Benchmarking the Freshman Class: Predictors of Success?

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Abstract

The Engineering Student Programs Office (ESPO) collects and maintains demographic, admissions, academic and retention information for freshmen cohort groups that have entered the School of Engineering since 1997. Based on data collected over the last five years the author will benchmark the first year classes in SOE at UNM. Data include demographics, students' entrance exam scores, high school background preparation, and university grades. This data will be used to make comparisons between cohort groups, the university freshmen cohort data and data taken from other departments and colleges within the university.

Introduction

The Engineering Student Programs Office of the School of Engineering (SOE) at the University of New Mexico works with first and second year students who are interested in majoring in Engineering who have completed trigonometry and pre-calculus, at minimum, for entrance into the program. Students who have completed the Calculus I and II sequence and introductory courses in science and the engineering area of interest are ready for admission to a SOE department. Our goal, like that of all advising centers, is to counsel the student into an appropriate major, aid them in course selection, provide an early warning system for students who are in danger of failing and retain the student through matriculation. We offer a one credit hour "Introduction to Engineering" courses as a method of aiding the student in making a decision on their choice of major within the SOE.

In order to better serve our students by providing accurate advising and referrals and to benchmark our current situation regarding retention and potential success, we sought to find the correlations that high school grade point average (HSGPA) and SAT/ACT scores had on engineering students' academic performance, and also to prepare the base for a longitudinal study of all first year students entering our particular program. Not only would this give us information on who was best prepared for the engineering field and how to advise students who were adequately prepared, it would also allow us to target high school recruiting, tailor information for summer new student orientation sessions (LOBOrientation), and advise students who were less than adequately prepared for a baccalaureate program in engineering or computer science.

Literature Review

There are quite a few studies seeking connections that aid in predicting college level performance for first year students, and a few studies include high school preparation and high school grade point average (HSGPA) in the correlations.[1] Alexander W. Astin conducted one of the largest studies of the impact college has on freshmen and published his results in What Matters In College: Four Critical Years Revisited.[2] Astin reported that engineering as a major choice had more impact in his study than any other major choice. The choice of engineering as a major leads to negative impacts on undergraduate grade point average, completion of the bachelor's degree and communication skills, but positive impacts on problem-solving and analytical skills and, interestingly enough, personal orientation toward materialism and a conservative political viewpoint. Astin found a decline in grades between high school and college, but on an individual level he found about one in three engineering students earns the same grades he or she did in high school, one in five engineering students earns higher grades and nearly half earn lower grades than they did in high school. Astin's longitudinal study also established that the two most accurate predictors of student success and retention are the SAT Verbal score and the HSGPA.[2]

Several studies have come to the same conclusion: HSGPA and entrance exam scores do aid in predicting who will succeed in college. Research by Pantages and Creedon on general college attrition found that HSGPA is the best and most accurate predictor of college level grade point average[3]. However, Rodriguez found that all predictors are much less accurate with students of color or students whose first language is not English.[4] Levin and Wycoff set the bar for studying the prediction of students' college success with their 1995 study of student success, persistence and retention in engineering. With a sample of 1,043 engineering freshmen, they identified ten cognitive and nine non-cognitive variables that aided in predicting freshman success. Six of the nineteen variables were accurate at predicting student success prior to college enrollment, and those included the HSGPA, algebra and chemistry sub-scores on the university placement test, as well as gender. Levin and Wyckoff also found that HSGPA is not a constant predictor of performance and is an important predictor during the first two years of college for engineering majors. [5]

Demographics

Our sample used a total of 472 students who entered the University of New Mexico as Pre-Engineering majors from 1998 to 2002 (Tables 1 and 2). We found that the SOE student is on average a little older than the university cohort; not surprisingly, our ratio of women to men is much lower than the university freshman cohort. When considering the HSGPA, SOE students entering during the last four years have a mean HSGPA of 3.55 on a 4.0 scale, while the freshman cohort for the university has a mean HSGPA of 3.28 for the same period. Students enrolled in the SOE Pre-Engineering Program also have higher entrance exam scores, and their SAT scores, on average, are 100 points higher than those students in the general university cohort. School of Engineering Pre-Major students exhibit higher ACT scores also, averaging 1.77 points above those for the university cohort.

Predicting Performance

We were interested in whether or not there was a correlation between ACT/SAT scores, HSGPA and college level academic success in science and mathematics courses, as measured by an average of the grades earned in these courses. We were searching for indicators that would identify those students more likely to be successful in completing the engineering curriculum, since math and science are the basics for the understanding and communication in the field of engineering. In the following analyses, r is the correlation between predicted and observed scores and p is the statistical significance of the regression. A higher p value indicates a greater significance of correlation between the exam score or sub-score and grades in college-level math and science courses.

