



**BOISE STATE UNIVERSITY**  
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**Predicting student success using ten years of cohorts data on retention data**

**Overview and Summary**

*All measures of new student success at Boise State have improved over the last ten years. First semester GPA is up by more than a quarter of a point. Retention one year later has improved by 11 percentage points. Six year graduation rates have improved by 5 percentage points, and four year graduation rates have more than doubled. What factors are related to these changes?*

*Using a variety of admissions information (index score, age, residency), early campus experience information (course withdrawal, taking both English and math in the first year, credits taken, living on-campus, Pell eligibility, and unmet financial need), and first semester GPA when possible, models were developed for the four success indicators: first semester GPA, retention after one year, and graduation after four and six years. Admissions information was entered into the model first, followed by early campus experiences, and then first semester GPA was added.*

*We were able to significantly predict/explain each success indicator using the set of variables provided. However, in each case, about 70% of the variability in student behavior remained unaccounted for by the data.*

*First semester GPA was influenced more by the admissions variables than by the early campus experience variables. However, almost all of the variables were significantly related to first semester GPA, with only Pell eligibility and living on-campus failing to reach statistical significance.*

*Retention after one year was most related to first semester GPA. In the final model, only index score and Pell eligibility were insignificant contributors to the model.*

*When predicting graduation after four (4) years, admissions information showed the strongest relationship to graduating in four years followed by first semester GPA. The only variables which did not make a significant contribution to the final model were age, unmet financial aid, and taking both math and English in the first year.*

*When predicting graduation after six (6) years, however, first semester GPA had the strongest relationship to graduating. Again, most variables were related to six-year graduation; only age and residency failed to make a significant contribution to the final model. Of particular interest was the finding that unmet financial need was not a contributor at the four-year mark but was at the six-year mark. Also, being an out-of-state resident helped at the four-year graduation mark but not at the six-year mark.*

*Student success, then, is due to a variety of factors. As the first step in the process, the admissions office plays a key role in selecting students likely to succeed. When students reach campus, however, all of the other academic and non-academic factors also begin influence their success. In particular, student GPAs have improved over the years, due in large part to their greater success in their first math and English course, the GPAs provided critical at every step of the process.*

*The results of the study also demonstrate, however, that we still lack a comprehensive model to explain student GPAs, retention, and graduation behaviors. Succeeding in college requires a complex series of behaviors from students in addition to many other factors out of the students' control (e.g., faculty member who teaches the course, personal health or health of family members, financial changes, etc.) While our improvements in first semester GPA, retention, and graduation show that we're on the right path, we can still improve on these measures as well as better determine the building blocks to student success.*

## Introduction

Improving the academic success of our students has always been an important topic at Boise State. And real improvements in student success have occurred over the past ten years. The percentage retained one year later has improved from 60% in fall of 2002 to 71% for the fall 2011 cohort. Though still low, the four-year graduation rate moved from 5% for the 2002 cohort to 12% for the 2008 cohort, and the six-year graduation rate from 24% for the 2002 cohort to 29% for the 2006 cohort. First term GPAs have increased from an average of 2.28 to 2.56 ten years later.

Why have retention and graduation rates been improving? Numerous published and unpublished studies of Boise State students have found a variety of indicators to predict both first semester GPA as well as retention that may provide some insights. Among some of the findings are the following:

