Abstract No. : 007-0216

Abstract Title: Investigating Academic Success Factors for Undergraduate Business Students

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Draft: February 20, 2007

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Abstract

Student academic performance is of major interest to all stakeholders of higher education institutions. This study questions whether or not statistical analysis of information that is readily available in most universities' official records system can be used to predict overall academic success. In particular, this study is an attempt to understand factors that affect academic success for business students by examining gender, age, ethnicity, and performance in two required core knowledge courses as predictors of academic success for a large sample of undergraduate students at an AACSB-accredited business school. The results suggest that student performance is significantly related to some basic demographic variables, but the strongest predictors of overall academic success are the grades the students receive in the core knowledge courses that are typically taken in the earlier semesters of business students' plans of study.

Investigating Academic Success Factors for

Undergraduate Business Students

Introduction

How predictable is the academic success of individual undergraduate students at an AACSB-accredited business school? As a group, undergraduate business students pose many different intelligence levels, behaviors, lifestyles, study skills and habits, preferred learning methods, experiences, backgrounds, and demographics. The complexities of the interactions between these factors make it difficult to predict *a priori* how successful any given student will be in an undergraduate business program.

The question considered in this study is whether statistical analysis of generally available information in most universities' official records systems about students engaged in business studies can identify *ex post* factors that predict these students' levels of academic success. In particular, this study considers whether grades received in certain required core knowledge courses that are typically completed early in a business student's plan of study can serve as good predictors of the student's overall grade point average at graduation. Such courses tend to have reputations as "weed out" courses and student performance in these courses is sometimes perceived as a useful predictor of a student's overall future success in business studies.

The analysis presented here suggests that student performance is significantly related to some basic demographic variables, but the strongest predictors of overall academic success are the grades the students receive in core knowledge courses. The findings of this study are

important for educators who are developing curriculum for core knowledge courses in business schools as well as the administrator who would like to predict attrition or retention rates early in business students' plans of study.

The next section of this paper provides an overview of several published studies that have examined intellectual and non-intellectual factors that may have value in predicting academic success. The second section describes a data sample containing academic and demographic information on 6,984 students who recently graduated from an AACSB-accredited business school. The third section proposes a method for analyzing the data to detect relationships between the available variables for the sample. The final section describes the results of applying this analysis method to the data and summarizes the findings of this analysis.

Literature Review

Numerous published research studies have considered a variety of potential predictors of academic success for college students. Most of these studies focus on variables that attempt to measure students' intellect and other non-intellectual variables that attempt to measure student's personality traits, behavioral tendencies, and demographic characteristics.

For college students in general (not necessarily business students), analyses by Willingham (1985), Young and Barrett (1992), Cabrera, Nora and Castaneda (1993), Mouw and Kkanna (1993), Eimers and Pike (1997), and Noble *et al.* (1999) provide evidence that intellectual variables can be useful predictors of overall academic outcomes. These intellectual variables include ACT and SAT scores, high school grades, and various measures of writing, quantitative, qualitative, and technology skills.

In studies specifically related to undergraduate business students, Brookshire and Palocsay (2005) and Smith and Schumacher (2006) consider such intellectual variables as SAT scores, percentile rank in high school graduating class, scores on college mathematics placement exams, grades in specific general education courses, and college grade point averages as predictors for success in an introductory management science course and graduates of an actuarial studies program (respectively). In general, intellectual variables such as these are statistically significant predictors of academic success (with the expected signs) for college students in general and business school students in particular, but the inclusion of non-intellectual variables has also been shown to increase success predictability for both types of students.

Studies that consider non-intellectual variables as predictors of academic success include those by Cantor *et al.* (1986), Wolfe and Johnson (1995), Harackiewicz *et al.* (2002), and Brookshire and Palocsay (2005), Nonis *et al.* (2005), and Smith and Schumacher (2006). Non-intellectual variables include demographic, behavioral, and personality constructs. Demographic variables considered in these studies include gender, race/ethnicity, age, and marital status. Behavioral variables include time spent on class/exam preparation, assignments, and outside work activities. Personality variables include self-assessed measures proposed to measure the level of students' academic motivation (achievement striving) and their confidence in their own abilities (self-efficacy). In general, the results from these studies suggest that some gains in predictability can be achieved by including non-intellectual variables in the analysis, but there is considerable variation in the significance of these variables across the studies identified here.

