for HSGPA (Woodruff & Ziomek, 2004). ACT scores reflect level of educational achievement at a moment in time, often at the end of a student's junior year or beginning of the senior year in high school. HSGPA, on the other hand, reflects performance in courses over the duration of high school, and is not only affected by level of content mastery, but is also affected by a student's personal behaviors, such as whether the student is prudent about taking good notes, putting forth effort and participating in class, completing homework assignments, and preparing well for course exams.

From part 2 of this study, we found that the ACT College Readiness Benchmarks are also useful for predicting long-term college success through degree completion for applicant pools, providing further validity evidence for using the Benchmarks as an empirical definition of college readiness. Typical success rates for predicting college outcomes beyond the first year were generally higher for the ACT Mathematics and Science Benchmarks than for the ACT English and Reading Benchmarks. In addition, typical success rates for the ACT Mathematics Benchmark were generally comparable to those based on ACTC scores that maximized prediction accuracy. The exceptions to this finding were for outcomes with relatively low success rates consistently seen across all institutions (e.g., associate's degree completion by year 3, year 6/year 3 cumulative GPA of 3.50 or higher).

The finding associated with the ACT Mathematics Benchmark is supported by the results from another study: Adelman (2006) found that the highest level of high school mathematics coursework is an important factor associated with bachelor's degree completion. A policy brief by Achieve (2008) suggests that the reason high school mathematics preparation is so important for college success is related to the higher-order thinking and critical reasoning skills that students learn beginning in Algebra I and continue to build upon in subsequent higher-level mathematics courses. Students who develop these skills are better equipped for their future career pathways, whichever path they may choose to follow.

The typical estimated success rates associated with the Benchmark scores and with the ACTC or HSGPA values that maximized prediction accuracy were only slightly lower for applicants at two-year institutions than for those at four-year institutions. This result was seen for the progress to degree outcomes based on cumulative hours earned over time, as well as the year 6/year 3 cumulative GPA outcomes.[12] These findings indicate that in order for all students to have a reasonable chance of progressing towards and completing a degree at either type of institution, they need to graduate from high school with a core set of academic skills that help put them on a more direct path towards long-term college success.

Unfortunately, too many high school graduates are underprepared for college-level coursework and need to take remedial coursework. For example, only 66% of the 1.6 million ACT-tested 2011 high school graduates met the ACT English Benchmark (ACT, 2011). The corresponding percentages were 45%, 52%, and 30% in mathematics, reading, and science, respectively. But, degree completion is often delayed for students taking remedial courses (Adelman, 2004). States, districts, and high schools are increasingly implementing policies to help address this need to prepare all students for college and career. For example, 45 states and the District of Columbia have formally adopted the Common Core State Standards (National Governors Association Center for Best Practices & Council of Chief State School Officers, 2012) in an effort to help improve the college and career readiness of their high school graduates.

The typical ACTC or HSGPA values that maximized prediction accuracy (that is, the values associated with at least a 50% chance of being successful) were relatively high for degree

[12] For these outcomes, the ACTC and HSGPA values that maximized prediction accuracy were similar between two- and four-year institutions so these comparisons are appropriate and meaningful. In addition, the corresponding typical maximum accuracy rates were comparable between the two types of institutions for these outcomes.

completion from the same initial institution, especially for two-year institutions.[13] Using these high selection values would result in a substantial percentage of applicants being rejected for admissions. However, in another study where students were followed *across* institutions, we (Radunzel & Noble, 2012) found that among students with ACTC scores or HSGPAs below the selection values identified in this study, a significant percentage of these students completed a degree by year 6. For example, 65% of students who initially enrolled in four-year institutions and had an ACTC score of 22 to 24 completed a bachelor's degree within six years of enrolling in college. It is interesting to note that for the institutions included in this study, the ACTC and HSGPA values that maximized prediction accuracy varied substantially across institutions, and were related to an institution's degree completion rate (lower selection scores were generally seen for institutions with higher degree completion rates). In part, the typical selection values are so high because six-year degree completion rates from the same initial institution are generally low: it is common for students to transfer to another institution (Hossler, Shapiro, Dundar, Ziskin, Chen, Zerquera, & Torres, 2012). It is also common for students from two-year institutions to take longer than three years to complete a degree (Green & Radwin, 2012).

In this study, we were limited to evaluating degree completion from the initial institution. But institutions are primarily interested in identifying applicants who are most likely to graduate from their institution. For two-year institutions, we also accounted for those students who transferred to an in-state four-year institution. Besides degree completion, we also considered progress to degree outcomes over time that were based on cumulative credit-bearing hours earned. These outcomes might be useful indicators of success for two-year institutions,

[13] These selection values are similar to those one might expect to see as criteria for admission at highly selective four-year institutions or for merit-based scholarships.

especially as they move towards establishing intermediate markers that help track students' progress along the pathway to degree completion (Moore et al., 2009).

Most institutions admit 50% to 85% of their applicants (Clinedinst et al., 2011). Institutions are able to compensate for lower admissions standards with effective support programs and interventions (Lotkowski, Robbins, & Noeth, 2004; Tinto, 2002). For example, ACT scores and HSGPA, along with measures of psychosocial factors can help campuses identify students who are most in need of academic support programs (Robbins et al., 2006). Moreover, using multiple measures, including augmenting pre-enrollment measures with information collected early in college (such as mid-term grades during a student's first term) to predict later college success enables colleges to identify and intervene with high-risk students in appropriate ways.

In this study, we could only approximate applicant pools for the institutions using data for all students who sent their ACT scores to these institutions over the study time period. In addition, the approach of evaluating one or two pre-enrollment measures at a time is a simplification of the admissions process. However, the methods used can be extended to include additional measures. Another limitation of the study was that the study sample is not a nationally representative sample. In spite of this limitation, this study was based on a large number of institutions and a large number of students. Another strength of the study was that we included results for ACT-tested students from both two- and four-year institutions. And, although the ACT is generally not required for admission to two-year institutions, in states that administer the ACT statewide, most if not all public high school graduates will have ACT scores available for use by institutions. Future research might consider examining these same research questions for

COMPASS®-tested students at two-year institutions.[14] Future research might also examine the effects of using ACTC score and HSGPA for predicting long-term college success across student demographic groups to ensure equity in the admissions process.