- Unmet financial need is associated with a lower probability of being retained (*A description of financial aid offered to new fall 2010 students and the relationship to retention, RR 2012-08*)
- New students who were “on-track” after only one semester (i.e., earned at least 12 credits with a 2.0 GPA) had greatly elevated four- and six-year graduation rates compared to others (*Progress toward graduation for fall 2005 first-time full-time degree-seeking freshmen, RR 2012-07*)
- For those who had graduated after four years, 64% had no repeat credits, and 90% had repeated six credits or less. The courses with the greatest number of repeated credits were generally math and English courses (*Course repeats and progress toward graduation, RR 2012-06*)
- When predicting retention one year later, the grade in the first English and Math course was more important than the level of the course. Students who do not take math and English their first year were less likely to return (*Testing our assumptions, paper in progress*)
- New full-time students who take more credits have higher GPAs compared to students taking fewer credits, even after controlling for academic preparation as measured by test scores (*Do full-time students taking fewer credits their first semester have greater success at Boise State? RR 2013-01*)
- New students who dropped from full-time to part-time status because of course withdrawals were less likely to be retained one year later (*Possible Ways to Improve Cohort Retention and Graduation Rates, unpublished, April 2012*)
- First semester GPA was the only variable needed to predict retention when step-wise regression was used to select the best set of predictors. Other variables individually related to retention included living and working on-campus, enrollment in college-level math or honors courses, high school GPA, and applying early for admission. First semester GPA was best predicted by a combination of high school GPA, age, percent of small classes, and enrollment in developmental math. Other variables significantly related to GPA but not selected for the final model including sex, residency, living and working on-campus. (*Predicting retention and first semester GPA based on readily available data, unpublished study*)

The purpose of this study is take four measures of student success—first semester GPA, retention one year later, and graduation after four and six years—and look at the impact that factors related to the admissions process, financial aid and campus life, and academic experiences have on these measures of success. Though the entire 10-year cohort includes 19,032 students, the number was reduced to 15,218 for the GPA and retention analyses mainly due to the fact that some students lacked index scores (especially if they were older) and some lacked financial aid information.

Each regression analysis starts by using the admissions data (index score, age, residency) to predict the success measure and identify the amount of variability accounted for by the set of admissions measures. Early campus experience measures are then added to the model and the increase in the variability accounted for is noted.

Early campus experience measures include whether or not the student had “Ws” in their first semester, whether or not they enrolled in an English and math course their first year, credits attempted, whether or not the student lived on-campus their first year, the extent that their financial aid package still left them with unmet need, and whether or not they were eligible for a Pell grant. For the analysis of first semester GPA, the process ends at this point. For the success measures of retention after one year, graduation in four years, and graduation in six years, a third step is included where first semester GPA is added to the model.

The variables were chosen to be as inclusive as possible without either reducing the dataset too much due to missing data or using variables that were highly related to one another. Table 1 below displays the correlations among a number of the scaled variables that were available for the study. Readers who are interested in a year-by-year look at the cohorts and how the variables have shifted over time can find tables on the Institutional Research website under “Data reports.” Go to <http://iassess.boisestate.edu/retention-and-graduation/> for further information.

Note that several high correlations among the variables exist. First term GPA is highly correlated with math and English grades at .67 and .71 respectively. Index score is a combination of high school GPA and test scores with high school GPA weighted approximately twice as heavily so it is no surprise to see correlations of .89 for high school GPA and .69 for ACT scores with index scores. Index scores are more highly correlated with first term GPA than either high school GPA or ACT scores at .47, but high school GPA is almost as close at .40. ACT scores will not be used because the relationship to GPA is weaker and fewer students have ACT test scores.

<b>Table 1. Pearson correlations among variables</b>									
		1st term GPA	Index score	High school GPA	ACT combined	Credits taken 1st term	Math grade points	English grade points	Unmet need
1st term GPA	Correlation	1	.469**	.396**	.239**	.142**	.668**	.705**	-.147**
	N	19032	15531	17816	12219	19032	14324	17159	18504
Index score	Correlation		1	.887**	.689**	.172**	.407**	.357**	-.145**
	N		15531	15516	12219	15531	12009	14221	15254
High school GPA	Correlation			1	.366**	.148**	.345**	.333**	-.114**
	N			17816	12207	17816	13584	16168	17379
ACT combined	Correlation				1	.154**	.199**	.158**	-.080**
	N				12219	12219	9383	11156	12028
Credits taken 1st term	Correlation					1	.103**	.075**	-.055**
	N					19032	14324	17159	18504
Math grade points	Correlation						1	.408**	-.052**
	N						14324	13337	13967
English grade points	Correlation							1	-.096**
	N							17159	16709
Unmet need	Correlation								1
	N								18504

\*\* . Correlation is significant at the 0.01 level (2-tailed).