We began with the college entrance exams scores since those were the best available tools for identifying background preparation for our students. We decided to test the correlation between the SAT and ACT test, including the sub-scores and composite exam scores, and an average of all grades in college-level math and science courses (CGPA). We also sought a correlation between HSGPA and performance in the college-level math and science courses.

In his study, Astin found that the SAT math sub-score and HSGPA to be the greatest predictors of college level performance. In our sample, of the composite SAT and the two sub-scores, math and reading, only the SAT math was correlated with any significance to college level GPA in science and mathematics courses. In other words, a higher score on the SAT math subtest does not necessarily mean that a student will then have a higher level of performance in college level math and science courses. We found no significant correlation between HSGPA and performance in college level math and science courses. Please see Tables 3 and 4 for the regression analyses and correlation information.

We analyzed the components of the ACT exam, which include English, Math, Reading and Science. Because each of these tests was correlated with performance in college level science and math courses, we began with a regression that included each of them as predictors in a simultaneous regression, then removed any that were not significant. The most significant regression was the ACT Reading sub-score. The theory that we hold is that reading and retention of material is crucial to understanding math and science.

Our intent was to run an additional analysis that included both SAT and ACT scores and sub-scores for students who had taken both exams, to see if the combination was an accurate predictor of performance, but the sample did not include enough students with SAT scores and ACT scores to perform the regression.

Summary

We now know our student demographic, and can make fairly accurate predictions of our students' expected performance based on a number of factors including HSGPA and entrance exam scores. In this population the most accurate predictor of college level performance was the ACT Reading sub-score. This information will aid us in course placement for beginning engineering students and as a result will yield higher grades in the math and science courses that are so necessary to the basic engineering education and better performance in engineering major courses.

We have "hard" information regarding student academic success and retention to convey to potential engineering students. We will continue to track all factors discussed in this paper, demographics, entrance exam scores and retention and graduation rates for our freshmen cohorts. This information will allow us to fine tune our summer new student LOBOrientation sessions, make better recommendations for students interested in pursuing majors in engineering and allow us to better focus our recruiting efforts on specific student populations.

Table 1
School of Engineering Freshmen Cohorts

Year of Admission	1998	1999	2000	2001
Total Entering Cohort	68	141	120	143
Female	16.1%	14.8%	21.6%	23.7%
Male	83.8%	85.1%	80.8%	76.2%
Native American	8.8%	.7%	3.3%	0%
African American	0%	.7%	.8%	3.4%
Asian/Pacific Islanders	8.8%	5.6%	5%	1.3%
Hispanic	23.5%	19.1%	24.1%	23.7%
White, Non- Hispanic	57.3%	68.7%	67.5%	69.9%
Mean Age	22.8	22	21	19.9
Mean HSGPA	3.48	3.50	3.63	3.57
Mean ACT Composite	23	23	26	22
Mean SAT Composite	1237	1120	1246	1184

Table 2
University of New Mexico Freshmen Cohort Groups

Year of admission	1998	1999	2000	2001
Total Entering Cohort	2665	2764	2639	2405
Female	56%	56%	57%	56%
Male	44%	44%	43%	44%
American Indian	5%	3%	4%	4%
Black, Non Hispanic	3%	3%	3%	3%
Asian/Pacific Islanders	4%	3%	3%	4%
Hispanic	36%	35%	37%	36%
White, Non- Hispanic	50%	53%	50%	51%
Mean Age	18.6	18.6	18.6	18.6
Mean HSGPA	3.25	3.27	3.29	3.32
Mean ACT Composite	22.1	22.1	22.1	22.0
Mean SAT Composite	1077	1068	1082	1061

Table 3
Regression Analysis

Predictor	Intercept	B	F	df	P	$S_{Y \mid X}$	Adjusted R^2
SAT Math	-1.75	.005	4.459	(1,33)	.042	.79	.092
ACT Reading	.692	.081	10.805	(1,77)	.002	.984844	.112
High School GPA (HSGPA)	-1.58	1.228	37.457	(1,87)	<.0005	.81	.293

Table 4
ACT Correlations

Constant	Standardized Coefficients Beta	Sig.
ACT_English – GPA	r = .281	p = .012
ACT_Math - GPA	r = .302	p = .007
ACT_Reading – GPA	r = .351	p = .002
ACT_Science – GPA	r = .273	p = .015

References

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