In conclusion, findings from this study suggest that if institutions wish to admit students with the highest likelihood of success, both ACTC score and HSGPA should be considered, as both measures are related to college success during the first year and in subsequent years through degree completion. The ACT Benchmarks are also effective at identifying students who are ready for college and likely to succeed beyond the first year of college. For four-year institutions wanting to incorporate a student's likelihood of long-term college success into their admission decisions, the results from this study suggest that HSGPA should carry

- slightly greater weight than ACTC score for evaluating a student's likelihood of progressing towards or completing a bachelor's degree within six years of initially enrolling (irrespective of students' final cumulative GPAs)[15], and
- approximately the same weight as ACTC score for predicting a student's likelihood of achieving moderate levels of year 6 cumulative GPA, and slightly less weight for predicting a student's likelihood of achieving higher levels of year 6 cumulative GPA.

For two-year institutions, HSGPA should carry approximately the same weight as ACTC score for predicting the progress to degree outcomes considered in this study, as well as moderate levels of year 3 cumulative GPA. For evaluating degree completion and higher levels of year 3 cumulative GPA, HSGPA should carry less weight than ACTC score.

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[14] COMPASS also has College Readiness Benchmarks (ACT, 2010a).

[15] This recommendation does not take into account students' cumulative GPAs; it addresses only whether students will graduate in six years (some students may graduate with lower cumulative GPAs). Findings from this study support the notion that ACTC score should carry the same or slightly greater weight than HSGPA for predicting final cumulative GPA.

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Appendix A

Figures A-1 to A-10

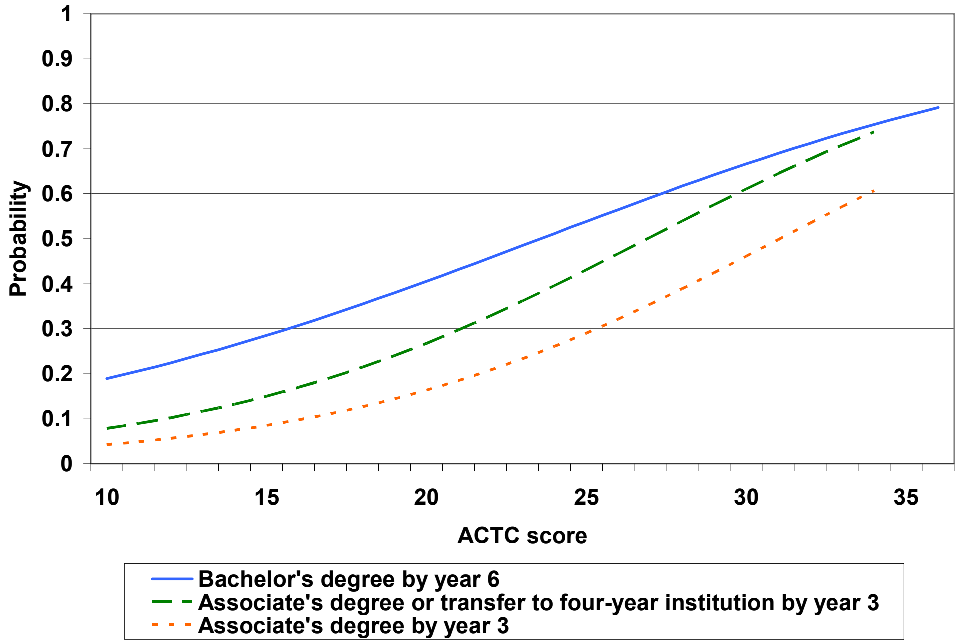

Figure A-1. Estimated probabilities of degree completion based on ACTC score. ACTC = ACT Composite.

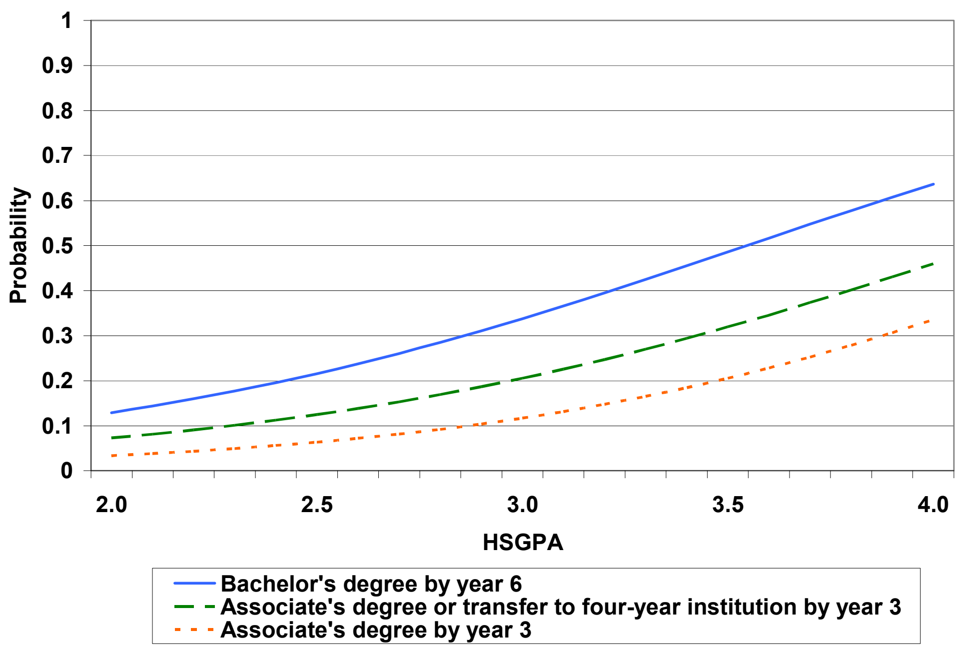

Figure A-2. Estimated probabilities of degree completion based on HSGPA. HSGPA = high school grade point average.