## Predicting first term GPA

To predict first semester GPA, a regression analysis was conducting using two steps: (1) factors related to admissions were considered by themselves, then (2) factors related to campus experience were also added to the model. Admissions factors included in the model were index score, age, and whether the student was an Idaho resident (1 if Idaho resident, 0 otherwise). Campus experience factors included whether the student lived on-campus (1 if lived on campus, 0 otherwise), whether they were eligible for a Pell grant (1 if eligible, 0 otherwise), the extent of their unmet financial need not covered by their financial aid package, whether they took both their first math and English course during their first year (1 if yes, 0 otherwise), and whether they withdrew from any of their courses during their first semester (1 if yes, 0 otherwise). The descriptive statistics are shown in Table 2.

**Table 2. Descriptive Statistics for predicting first semester GPA**

	Mean	Std. Deviation	N
First semester GPA (dependent)	2.45	1.09	15218
Idaho resident (1if yes, 0 if no)	.79	.41	15218
Age	18.47	.83	15218
Index score	54.13	17.21	15218
Withdrew from 1 or more courses 1 <sup>st</sup> semester (1 if yes, 0 if no)	.08	.27	15218
Took both math and English course during 1 <sup>st</sup> year	.72	.45	15218
Eligible for Pell grant	.36	.48	15218
Credits taken during 1 <sup>st</sup> semester	13.91	1.75	15218
Amount of federal unmet need (in 1000s)	3.98	4.99	15218
Lived on-campus (1 if yes, 0 otherwise)	.46	.50	15218

As shown by Table 3, the admissions variables accounted for 23.4% of the variability in first semester GPA. Adding the campus experience variables improved the model to account for 27.6% of the variability in GPA.

**Table 3. Model Summary for predicting first semester GPA**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.484 <sup>a</sup>	.234	.234	.95330	.234	1550.300	3	15214	.000
2	.525 <sup>b</sup>	.276	.276	.92710	.042	146.356	6	15208	.000

a. Predictors: (Constant), Index score, Idaho resident, age

b. Predictors: (Constant), Index score, Idaho resident, age, took math and English, withdrew from one or more courses, eligible for Pell grant, amount of federal unmet need, credits taken, lived on-campus

Table 4 displays the coefficients for both models. Note that when all variables were included in the model, only Pell eligibility and living on-campus failed to reach statistical significance using  $p \leq .05$ . Variables which were positively associated with higher GPAs included age, index scores, taking both English and math, and number of credits attempted. Variables negatively associated with higher GPAs included being an Idaho resident, withdrawing from one or more courses, and having a greater amount of unmet need.

**Table 4. Model coefficients for predicting first semester GPA**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.157	.178		-.880	.379
	Idaho resident	-.297	.019	-.111	-15.671	.000
	Age	.067	.009	.051	7.098	.000
	Index score	.030	.000	.472	65.872	.000
2	(Constant)	-.997	.187		-5.319	.000
	Idaho resident	-.267	.021	-.100	-12.669	.000
	Age	.077	.009	.059	8.451	.000
	Index score	.028	.000	.435	60.549	.000
	Withdrew from 1 or more courses	-.657	.028	-.163	-23.359	.000
	Took both English & math	.112	.017	.046	6.604	.000
	Pell eligible	.002	.016	.001	.101	.920
	Credits attempted 1 <sup>st</sup> term	.055	.004	.089	12.337	.000
	Federal unmet need in 1000s	-.015	.002	-.071	-9.977	.000
	Lived on-campus	.012	.017	.006	.706	.480

**Prediction of retention one year later**

To predict retention one year later the same approach was used except that logistic regression was employed as the statistical tool and first term GPA was added as additional variable, making it into a three-step model. Step 1 included the admissions variables index score, age, and Idaho residency. Step 2 included living on-campus, course withdrawal, taking English and math, number of credits taken first term, Pell eligibility, and unmet financial need (expressed in 1000s). In step 3, first semester GPA was added to the model.