Although these studies provide some understanding of the intellectual and non-intellectual factors that may predict academic success for college students, none of the studies

described above specifically focus on the role of performance in required business core knowledge courses in predicting overall academic success for business students. Such courses are usually completed early in a student's plan of study (typically in the junior year) and the grades students earn in these courses may serve as good indicators of the student's overall academic success later in the degree program. The present study attempts to contribute to the understanding of factors affecting academic success for business students by examining gender, age, ethnicity, and performance in two required core knowledge courses as predictors of academic success for a large sample of undergraduate business students in several different degree programs (majors) at an AACSB-accredited business school.

Data Sample

To investigate factors affecting the academic success of undergraduate business students, a sample of 6,984 grade point averages was obtained from the official university records system at Florida Atlantic University (FAU) for recent graduates with undergraduate degrees in business along with their age, gender, ethnicity, major, minors (if any), total credit hours earned, and grades received in two required core knowledge business courses that are typically completed in the first year of business studies (junior year).

The students included in this sample are graduates of the Barry Kaye College of Business at FAU, a Southern Association of Colleges and Schools (SACS) accredited, public university located in southeast Florida. As of 2006, FAU had enrollment of 26,000+ students, including 6,300+ full- and part-time business students at the graduate and undergraduate level. The business school is fully accredited through the doctoral level by AACSB International, The Association to Advance Collegiate Schools of Business.

Business students at FAU can choose to major in one or more of the following fields of study: Accounting, Computer Information Systems, Economics, Finance, Health Administration, International Business, Management, Management Information Systems, Marketing, and Real Estate.[1] A variety of minors (usually 9 credit hours) are also available that allow business students to combine courses from different majors and create customized plans of study.

Between 2000 and 2005, the Barry Kaye College of Business conferred business degrees on 6,984 undergraduate students. Of these graduates, 6,229 of them received grades in either MAN3506 (Operations Management) or FIN3403 (Principles of Financial Management) or both during their degree programs, usually during their first year of business studies (junior year). (Some graduates were not required to take one or both of these courses at FAU because they have completed substitute courses at other schools and transferred the credits to FAU.)

These two courses have the reputation among some students and faculty as being "weed out" courses that serve as a screening mechanism that may identify students who are not adequately prepared for business studies even though the students meet the initial admission standards for the Barry Kaye College of Business. The Operations Management course provides students with an overview of the basic concepts and techniques of managing operations both in manufacturing and non-manufacturing sectors, including operations strategy, product and process design, demand forecasting, facilities layout and location, materials management, inventory management, production planning, and quality assurance. The Financial Management course provides students with a survey treatment of fundamental financial management issues, including capital budgeting, cost of capital and financial decision making. Both courses are

taught with a common syllabus, grading scheme, and final examination to maintain a minimum measure of consistency across instructors.

The data sample for this study consists of the 6,229 students who graduated from the business school between 2000 and 2005 and attempted one or both of the core knowledge courses described above. The average grade point average (GPA) for graduates over the study period is 2.954 on a 4.0 scale. Adjusting each student's GPA for each student to remove the influence of the grades earned in MAN3506 and FIN3403 changes the average GPA for the sample to 2.944 on a 4.0 scale.

For the full sample, 83.3 percent (5,190) of the graduates took both MAN3506 and FIN3043, 94.0 percent took MAN3506, and 89.2 percent took FIN3043. The average grades received by students taking MAN3506 and FIN3043 are 3.274 and 3.058, respectively (letter grades converted to the numerical 4.0 scale). The average age of graduates over the study period is 28.2 years. Of the full sample, 45.9 percent of the graduates are male and 54.1 percent are female, 58.9 percent are White, 16.3 percent are African-American, 16.5 percent are Hispanic, 7.4 percent are Asian, and less than one percent are Native American or "other" ethnicity. Additional descriptive statistics for the variables available for this study are provided in Table 1.