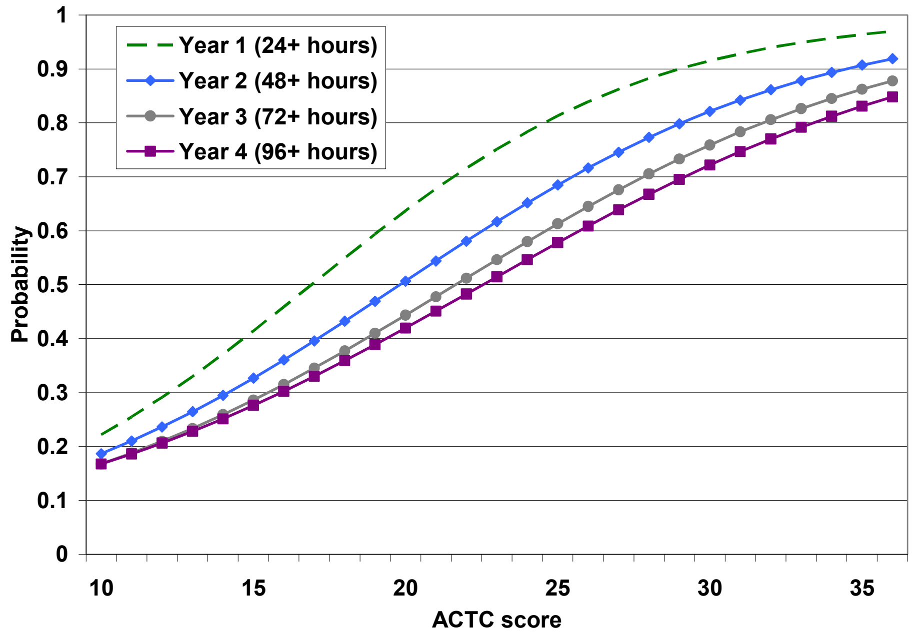

Figure A-3. Estimated probabilities of progressing towards a degree based on ACTC score for four-year institutions. ACTC = ACT Composite.

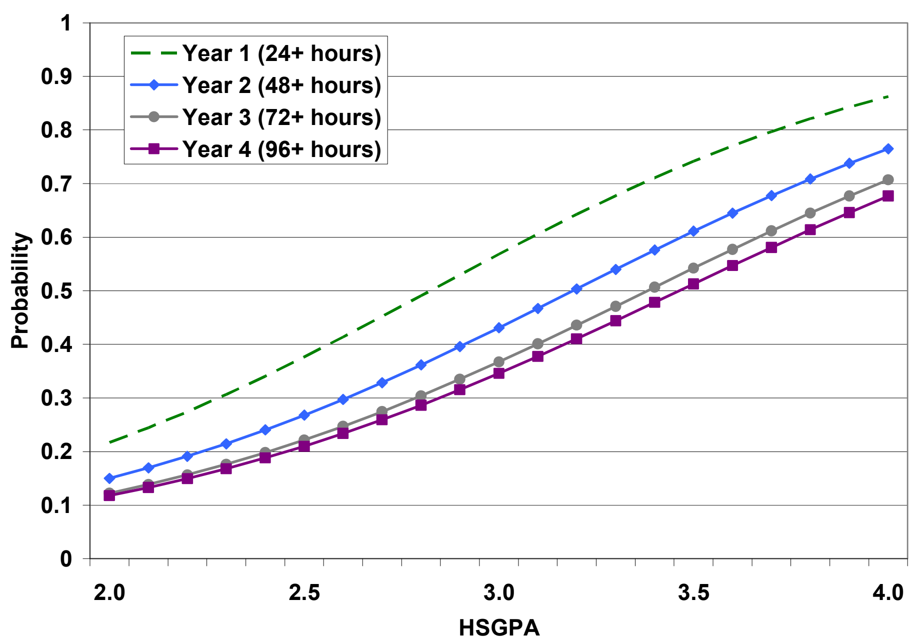

Figure A-4. Estimated probabilities of progressing towards a degree based on HSGPA for four-year institutions. HSGPA = high school grade point average.

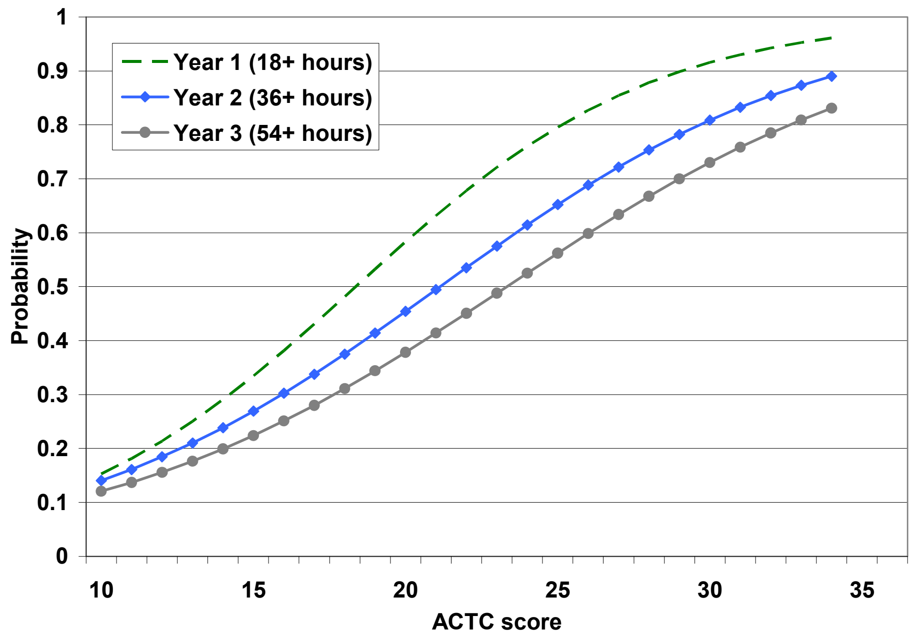

Figure A-5. Estimated probabilities of progressing towards a degree based on ACTC score for two-year institutions. ACTC = ACT Composite.