As shown by Table 5, the Nagelkerke (pseudo)  $R^2$  changed from .06 for the admissions variables to .11 for the early college experience variables to .27 when first semester GPA was added to the model. This finding indicates that first semester GPA is the key predictor of retention.

**Table 5. Model summary in three steps for predicting retention one year later**

Step	-2 Log likelihood	Cox & Snell $R^2$	Nagelkerke $R^2$
1: Admissions variables	18440.230	.044	.061
2: Add early college experience variables	17864.047	.079	.111
3: Add 1 <sup>st</sup> semester GPA	15791.302	.196	.274

Table 6 displays the model coefficients to explain retention at each step of the process. When only admissions measures were included, index scores were positively related to retention and Idaho residency was negatively related to retention. When the set of early college experience measures was added, index scores and residency

remained statistically significant predictors of retention. In addition, living on-campus, taking more credits, and taking English and math were positively associated with retention. Withdrawing from one or more classes and having a greater amount of financial need were negatively associated with being retained. Pell eligibility was not statistically significant nor was age.

When first semester GPA was added to the model, the only variables which were *not* statistically significant using  $p \leq .05$  were index score ( $p = .142$ ) and Pell eligibility ( $p = .067$ ). All other variables were significant predictors of retention. Some variables switched their relationship to retention after first semester GPA was added, indicating a complex relationship to both GPA and retention. “Switchers” included Idaho residency which was now positively related to retention, and age which was previously unrelated to retention. Other variables with a positive relationship included taking both math and English during the first year, taking a greater number of credits, living on-campus, and having a higher first semester GPA. Variables with a negative relationship included withdrawing from courses, and having more unmet financial need.

The fact that index scores were significant contributors to the prediction of retention at step 1, which included only admissions variables, and again at step 2, which included admissions and early experience variables, but NOT at step 3 when first semester GPA was added deserves further discussion. Note that at each step of the process, the B weight and significance is calculated after accounting for the contributions of all of the other variables first. Because index scores lost their significance at step 3 when first term GPA was added, we can conclude that first term GPA accounted for so much of the variability that not enough remained for index scores to reach significance.

**Table 6. Variables in the equation at each step of predicting retention**

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1: Admissions indicators	Index score	.026	.001	562.162	1	.000	1.026
	Age	-.009	.021	.196	1	.658	.991
	Idaho resident	-.339	.045	55.558	1	.000	.713
	Constant	-.160	.398	.163	1	.687	.852
Step 2: Add early college experience indicators	Index score	.022	.001	376.225	1	.000	1.022
	Age	.023	.021	1.149	1	.284	1.023
	Idaho resident	-.145	.053	7.449	1	.006	.865
	Living on-campus	.284	.042	46.246	1	.000	1.329
	Credits attempted 1 <sup>st</sup> term	.102	.011	80.996	1	.000	1.107
	Pell eligible	-.071	.038	3.387	1	.066	.932
	Took both math and English during 1 <sup>st</sup> yr	.402	.040	101.153	1	.000	1.494
	Withdrew from course(s) 1 <sup>st</sup> term	-.832	.064	168.042	1	.000	.435
	Unmet financial need (in 1000s)	-.036	.004	99.156	1	.000	.965
Constant	-2.274	.442	26.519	1	.000	.103	
Step 3: Add 1 <sup>st</sup> term GPA	Index score	-.002	.001	2.157	1	.142	.998
	Age	-.055	.024	5.426	1	.020	.947
	Idaho resident	.134	.057	5.487	1	.019	1.143
	Living on-campus	.319	.045	49.729	1	.000	1.376