Statistical Analysis Method

Previous studies of academic success factors have used several different statistical analysis methods to explore the relationships between academic success (typically measured by GPA) and intellectual and non-intellectual predictor variables. These methods include simple correlation analysis, ANOVA, OLS regression, hierarchical regression, and logistical regression,

among others. For this study, a truncated regression analysis of the following conceptual model is appropriate for reasons described below:

ADJUSTED GPA = f(gender, age, ethnicity,MAN3506, FIN3403, major, year, minor)

In this conceptual model, overall grade point average at graduation (adjusted to remove the grades in MAN3506 and FIN3403) is a function of the student's gender, age at graduation, ethnicity, grades earned in the core knowledge courses MAN3506 and FIN3403, choice of major, graduation year, and whether or not the student also earned a minor to supplement the major. Including students' choice of major and minor in the model addresses the potential for self-selection into majors and minors where professors tend to grade with more (or less) rigor. Including year of graduation in the model addresses the potential for any linear grade inflation/deflation over the study period.

A truncated regression approach is appropriate for investigating this conceptual model sample because some observations in the population (all students who attended the FAU business school during this time period) are systematically excluded from the analysis because they were dismissed from the program due to poor performance (cumulative GPA of less than 2.0 on a 4.0 scale) prior to graduation from the program.[2] Thus, the sample is drawn from a restricted part of the population: the sample is "truncated from below" with a minimum GPA of 2.0 for all observations.

Inferences drawn from analysis of truncated data samples can be biased by the omission of information in the truncated observations if the OLS estimator is used to fit the model. The classic example of the impact of such bias is the dramatic failure by political forecasters to predict Truman's presidential victory over Dewey in the 1948 U.S. presidential election. As described by Kennedy (2003, p. 286), surveys were taken via telephone prior to the election at a

time when telephones were more likely to be owned by wealthy voters. These surveys indicated that Dewey would win the election, but the unmeasured variable wealth affected both the survey answers and the probability of the respondents being selected to participate in the survey. The surveys suffered from selection bias because the responses were drawn from a truncated sample.

A more formal exposition of the truncated sample problem (following Long (1997)) is summarized below. Assume that the truncated variable x has a normal distribution with mean μ and standard deviation σ. The density function of the truncated normal distribution is

$$f(x \mid a < x < b) = \frac{f(x)}{\Phi\left(\frac{b-\mu}{\sigma}\right) - \Phi\left(\frac{a-\mu}{\sigma}\right)} = \frac{\frac{1}{\sigma}\phi\left(\frac{x-\mu}{\sigma}\right)}{\Phi\left(\frac{b-\mu}{\sigma}\right) - \Phi\left(\frac{a-\mu}{\sigma}\right)}.$$

where φ and Φ are the density and distribution functions of the standard normal distribution. When the truncation is "from below" (with a in this situation equal to 2.0), the mean of the truncated variable is greater than the true mean of the distributed and the variance is less than the true variance.

In the presence of truncation, Ordinary Least Squares is a biased estimator when the goal is to draw inferences about the full population. (OLS is, however, unbiased if the goal is to draw inferences only about the restricted population). Maximum Likelihood Estimation (MLE) provides an unbiased estimate of the parameters of the regression equation when the dependent variable is truncated. The log likelihood function when a is the lower limit and b is the upper limit is

$$L = -\frac{n}{2}\log(2\pi\sigma^2) - \frac{1}{2\sigma^2}\sum_{i=1}^{n}(y_i - x_i\beta)^2 - \sum_{i=1}^{n}\log\left[\Phi\left(\frac{b-x_i\beta}{\sigma}\right) - \Phi\left(\frac{a-x_{i\beta}}{\sigma}\right)\right].$$

Fitting the conceptual model provided above to the data sample using MLE provides the results discussed in the next section.

Results

Tables 2 and 3 show the truncated regression results for the full sample with 6,229 observations (all graduates who completed either or both of MAN3506 and FIN3403) and for the reduced sample with 5,190 observations (only those graduates who completed both MAN3506 and FIN3403). The Wald χ^2 statistics for both models provide strong evidence that the models provide a good fit for the data, with both statistics being significant at greater than the 99.99% level. Similarly, the *pseudo-*R^2 for the equations indicate that the models account for (or "explain") 35.5 percent and 38.6 percent of the variation in undergraduate business students' adjusted overall GPA.