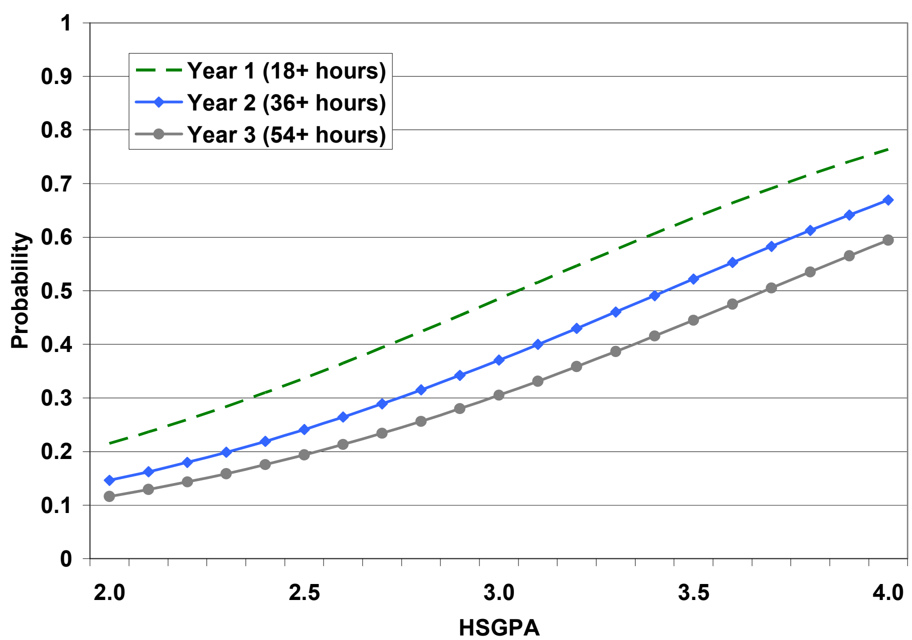

Figure A-6. Estimated probabilities of progressing towards a degree based on HSGPA for two-year institutions. HSGPA = high school grade point average.

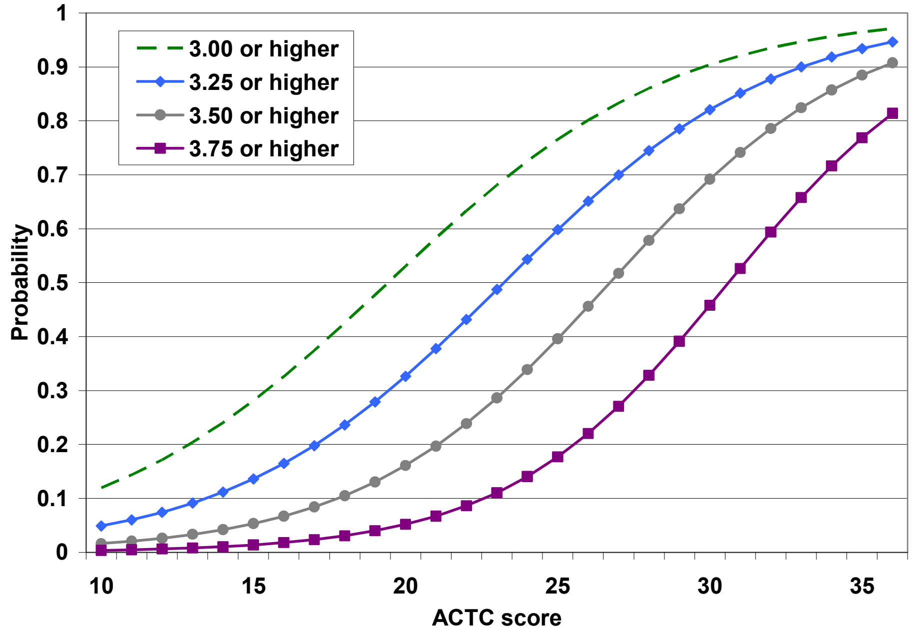

Figure A-7. Estimated probabilities of achieving specific year 6 cumulative GPAs based on ACTC score for four-year institutions. ACTC = ACT Composite.

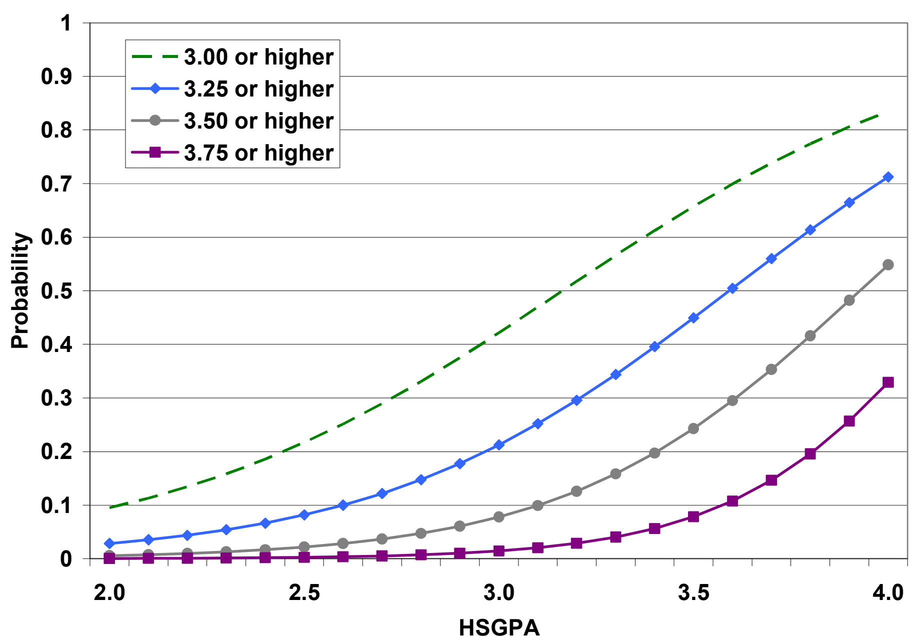

Figure A-8. Estimated probabilities of achieving specific year 6 cumulative GPAs based on HSGPA for four-year institutions. HSGPA = high school grade point average.

