Non-Intellectual Variables as Factors in Determining Academic Success: Are Older Students Likely to be More Successful?[1]

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Using a sample of 445 graduates from a SACS-accredited institution and the maximum likelihood technique, this paper explores the relationship between overall academic success and intellectual and non-intellectual variables of students taking public administration courses. A large number of these students are working public officials thus the average age of these students are generally higher than those in other disciplines. Are these students likely to be more successful due to age or maturity? Other variables used in this model are gender, ethnicity, the number of years the student takes to graduate, and enrollment in a college minor. Because age proved to be a significant variable, the hypothesis that the older students who bring a wealth of knowledge acquired through employment and or life experience to the program should perform better in public administration program, was not rejected.

GPA, non-intellectual variables, academic success, Maximum Likelihood Estimator

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Introduction

What are the determinants of success for undergraduate public management, social work, urban and regional planning, and criminal justice majors? How important are non-academic variables in these majors? Is the fact that the average age of these students tends to be higher than students in the business or engineering program, a factor in achieving success in these programs, and does this cause older students to self-select to these programs? The argument can be made that because courses in public management, social work, urban and regional planning, incorporate a large amount of life skills and experience,older students tend to be more successful in these programs. An even broader question is whether or not statistical analysis of generally available information in most universities' official records systems about students engaged in undergraduate programs can identify *ex post* factors that predict students' levels of academic success.

Research of this nature is not new as studies by Author (2008, 2009, and 2011), Dolan (2008), Ullah and Wilson (2007), Nonis, Philhours, Syamil, and Hudson (2005), Wolfe and Johnson (1995), and Rubin (1977) have used non-intellectual variables to explain academic performance. For example among the conclusion in the paper by Author (2009) was that age of students, and the number of credits earned do not influence business majors' overall academic success, but Dolan (2008) research indicated that isolation and alienation impacted the academic success of minority students negatively.

The paper is structured as follows: the next section provides an overview of several published studies that examine intellectual and non-intellectual variables that may have value in predicting academic success. This is followed by the section describing describes the data used in this research. Although close to 4,400 students graduated from the university between 2009 -10 we limited the sample to only those students that completed programs in the College for Design and Social Inquiry at Florida Atlantic University to make the sample more uniform. The paper then proposes a method for analyzing the data to detect relationships between the available variables for the sample. The final section describes the results and summarizes the findings of this analysis.

Literature Review

Numerous published studies have considered a variety of potential predictors of academic success for college students and different techniques have been used in these studies. Some of these studies focused on variables that attempted to measure students' non-intellect variables, while others have used a combination of intellectual and non-intellectual variables. Also, some studies have used samples from the entire university while others have focused on students in a single college, discipline, or course. Although most studies have focused on undergraduate students, there have also been a few studies that focused on students seeking advanced degrees.

An early study by Rubin (1977) on the factors that affect academic success of business or economics majors, focused mostly on the *socioeconomic variables,* and included the following

independent variables: the education of the parents, hours per week studied (excluding class time), students' earnings, family size, and the number of times families moved. The estimated equation did not produce a good fit, and furthermore some of the a priori assumptions did not hold. For example the assumption that the education of parent is positively correlated with their child's academic success did not hold for either parent. Also, the assumption that students who worked outside the school they attend made lower grades, perhaps because their study time is more limited, did not hold. However the study did prove that study-time is important in enhancing students' grades and that there is a significant negative relationship between the numbers of times a family moves and academic success, and family size and academic success.

Along the same line as the Rubin (1977) study, non-intellectual variables were included in studies by Dolan (2008), Ullah and Wilson (2007), Nonis, Philhours, Syamil, and Hudson (2005), and Wolfe and Johnson (1995). Along with the usual demographic variables, Dolan (2008) included the "skills" that minority students need in order to achieve academic success at the college and university level. Dolan's (2008) most important conclusion was that isolation and alienation impact the academic success of minority students negatively.

Focusing on gender, Ullah and Wilson (2007) concluded that male students' relationships with peers influence their academic achievement negatively. The study by Nonis, Philhours, Syamil, and Hudson (2005)investigated the impact of non-intellectual variables such as demographics, personality, and behavior on academic success for students who are early and late in their undergraduate career. After controlling for intellectual variables, Nonis, Philhours, Syamil, and Hudson (2005, 57) concluded that non-intellectual variables explained between 16% and 23% of the variance in academic success of 269 business students.