Credits attempted 1 <sup>st</sup> term	.061	.012	24.653	1	.000	1.063
Pell eligible	-.076	.042	3.351	1	.067	.927
Took both math and English during 1 <sup>st</sup> yr	.355	.044	66.026	1	.000	1.426
Withdrew from course(s) 1 <sup>st</sup> term	-.355	.074	23.088	1	.000	.701
Unmet financial need (in 1000s)	-.026	.004	43.321	1	.000	.974
1 <sup>st</sup> term GPA	.914	.022	1747.470	1	.000	2.494
Constant	-1.438	.486	8.757	1	.003	.237

### Predicting graduation in four years

For the analysis of graduation in four years the group was reduced to the 9,701 cohort members, who had been at Boise State long enough to graduate, i.e., students who began in 2002 through 2008. Again, the prediction of graduation in four years was conducted using logistic regression. The explanatory variables were added in a series of steps starting with admissions variables, moving to early college experience predictors, and then including first semester GPA in the third step. Note that the Nagelkerke (pseudo)  $R^2$  changed from .170 to .206 to .275 indicating that admissions variables and first term GPA were more important than the set of early experience variables (see Table 7).

**Table 7. Model Summary to predict four-year graduation in three steps**

Step	-2 Log likelihood	Cox & Snell $R^2$	Nagelkerke $R^2$
1: Admissions	4891.369	.075	.170
2: Early experience	4724.712	.091	.206
3: 1 <sup>st</sup> term GPA	4393.671	.121	.275

As shown in Table 8, when only admissions variables were considered, higher index scores made a positive contribution to the probability of graduating in four years and being an Idaho resident was negatively related to graduating in four years. Age was unrelated to graduation in four years. When the set of early college experience variables were added to the model, the two admissions variables continued to be related to four-year graduation. In addition, living on-campus and taking more credits during the first semester were positively related to graduating in four years, while being Pell-eligible and withdrawing from one or more courses were negatively related to graduating in four years. When first semester GPA was added in the final model, it too was positively related to graduation in four years, and variables which were previously significant remained significant.

### **Predicting graduation in 6 years**

When predicting graduation in six years, only the cohort years of 2002 through 2006 (N=6,395) could be employed in the analysis. As shown by Table 9, the Nagelkerke R<sup>2</sup> changed from .14 when only admissions variables were included to .18 with the addition of the early college experience variables to .30 when first semester GPA was added, again confirming the importance of both admissions variables and academic performance.

Using only the three admissions variables in the model, index score made a positive contribution to graduating in six years, while being an Idaho resident was negatively related to graduating in six year. Age was unrelated to graduation.

The two admissions variables remained significant when the early college experience variables were added to the model. All of the early college experience variables were significantly related to graduation in six years. Variables which improved the odds of graduating include living on-campus in the first year, taking more credits, and taking math and English during the first year. Variables which reduced the odds of graduating in six years included withdrawing from courses in the first term, having a greater amount of financial need remaining after financial aid packages were offered, and being eligible for a Pell grant, i.e., being lower income. When first term GPA was added to the model in step 3, GPA was a highly significant addition. All other variables also were significant with the exception of age and Idaho residency. Further details can be found in Table 10.