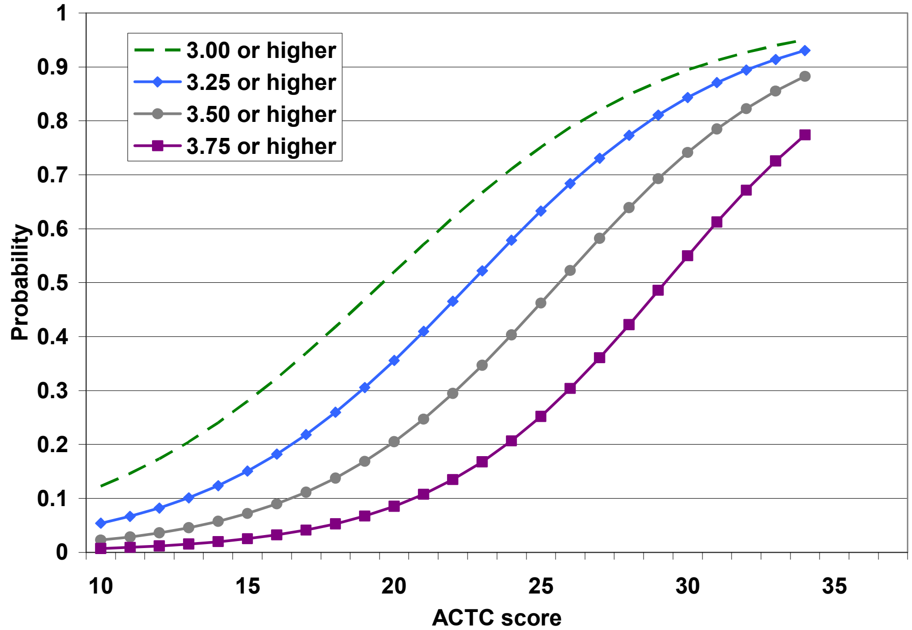

Figure A-9. Estimated probabilities of achieving specific year 3 cumulative GPAs based on ACTC score for two-year institutions. ACTC = ACT Composite.

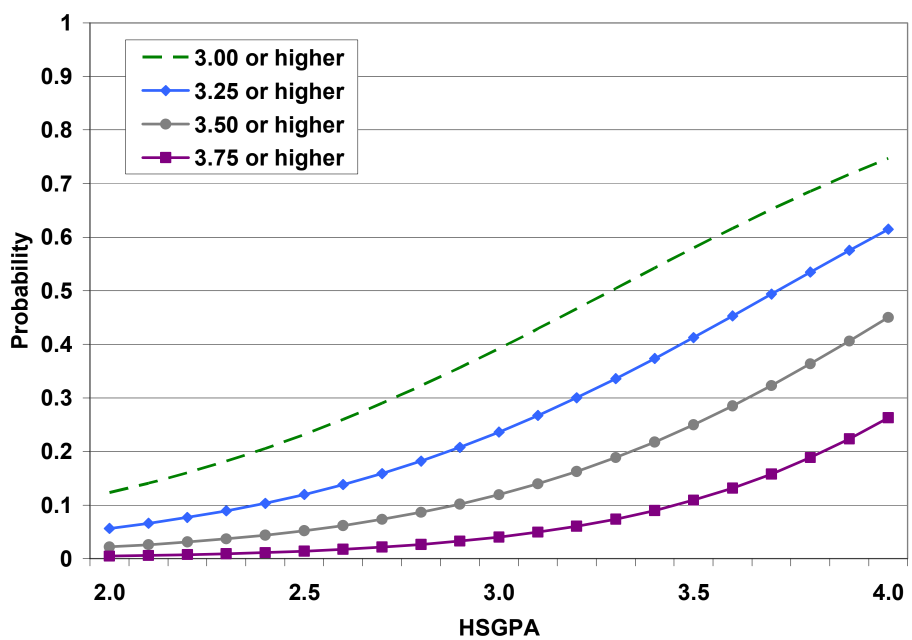

Figure A-10. Estimated probabilities of achieving specific year 3 cumulative GPAs based on HSGPA for two-year institutions. HSGPA = high school grade point average.

Appendix B

Tables B-1 to B-4

Appendix B

Table B-1

Results for Bachelor's Degree Completion and Progress to Degree at Four-Year Institutions based on ACTC Score and HSGPA Models

Predictor variable	Number of institutions with viable models	Selection value (SV)		Maximum accuracy rate (maxAR)		Increase in AR (ΔAR)		Success rate (SR)		Observed percentage below SV	
		Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max
Bachelor's degree completion by year 6											
ACTC	58	25	9/31	64	55/84	24	0/67	57	52/73	84	0/100
HSGPA	56	3.57	2.20/4.00	65	58/79	23	0/57	58	50/77	67	3/96
ACTC & HSGPA[a]	61			67	58/84	26	0/67	60	53/76	71	1/98
Progress to degree year 1											
ACTC	44	18	10/23	71	62/84	4	0/58	70	61/84	22	0/89
HSGPA	48	2.80	1.39/3.72	73	66/86	6	0/51	73	58/86	25	0/89
ACTC & HSGPA[a]	48			74	66/83	6	0/59	74	67/83	28	0/87
Progress to degree year 2											
ACTC	49	20	10/26	65	58/84	12	0/66	63	58/77	52	0/94
HSGPA	50	3.13	2.07/3.91	69	61/81	14	0/61	66	54/79	45	1/95
ACTC & HSGPA[a]	50			69	61/84	15	0/67	67	62/75	50	2/93
Progress to degree year 3											
ACTC	50	22	9/28	65	55/84	19	0/68	60	55/76	66	0/97
HSGPA	50	3.39	2.38/3.97	67	60/82	21	0/64	62	51/76	57	2/97
ACTC & HSGPA[a]	50			68	59/85	22	0/68	64	59/74	62	2/95

Table B-1 (cont.)