The results in Table 2 (sample of students completing either or both MAN3506 and FIN3403) suggest that the average grades earned in these two core knowledge courses are positively related to students' ultimate GPA. More specifically, a one-letter-grade increase in a student's average grade from MAN3506 and FIN3403 suggests an increase in overall adjusted GPA at graduation of 0.421, or just under a half letter grade. This result is arguably the most important finding from this analysis.

The results also indicate that older students and female students tend to have higher GPA than younger students and male students. The coefficients on the ethnicity variables indicate that African-American, Hispanic, and Asian students tend to have lower GPA at graduation than White students (the omitted category). There is evidence that students choosing to major in Economics, Health Administration, and International Business tend to have higher GPA at graduation than students who choose other majors (Management is the omitted category). The coefficient on the YEAR variable is not significantly different from zero, dispelling the perception that grades are inflating/deflating over the study period. The coefficient on the

MINOR variable is not significantly different from zero, suggesting that students who include a minor in their plan of study do not earn a different GPA from those students who do not include a minor.

The results for the sample of students who complete both MAN3506 and FIN3403 are shown in Table 3. In this model, the grades received in the two core knowledge classes are treated as separate independent variables. The results indicate that overall GPA is higher by 0.287 for students who earn one-letter-higher grade in MAN3506 and by 0.192 for students who earn a one-letter-higher grade in FIN3403. Again, the strong relationship between grades in these two core courses and overall academic success is perhaps the most important finding from this analysis.

The results also indicate that female students have higher GPA than male students, that older students have higher GPA than younger students, that White students have higher GPA than African-American, Hispanic, and Asian students, and that students majoring in Economics, Health Administration, and International Business have higher GPA than students majoring in other fields of study. Again, no evidence is found to suggest there is any trend in overall GPA over the study period or that students who add a minor to the study plans earn different GPA than those who do not.

Conclusions

In summary, the analysis presented here provides useful insight into the factors that affect the academic success of undergraduate business students. Previous research on academic success factors suggests that both intellectual and non-intellectual variables may serve as useful predictors of a student's academic success. This study contributes to that line of research and

shows that grades earned by students in two core knowledge courses that are typically taken early in a business school plan of study are good predictors of overall academic success. These findings support the contention that these two core knowledge courses may serve as "weed out" courses in the business school curriculum.

The analysis also confirms that certain demographic variables (age, gender, and ethnicity) can be useful indicators of students' overall academic success. The analysis controls for students' choices for majors and minors and for potential grade inflation/deflation over the study period. The data sample does not include behavioral or personality variables that other researchers have shown to be important as predictors of academic success, but future research may permit these issues to be examined more carefully.

Overall, the results of this study provide strong evidence that information that is readily available from most universities' official records systems can be useful in predicting students' future academic success. By treating student performance in the core knowledge courses as an "early warning signal," faculty, administrators, and students might be able to identify students who could benefit from early intervention and help them increase their probabilities of academic success in business studies.

End Notes

[1] The Hospitality and Tourism Management major was created in 2004, but only 2 students had completed the major as of 2005 (the last year of the study period). Additionally, FAU combined the MIS and CIS majors in late 2003 and is no longer accepting students in the Computer Information Systems major, though a few students are still in the process of completing that major under rules that permit students to elect whether or not to adopt new curriculum after they have already specified a plan of study.

[2] The sample also omits students who transferred to other schools during their degree programs at FAU or otherwise voluntarily withdrew from FAU. We assume those transfers and withdrawals are randomly distributed and do not bias the remaining sample.