**Table 8. Variables in the model to predict four-year graduation at each of three steps**

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1: Admissions measures	Index score	.058	.003	527.832	1	.000	1.060
	Age	-.032	.057	.320	1	.572	.968
	Idaho Resident	-.909	.086	111.171	1	.000	.403
	Constant	-4.566	1.074	18.094	1	.000	.010
Step 2: Add early college experience measures	Index score	.051	.003	378.997	1	.000	1.052
	Age	.020	.059	.115	1	.735	1.020
	Idaho Resident	-.609	.097	39.515	1	.000	.544
	Withdrew from course(s)	-.589	.163	13.041	1	.000	.555
	Took both math & English	-.141	.086	2.713	1	.100	.868
	Pell eligible	-.333	.097	11.838	1	.001	.717
	Credits attempted 1 <sup>st</sup> term	.226	.022	104.257	1	.000	1.254
	Unmet financial need (in 1000s)	-.016	.013	1.493	1	.222	1.000
	On campus resident	.429	.087	24.096	1	.000	1.536
Constant	-8.465	1.166	52.741	1	.000	.000	
Step 3: Add 1 <sup>st</sup> term GPA	Index score	.025	.003	76.951	1	.000	1.026
	Age	-.042	.059	.498	1	.480	.959
	Idaho Resident	-.493	.100	24.294	1	.000	.611
	Withdrew from course(s)	-.358	.170	4.444	1	.035	.699
	Took both math & English	-.102	.088	1.341	1	.247	.903
	Pell eligible	-.400	.098	16.720	1	.000	.671
	Credits attempted 1 <sup>st</sup> term	.213	.023	85.703	1	.000	1.237
	Unmet financial need (in 1000s)	-.002	.013	.016	1	.901	1.000
	On campus resident	.466	.090	26.708	1	.000	1.594
	1 <sup>st</sup> term GPA	1.089	.069	248.200	1	.000	2.970
Constant	-8.984	1.174	58.554	1	.000	.000	

**Table 9. Model summary for predicting six-year graduation using three sets of variables**

Step	-2 Log likelihood	Cox & Snell R <sup>2</sup>	Nagelkerke R <sup>2</sup>
1: Admissions variables only	7103.495	.100	.142
2: Add early college experience variables	6903.877	.128	.182
3: Add 1 <sup>st</sup> semester GPA	6278.470	.209	.297

**Table 10. Variables in the equation to predict graduation in six years using three steps**

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1: Admissions	Index score	.042	.002	542.981	1	.000	1.043
	Age	.020	.038	.275	1	.600	1.020
	Idaho resident	-.532	.082	42.164	1	.000	.588
	Constant	-3.093	.725	18.218	1	.000	.045
Step 2: Add early college experience variables	Index score	.038	.002	423.878	1	.000	1.039
	Age	.065	.039	2.858	1	.091	1.067
	Idaho resident	-.322	.091	12.559	1	.000	.725
	Withdrew from course(s)	-.749	.117	41.145	1	.000	.473
	Took both math & English during 1 <sup>st</sup> yr	.251	.067	13.952	1	.000	1.285
	Pell eligible	-.214	.068	9.939	1	.002	.807
	Credits attempted	.129	.018	51.363	1	.000	1.138
	Unmet financial need (in 1000s)	-.053	.010	25.847	1	.000	.948
	Living on-campus	.321	.065	24.121	1	.000	1.379
Constant	-5.711	.790	52.300	1	.000	.003	
Step 3: Add 1 <sup>st</sup> term GPA	Index score	.016	.002	60.395	1	.000	1.016
	Age	-.006	.040	.026	1	.872	.994
	Idaho resident	-.155	.096	2.604	1	.107	.857
	Withdrew from course(s)	-.483	.127	14.544	1	.000	.617
	Took both math & English during 1 <sup>st</sup> yr	.313	.071	19.231	1	.000	1.367
	Pell eligible	-.316	.071	19.943	1	.000	.729
	Credits attempted	.114	.019	36.059	1	.000	1.121
	Unmet financial need (in 1000s)	-.031	.011	7.932	1	.005	.969
	Living on-campus	.401	.069	33.361	1	.000	1.493
	1 <sup>st</sup> term GPA	.922	.041	498.643	1	.000	2.513
Constant	-5.649	.818	47.706	1	.000	.004	

### Summary and Conclusions

It is impossible to identify a single factor that is predictive of student success since a number of significant measures were found in the analyses. Because getting admitted is the first step in the process, admissions measures were entered first. We found that about 23% of the variability in first semester GPA could be accounted for by the combination of index score, Idaho residency, and age. Adding information on students' early experiences on campus increased the amount of variability in first term GPA to 28%. All variables included in the model were significant with the exception of whether or not the student was eligible for a Pell grant. Index scores appeared to be especially significant.