Predictor variable	Number of institutions with viable models	Selection value (SV)		Maximum accuracy rate (maxAR)		Increase in AR (ΔAR)		Success rate (SR)		Observed percentage below SV	
		Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max
Progress to degree year 4											
ACTC	48	24	10/29	64	55/83	23	0/65	59	53/72	71	0/98
HSGPA	49	3.46	2.46/4.00	67	59/81	23	1/61	60	50/75	60	4/97
ACTC & HSGPA[a]	50			68	58/83	25	0/65	62	57/74	65	2/96

Note. The selection value is the predictor value associated with the maxAR. There were 61 and 50 institutions with available data for bachelor's degree completion and progress to degree analyses, respectively. Med = Median; Min = Minimum; Max = Maximum; ACTC = ACT Composite; HSGPA = high school grade point average.

[a]Multiple combinations of ACTC score and HSGPA corresponded to a probability of 0.50 for the joint model.

Table B-2

Results for Associate's Degree Completion and Progress to Degree at Two-Year Institutions based on ACTC Score and HSGPA Models

Predictor variable	Number of institutions with viable models	Selection value (SV)		Maximum accuracy rate (maxAR)		Increase in AR (ΔAR)		Success rate (SR)		Observed percentage below SV	
		Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max
Associate's degree completion by year 3											
ACTC	25	29	24/33	81	66/93	63	32/86	55	51/62	99	92/100
HSGPA	5	3.92	3.82/3.98	72	69/74	43	36/48	52	51/54	90	83/94
ACTC & HSGPA[a]	25			82	66/93	64	31/86	53	50/56	99	82/100
Associate's degree completion or transfer to four-year institution by year 3											
ACTC	38	27	21/33	77	63/88	54	22/77	55	50/60	98	76/100
HSGPA	14	3.75	3.43/3.96	69	63/75	37	24/51	54	51/60	86	63/97
ACTC & HSGPA[a]	38			77	63/88	54	25/77	55	51/62	96	65/100
Progress to degree year 1											
ACTC	41	19	11/31	66	57/80	17	0/59	65	52/73	52	0/99
HSGPA	41	3.03	1.66/3.68	65	62/77	15	0/47	64	56/77	50	1/90
ACTC & HSGPA[a]	42			68	62/79	18	0/58	67	52/77	51	1/100
Progress to degree year 2											
ACTC	41	21	15/27	65	59/79	25	1/57	60	54/65	75	16/96
HSGPA	41	3.38	2.44/3.89	66	60/78	26	2/56	59	53/67	72	19/97
ACTC & HSGPA[a]	41			67	61/80	28	3/58	62	55/68	71	22/93

Table B-2 (cont.)

Predictor variable	Number of institutions with viable models	Selection value (SV)		Maximum accuracy rate (maxAR)		Increase in AR (ΔAR)		Success rate (SR)		Observed percentage below SV	
		Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max
Progress to degree year 3											
ACTC	41	23	17/30	67	58/82	34	5/64	57	53/61	88	37/99
HSGPA	36	3.62	2.85/3.96	68	58/77	33	6/54	56	51/65	83	40/98
ACTC & HSGPA[a]	41			69	59/83	35	7/65	58	54/66	81	42/98

Note. The selection value is the predictor value associated with the maxAR. There were 43 and 42 institutions with available data for associate's degree completion and progress to degree analyses, respectively. There were 40 institutions with data available for associate's degree completion or transfer to a four-year institution by year 3. Med = Median; Min = Minimum; Max = Maximum; ACTC = ACT Composite; HSGPA = high school grade point average.
[a]Multiple combinations of ACTC score and HSGPA corresponded to a probability of 0.50 for the joint model.

Table B-3

Results for Achieving Levels of Year 6 College Cumulative GPA at Four-Year Institutions based on ACTC Score and HSGPA Models

Predictor variable	Number of institutions with viable models	Selection value (SV)		Maximum accuracy rate (maxAR)		Increase in AR (ΔAR)		Success rate (SR)		Observed percentage below SV	
		Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max
3.00 or higher college GPA											
ACTC	57	20	16/23	67	61/73	12	3/33	68	62/75	43	18/85
HSGPA	57	3.17	2.69/3.69	70	65/75	16	5/36	70	60/77	41	21/78
ACTC & HSGPA[a]	57			71	63/75	18	6/38	71	63/78	49	24/82
3.25 or higher college GPA											
ACTC	57	24	20/27	70	64/81	33	15/60	64	56/70	76	45/96
HSGPA	57	3.59	3.03/3.96	73	64/80	35	10/59	63	53/70	68	33/94
ACTC & HSGPA[a]	57			75	67/82	39	12/63	67	61/73	74	41/94
3.50 or higher college GPA											
ACTC	57	27	22/31	79	69/92	56	33/83	61	55/69	92	77/99
HSGPA	40	3.86	3.53/4.00	79	69/87	56	28/73	56	50/62	86	65/97
ACTC & HSGPA[a]	57			83	70/92	62	30/84	63	57/69	90	71/99

Table B-3 (cont.)

Predictor variable	Number of institutions with viable models	Selection value (SV)		Maximum accuracy rate (maxAR)		Increase in AR (ΔAR)		Success rate (SR)		Observed percentage below SV	
		Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max
3.75 or higher college GPA											
ACTC	56	31	26/34	91	78/98	82	57/96	58	52/65	99	94/100
HSGPA	2	4.00	4.00/4.00	84	79/89	67	57/77	50	50/50	90	87/92
ACTC & HSGPA[a]	57			92	80/98	84	57/96	59	54/64	98	89/100

Note. The selection value is the predictor value associated with the maxAR. Students' cumulative GPAs at degree completion were included in year 6 GPA analyses for students who graduated with a bachelor's degree before the end of year 6. There were 57 institutions with data available for the year 6 college GPA analyses. Med = Median; Min = Minimum; Max = Maximum; ACTC = ACT Composite; HSGPA = high school grade point average.
[a]Multiple combinations of ACTC score and HSGPA corresponded to a probability of 0.50 for the joint model.