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Table 1: Descriptive Statistics for Variables in the Sample

$N = 6{,}229$

CONTINUOUS VARIABLES	*MEAN*	*STANDARD DEVIATION*
GPA	2.954	0.46
ADJUSTED GPA	2.944	0.46
MAN3506 GRADE	3.274	0.74
FIN3043 GRADE	3.058	0.93
AGE AT GRADUATION	28.245	7.01

BINARY VARIABLES	*COUNT*	*PERCENT*
DEMOGRAPHICS		
FEMALE	3,370	54.1
MALE	2,861	45.9
WHITE	3,672	58.9
AFRICAN-AMERICAN	1,018	16.3
HISPANIC	1,026	16.5
ASIAN	462	7.4
NATIVE AMERICAN	28	0.4
OTHER	25	0.4
MAJORS		
MANAGEMENT	1,538	24.7
ECONOMICS	79	1.3
HEALTH ADMINISTRATION	192	3.1
FINANCE	1,040	16.7
ACCOUNTING	1,078	17.3
MARKETING	852	13.7
MANAGEMENT INFORMATION SYSTEMS	624	10.0
INTERNATIONAL BUSINESS	566	9.1
COMPUTER INFORMATION SYSTEMS	186	3.0
REAL ESTATE	74	1.2
MINOR	4,889	78.5

Table 2: Truncated Regression Results Obtained from MLE for all Graduates Completing Either or Both MAN3506 and FIN3403

dependent variable = adjusted GPA
N = 6,229

Variable	*Coefficient*	*Standard Error*	*Wald z-statistic*
AVERAGE GRADE MAN3506 FIN3043	0.421	0.009	47.640***
AGE AT GRADUATION	0.007	0.001	9.170***
FEMALE	0.118	0.011	11.070***
AFRICAN-AMERICAN	-0.177	0.015	-11.790***
HISPANIC	-0.076	0.015	-5.200***
ASIAN	-0.076	0.020	-3.780***
INDIAN	-0.049	0.077	-0.630
OTHER	0.107	0.079	1.340
ECONOMICS	0.088	0.047	1.880*
HEALTH ADMINISTRATION	0.339	0.032	10.660***
FINANCE	0.020	0.017	1.210
ACCOUNTING	-0.016	0.016	-0.960
MARKETING	-0.008	0.018	-0.470
MANAGEMENT INFORMATION SYSTEMS	0.012	0.020	0.590
INTERNATIONAL BUSINESS	0.072	0.020	3.540***
COMPUTER INFORMATION SYSTEMS	-0.021	0.032	-0.660
REAL ESTATE	-0.056	0.049	-1.140
YEAR OF GRADUATION	0.000	0.003	0.110
MINOR	0.007	0.013	0.550
Constant	0.657	6.329	0.100
Wald χ^2 *(19 d.f.)*	2,956.96***		
Pseudo-R^2	35.48%		

, **, and * indicate significance of the coefficients at the 10, 5, and 1 percent levels, respectively.*

Table 3: Truncated Regression Results Obtained from MLE for all Graduates Completing Both MAN3506 and FIN3403

dependent variable = adjusted GPA
N = 5,190

Variable	*Coefficient*	*Standard Error*	*Wald z-statistic*
MAN3506 GRADE	0.287	0.009	32.190***
FIN3403 GRADE	0.192	0.007	28.100***
AGE AT GRADUATION	0.007	0.001	8.870***
FEMALE	0.109	0.011	9.740***
AFRICAN-AMERICAN	-0.155	0.016	-9.660***
HISPANIC	-0.079	0.015	-5.140***
ASIAN	-0.055	0.021	-2.600***
INDIAN	-0.072	0.082	-0.880
OTHER	0.099	0.080	1.250
ECONOMICS	0.133	0.054	2.470**
HEALTH ADMINISTRATION	0.234	0.132	1.780*
FINANCE	0.017	0.017	1.030
ACCOUNTING	-0.012	0.017	-0.690
MARKETING	-0.001	0.018	-0.050
MANAGEMENT INFORMATION SYSTEMS	0.007	0.020	0.370
INTERNATIONAL BUSINESS	0.058	0.021	2.770***
COMPUTER INFORMATION SYSTEMS	-0.025	0.033	-0.760
REAL ESTATE	-0.059	0.049	-1.190
YEAR OF GRADUATION	0.004	0.003	1.330
MINOR	0.018	0.014	1.330
Constant	-7.611	6.602	-1.150
Wald χ^2 *(20 d.f.)*	2,813.710***		
Pseudo-R^2	38.64%		

, **, and * indicate significance of the coefficients at the 10, 5, and 1 percent levels, respectively.*