After one year, however, the prediction of retention had a fairly minor relationship with admissions variables with only about 6% of the "variability" in retention accounted for by this set of measures. Adding information on early campus experiences almost doubled the variability accounted for to 11%. The key factor, however, was

first semester GPA. Adding this measure to the model caused the pseudo  $R^2$  to jump to 27%, once again showing that having a successful academic experience the first semester is the key approach to retaining students. In fact, in the final model, index scores were non-significant contributors to the prediction of retention. The only other variable that did not reach significance was eligibility for a Pell grant. It appeared that while index scores were critical to helping students obtain a satisfactory GPA their first semester, first semester GPA was much more than a simple output from test scores and high school GPA (the two components of the index). Rather, first semester GPA was an *accumulation* of on-campus experiences. Certainly better performance in math and English courses was a part of this measure, even if not specifically included in the models because of the close relationship to GPA.

Admissions measures, however, again played a key role in the prediction of graduation after four years, accounting for 17% of the graduation variability. The percentage rose to 21% with the addition of the early campus experience variables and to 28% with the addition of first semester GPA. In the final analysis, all measures were significant except age, unmet financial need, and taking both math and English in the first year.

Admissions measures were somewhat less crucial in the role they played in graduation in six years, and first semester GPA was somewhat more significant compared to the four-year graduation mark. The variability accounted for by admissions measures was 14% instead of 17% after four years. Early campus experience measures helped raise the percentage to 18%, but first semester GPA provided the largest boost, bringing the variability accounted for to 30% compared to 28% at the four-year mark. At the six-year point, all measures were significant predictors of graduation except for age and Idaho residency. It appeared, therefore, that students who graduated in four years were somewhat different compared to students who graduated in six years. Of particular interest was the fact that unmet need did not play a role at the four-year point but it did at the six-year point. Do students who graduate in four years have fewer financial difficulties? In both cases, being eligible for a Pell grant (and thus lower income) was negatively related to graduation, indicating that lower income students have a more difficult time reaching graduation, especially given the fact that Pell eligibility did not play a significant role in predicting retention.

These findings point to the value and necessity of a combined approach from all fronts on improving retention and graduation rates. The Admissions office finds students whom they believe will be successful at Boise State. The new students then arrive on campus and begin to form their impression of the institution through their early in-class and out-of-class experiences. Their GPA at the end of their first semester provides an indicator of their academic integration with the institution and strongly influences their continuance. Providing a successful first-semester experience both academically and socially is critical to students' continued enrollment and graduation.

The results of the study also demonstrate, however, that we still lack a comprehensive model to explain student GPAs, retention, and graduation behaviors. About 70% of the variability in each of these success measures remains unexplained after the full model was applied. Succeeding in college requires a complex series of behaviors from students in addition to many other factors out of the students' control (e.g., faculty member who teaches the course, personal health or health of family members, financial changes, etc.) While our improvements in first semester GPA, retention, and graduation show that we're on the right path, we can still improve on these measures as well as better determine the building blocks to student success.

Appendix A. Definitions of variables included in the study or available for study