Table B-4

Results for Achieving Levels of Year 3 College Cumulative GPA at Two-Year Institutions based on ACTC Score and HSGPA Models

Predictor variable	Number of institutions with viable models	Selection value (SV)		Maximum accuracy rate (maxAR)		Increase in AR (ΔAR)		Success rate (SR)		Observed percentage below SV	
		Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max
3.00 or higher college GPA											
ACTC	42	20	17/23	66	62/71	22	5/38	63	58/70	67	34/92
HSGPA	42	3.30	2.70/3.54	68	63/72	25	6/42	62	59/68	64	32/85
ACTC & HSGPA[a]	42			70	63/74	27	7/44	66	61/71	67	39/84
3.25 or higher college GPA											
ACTC	42	23	21/26	74	65/80	46	24/61	62	55/67	88	62/98
HSGPA	42	3.73	3.41/3.95	75	64/80	48	24/58	56	52/61	86	68/96
ACTC & HSGPA[a]	42			77	67/81	50	27/61	64	58/67	85	64/95
3.50 or higher college GPA											
ACTC	42	26	23/29	84	74/89	66	44/78	60	53/66	97	86/100
HSGPA	5	3.98	3.93/4.00	78	76/81	55	51/63	51	50/53	93	88/95
ACTC & HSGPA[a]	42			85	76/90	68	48/79	61	55/64	95	84/99

Table B-4 (cont.)

Predictor variable	Number of institutions with viable models	Selection value (SV)		Maximum accuracy rate (maxAR)		Increase in AR (ΔAR)		Success rate (SR)		Observed percentage below SV	
		Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max	Med	Min/Max
3.75 or higher college GPA											
ACTC	40	29	27/33	92	85/96	84	70/91	58	50/69	99	98/100
HSGPA	0										
ACTC & HSGPA[a]	41			93	86/96	85	72/91	58	52/80	99	97/100

Note. The selection value is the predictor value associated with the maxAR. Students' cumulative GPAs at degree completion were included in year 3 GPA analyses for students who graduated with an associate's degree before the end of year 3. There were 42 institutions with available data for the year 3 cumulative GPA analyses. Med = Median; Min = Minimum; Max = Maximum.

[a]Multiple combinations of ACTC score and HSGPA corresponded to a probability of 0.50 for the joint model.

Appendix C

Tables C-1 to C-4

Table C-1

Results for Bachelor's Degree Completion and Progress to Degree at Four-Year Institutions based on ACT College Readiness Benchmarks

Subject area	ACT Benchmark score	Probability of success at Benchmark		Success rate (SR)		Increase in SR (ΔSR)	
		Med	Min/Max	Med	Min/Max	Med	Min/Max
Bachelor's degree completion by year 6							
English	18	0.35	0.12/0.76	46	21/80	5	1/12
Mathematics	22	0.46	0.23/0.79	53	30/82	13	3/30
Reading	21	0.39	0.17/0.78	47	22/80	5	1/13
Science	24	0.47	0.24/0.80	52	29/81	11	2/25
Progress to degree year 1							
English	18	0.59	0.26/0.84	71	44/88	6	2/21
Mathematics	22	0.73	0.51/0.87	82	66/90	15	4/47
Reading	21	0.67	0.35/0.86	74	45/89	7	2/21
Science	24	0.76	0.53/0.89	81	61/91	12	3/42
Progress to degree year 2							
English	18	0.45	0.15/0.74	59	31/81	6	3/15
Mathematics	22	0.61	0.36/0.77	70	49/83	15	5/38
Reading	21	0.53	0.24/0.79	61	34/83	7	2/15
Science	24	0.62	0.39/0.83	69	47/85	14	4/33
Progress to degree year 3							
English	18	0.39	0.12/0.73	51	25/79	6	3/13
Mathematics	22	0.53	0.29/0.76	62	42/81	16	4/33
Reading	21	0.46	0.19/0.77	53	27/81	7	3/14
Science	24	0.56	0.31/0.80	61	39/82	14	4/30
Progress to degree year 4							
English	18	0.37	0.12/0.73	48	24/79	6	2/12
Mathematics	22	0.51	0.27/0.76	57	38/81	15	4/28
Reading	21	0.43	0.18/0.77	51	26/80	7	2/13
Science	24	0.53	0.29/0.80	58	36/82	13	4/25

Note. These analyses were based on all institutions with available data for each outcome (61 institutions for bachelor's degree completion and 50 for progress to degree outcomes). Med = Median; Min = Minimum; Max = Maximum.

Table C-2

Results for Associate's Degree Completion and Progress to Degree at Two-Year Institutions based on ACT College Readiness Benchmarks

Subject area	ACT Benchmark score	Probability of success at Benchmark		Success rate (SR)		Increase in SR (ΔSR)	
		Med	Min/Max	Med	Min/Max	Med	Min/Max
Associate's degree completion by year 3							
English	18	0.12	0.04/0.34	18	6/41	4	1/9
Mathematics	22	0.22	0.07/0.50	28	10/59	14	3/26
Reading	21	0.15	0.05/0.36	19	7/42	5	2/10
Science	24	0.23	0.07/0.49	26	9/54	12	4/21
Associate's degree completion or transfer to four-year institution by year 3							
English	18	0.21	0.09/0.41	29	13/51	6	3/11
Mathematics	22	0.36	0.15/0.61	42	19/70	19	11/28
Reading	21	0.25	0.10/0.45	30	13/52	7	4/11
Science	24	0.35	0.14/0.58	38	16/63	16	8/22
Progress to degree year 1							
English	18	0.49	0.16/0.78	62	26/83	12	6/21
Mathematics	22	0.70	0.23/0.87	79	29/90	27	9/44
Reading	21	0.56	0.20/0.80	64	27/83	14	5/26
Science	24	0.70	0.30/0.86	74	38/88	23	11/38
Progress to degree year 2							
English	18	0.38	0.10/0.62	49	14/69	9	2/16
Mathematics	22	0.57	0.13/0.78	64	15/83	24	4/35
Reading	21	0.44	0.12/0.64	50	15/70	10	3/17
Science	24	0.57	0.16/0.75	62	19/78	20	7/29
Progress to degree year 3							
English	18	0.32	0.06/0.55	41	9/63	8	2/12
Mathematics	22	0.49	0.08/0.71	57	10/77	22	3/31
Reading	21	0.37	0.07/0.58	43	10/64	9	3/12
Science	24	0.49	0.09/0.69	53	11/73	19	4/24

Note. These analyses were based on all institutions with available data for each outcome (43 institutions for associate's degree completion, 40 for associate's degree completion or transfer to a four-year institution, and 42 for progress to degree outcomes). Med = Median; Min = Minimum; Max = Maximum.

Table C-3

Results for Achieving Levels of Year 6 College Cumulative GPA at Four-Year Institutions based on ACT College Readiness Benchmarks

Subject area	ACT Benchmark score	Probability of success at Benchmark		Success rate (SR)		Increase in SR (ΔSR)	
		Med	Min/Max	Med	Min/Max	Med	Min/Max
3.00 or higher college GPA							
English	18	0.46	0.33/0.62	65	49/78	10	5/19
Mathematics	22	0.66	0.48/0.78	76	60/86	19	9/35
Reading	21	0.59	0.43/0.71	69	53/81	12	7/22
Science	24	0.72	0.54/0.82	77	60/86	19	11/33
3.50 or higher college GPA							
English	18	0.13	0.05/0.35	29	19/43	7	3/11
Mathematics	22	0.28	0.14/0.52	40	24/60	18	8/29
Reading	21	0.22	0.12/0.41	34	22/48	10	6/16
Science	24	0.34	0.20/0.53	43	30/56	19	10/25

Note. Students' cumulative GPAs at degree completion were included in Year 6 GPA analyses for students who graduated with a bachelor's degree before the end of year 6. These analyses were based on all 57 institutions with year 6 college cumulative GPA data available. Med = Median; Min = Minimum; Max = Maximum; GPA = grade point average.

Table C-4

Results for Achieving Levels of Year 3 College Cumulative GPA at Two-Year Institutions based on ACT College Readiness Benchmarks

Subject area	ACT Benchmark score	Probability of success at Benchmark		Success rate (SR)		Increase in SR (ΔSR)	
		Med	Min/Max	Med	Min/Max	Med	Min/Max
3.00 or higher college GPA							
English	18	0.42	0.33/0.59	55	43/70	13	8/15
Mathematics	22	0.63	0.51/0.79	70	57/86	26	17/31
Reading	21	0.50	0.40/0.64	60	46/73	16	10/21
Science	24	0.63	0.51/0.78	68	55/82	24	18/31
3.50 or higher college GPA							
English	18	0.14	0.09/0.25	25	17/40	8	5/12
Mathematics	22	0.30	0.21/0.50	39	28/63	23	15/35
Reading	21	0.21	0.13/0.32	29	21/44	12	8/16
Science	24	0.34	0.22/0.51	41	28/59	23	15/31

Note. Students' cumulative GPAs at degree completion were included in Year 3 GPA analyses for students who graduated with an associate's degree before the end of year 3. These analyses were based on all 42 institutions with year 3 college cumulative GPA data available. Med = Median; Min = Minimum; Max = Maximum; GPA = grade point average.

Appendix D

Tables D-1 to D-2

Table D-1

Direct, Indirect, and Total Effects on Long-Term College Outcomes for Four-Year Institutions

	First-year college GPA	Long-term college outcome		
Predictor	Direct effect	Direct effect	Indirect effect	Total effect
Bachelor's degree completion by year 6				
ACTC	0.26	NS	0.26	0.26
HSGPA	0.35	0.07	0.24	0.31
First-year GPA	–	0.52	–	0.52
Year 6 college cumulative GPA				
ACTC	0.31	0.09	0.36	0.45
HSGPA	0.32	0.12	0.35	0.47
First-year GPA	–	0.68	–	0.68
Progress to degree year 2				
ACTC	0.26	NS	0.29	0.29
HSGPA	0.35	0.07	0.29	0.36
First-year GPA	–	0.62	–	0.62
Progress to degree year 3				
ACTC	0.26	NS	0.28	0.28
HSGPA	0.35	0.07	0.28	0.35
First-year GPA	–	0.59	–	0.59
Progress to degree year 4				
ACTC	0.26	NS	0.28	0.28
HSGPA	0.35	0.07	0.27	0.34
First-year GPA	–	0.58	–	0.58

Note. The direct effects of ACTC score and HSGPA on first-year college GPA for the analyses based on year 6 college cumulative GPA differ from those based on the other outcomes, because the former case includes only those students with a year 6 cumulative GPA (i.e., those who either graduated prior to year 6 or were still enrolled at year 6). In comparison, the latter group includes all students from four-year institutions with the needed data available to calculate the outcome of interest (see Table 1). ACTC = ACT Composite; HSGPA = high school grade point average; GPA = grade point average; NS = not significant at the 0.01 level.

Table D-2

Direct, Indirect, and Total Effects on Long-Term College Outcomes for Two-Year Institutions

	First-year college GPA	Long-term college outcome		
Predictor	Direct effect	Direct effect	Indirect effect	Total effect
Associate's degree completion by year 3				
ACTC	0.18	0.06	0.21	0.27
HSGPA	0.29	0.16	0.20	0.36
First-year GPA	–	0.46	–	0.46
Associate's degree completion or transfer to four-year institution by year 3				
ACTC	0.18	0.09	0.20	0.29
HSGPA	0.30	0.13	0.21	0.34
First-year GPA	–	0.44	–	0.44
Year 3 college cumulative GPA				
ACTC	0.22	0.10	0.34	0.44
HSGPA	0.35	0.12	0.38	0.50
First-year GPA	–	0.71	–	0.71
Progress to degree year 2				
ACTC	0.18	0.14	0.20	0.34
HSGPA	0.29	0.13	0.24	0.37
First-year GPA	–	0.47	–	0.47
Progress to degree year 3				
ACTC	0.18	0.10	0.20	0.30
HSGPA	0.29	0.14	0.22	0.36
First-year GPA	–	0.46	–	0.46

Note. The direct effects of ACTC score and HSGPA on first-year college GPA for the analyses based on year 3 cumulative GPA differ from those based on the other outcomes, because the former case includes only those students with a year 3 cumulative GPA (i.e., those who either graduated prior to year 3 or were still enrolled at year 3). In comparison, the latter group includes all students from two-year institutions with the needed data available to calculate the outcome of interest (see Table 1). ACTC = ACT Composite; HSGPA = high school grade point average; GPA = grade point average; NS = not significant at the 0.01 level.