ACT comp	The ACT score calculated from the combination of scores on the ACT test. A majority of students admitted (64%) presented ACT scores
Age	Age in years at the time that classes started for their cohort year. Age information was available for everyone except 1 person
Average federal unmet need	Based on financial aid records, average unmet need is the number of dollars that are still lacking after financial aid packages are put together compared to what the student needs based on family income. Financial aid information was available for 97% of the group.
Cohort	First-time full-time bachelor's degree seeking students who first enrolled in the fall term identified with the cohort. The total size of the group was 19,032.
Credits attempted 1st term	The number of credits students are enrolled in that count toward a degree at the end of the add/drop period for regular classes.
Credits earned 1 year later if retained	The total credits accumulated at the time of the start of the fall term one year later if the student was enrolled.
First generation	When neither parent graduated from college, the student is considered "first generation." Data for first-generation status were obtained from financial aid records. Only 68% had first generation data available for both parents.
First math grade	The number of grade points awarded in the first course that students took during (or immediately prior to) their first cohort term.
First term GPA	The GPA for the first term of enrollment for all credit-bearing classes where grades are awarded. Information available for all students.
Graduated in four years	To be counted as graduating in 4 years, the student needed to receive a bachelor's degree prior to the opening of the fall term four years after they began.
Graduated in six years	To be counted as graduating in 6 years, the student needed to receive a bachelor's degree prior to the opening of the fall term six years after they began.
HS GPA	High school GPAs standardized to a 0 to 4 scale. HS GPAs were available for 94% of the group.
Idaho resident	Students who claim a residence in Idaho at the time of admission. Information available on everyone
Index score	A weighted combination of test scores and high school GPA with scores ranging from 1 to 100. Index scores were available for 82% of the group.
Lived on-campus	The student lived in the residence halls during their first year. Information available on everyone using payment records.
Minority	Ethnicity reported that was other than "White non-Hispanic." Minority status reported as missing if ethnicity was listed as "unknown" or "non-resident alien." Missing information on 5%.
Pell eligible	Pell grants are awarded to lower income students based on their completed FAFSAs. Financial aid information was available for 97% of the group.
Retained next fall	Enrolled for one or more credits the next fall term. Information available on all students.
Took English	If the student took an English course during their first cohort year or in the year prior, they are counted as having taken English; 90% of the group had an English course. Data was limited to Boise State courses.

Took math	If the student took a math course during their first cohort year or in the year prior, they are counted as having taken math; 75% of the group had a math course. Data was limited to Boise State math courses.
Took math and English	The student received a grade in both a Boise State math and English course during their first year or in the year prior when they were a concurrent enrollee.
Withdrew during 1st term	The student withdrew from one or more courses after the add/drop date

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Appendix B. A short explanation of odds ratios (Exp(B))

An odds ratio expresses the increase or decrease in the odds of being retained or graduated (for our purposes) when the value of the predictor increases by one unit. In statistical models such as logistic regression, odds ratios are called “Exp(B).” If the odds are evenly split, the odds ratio is “1”. Odds ratios greater than 1 indicate that an increase in the predictor variable by one unit increase the odds of being retained, while an odds ratio of less than 1 indicates that an increase in the predictor variable by one unit decreases the odds of being retained. Note that in the table below, odds ratios are less than one when Beta is negative and greater than one when Beta is positive.

Odds ratios are only interpreted when the variable is a statistically significant part of the model. Note that the odds ratio is NOT the same thing as the probability of being retained or graduating, though the odds ratio can be used to obtain the probability of graduating.

In table 9, for example, we would interpret the final model at follows:

	B	Sig.	Exp(B)	Explanation of Exp(B) or odds ratio
Index score	.025	.000	1.026	For each 1 point increase in the index score, the odds of graduating in 4 years improve by 2.6%
Age	-.042	.480	.959	Do not interpret – not significant
Idaho Resident	-.493	.000	.611	Being an Idaho resident decreases the odds of graduating by more than a third. For easier interpretation, invert the odds ratio, i.e., $1/.611=1.64$ . This can now be interpreted NOT being an Idaho resident increases the odds of graduating by 64%.
Withdrew from course(s)	-.358	.035	.699	$1/.699=1.43$ so NOT withdrawing from a course improves the odds of graduating by 43%.
Took both math & English	-.102	.247	.903	Do not interpret – not significant
Pell eligible	-.400	.000	.671	$1/.671=1.49$ so NOT being Pell eligible improves the odds of graduating by 49%.
Credits attempted 1 <sup>st</sup> term	.213	.000	1.237	For each additional credit taken beyond 12, the odds of graduating improve by 23.7%.
Unmet financial need (in 1000s)	-.002	.901	1.000	Do not interpret – not significant
On campus resident	.466	.000	1.594	Living on-campus increases the odds of graduating by 59.4%.
1 <sup>st</sup> term GPA	1.089	.000	2.970	For each 1 unit increase in GPA, the odds of graduating are almost tripled.
Constant	-8.984	.000	.000	