Studies that focused on intellectual variables [Willingham (1985), Young and Barrett (1992), Cabrera, Nora and Castaneda (1993), Mouw and Kkanna (1993), Eimers and Pike (1997), Noble *et al.* (1999), Brookshire and Palocsay (2005) and Smith and Schumacher (2006)] provide evidence that intellectual variables can be useful predictors of overall academic success. The intellectual variables include ACT and SAT scores, high school grades, and various measures of writing, quantitative, and technology skills. For example, the research by Brookshire and Palocsay (2005) and Smith and Schumacher (2006)that focused on the intellectual variables of business majors include (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 on the success of students in an introductory management science course and in an actuarial studies program, respectively), concluded that intellectual variables are good predictors of academic success for college students in general and business school students in particular.

Other more recent studies that focus on factors affecting overall academic success of college student include Vivo and Franco (2008) and Author (2009 and 2011). Vivo and Franco (2008) used the receiver operating characteristic (ROC) curve that produces a standard method to measure the accuracy for academic success predictors. ROC analysis focuses on university entrance factor for predicting academic success. Author (2009) explored the relationship between overall academic success and performance on the Principles of Economics courses. The estimated model also included some demographic variables and the results show that the rank of professors teaching the

course, age of students, and the number of credits earned do not influence business majors' overall academic success. However, the grades earned on the Principles of Economics courses, gender, ethnicity, the major in which the student is enrolled, the number of years the student takes to graduate, as well as whether or not the student is completing a minor, significantly affected the overall academic success or the final GPA of business majors. In Author (2011) research that compared academic success of student enrolled in weekend bachelor degree business program, and students in the tradition bachelor degree business program, Author (2011) concluded that some demographic factors that are correlated with the level of overall academic performance in the weekend program significantly differ from the demographic factors that are correlated with students' performances in the traditional program. However, Author (2011) concluded that underperformance by minority students is consistent in both traditional and weekend programs.

Various estimation techniques have been used to study students' performance. Chan, Shum, and Wright (1997) used the TOBIT model and found that class attendance and status have positive and significant effects on course grades for finance majors, but that GPA, course load, number of credit hours currently enrolled, weekly work hours, and age are not significant determinants of course grades. Didia and Hasnat (1998) used an input-output approach to consider the determinants of grades received in the principles of finance course for students enrolled at the State University of New York at Brockport. Van Ness, Van Ness, and Kamery (1999) and Johnson, Joyce, and Sen (2002) employed both ordinary least squares (OLS) and ordered-probit regression techniques to show the effect of student effort, full- and part-time status and rank of instructors, declared majors, and mathematical background on student success in basic finance courses. Author (2009 and 2011) used maximum-likelihood estimators in their research.

Data Sample

To investigate factors affecting the academic success of undergraduate students, a sample of 445 grade point averages was obtained from the official university records system at Florida Atlantic University (FAU) for graduates from the College of Design and Social inquiry. The students' age, gender, ethnicity, minor (if any), and total credit hours earned were also collected from the university records. The sample was obtained from a population of 4,399 students that graduated from Florida Atlantic University between 2009 and 2010.

FAU, currently serving over 28,000 students on seven campuses, is a comprehensive public university that is fully accredited by the Southern Association of Colleges. FAU offers more than 170 undergraduate and graduate degree programs to a student body that ranks as the most racially, ethnically and culturally diverse in Florida's State University System.

The College for Design and Social Inquiry at FAU is a unique configuration of professional programs addressing social justice, design, public policy and planning in and for communities. The College for Design and Social Inquiry at FAU is accredited by the Southern Association of Colleges and Schools (SACS), and currently offers courses to just over 2,400 students or 8% of the student body. Of this amount 2,000+ are full-time students and 370+ are part students at the graduate and undergraduate level.

At the undergraduate level, the College for Design and Social Inquiry awards the degrees of Bachelor of Architecture, Bachelor of Arts majoring in Criminal Justice, Bachelor of Public Management, Bachelor of Social Work, and Bachelor of Urban and Regional Planning. It also awards a joint Bachelor of Architecture/Master of Urban and Regional Planning degree and several minors. Applicants for admission to the College for Design and Social Inquiry must meet the general freshman or transfer admission requirements of the University. Students applying to the College for Design and Social Inquiry must have a minimum cumulative grade point average of 2.0 (except in the Bachelor of Social Work, which requires a minimum FAU GPA of 2.5 to begin the practice class sequence and to be eligible for field education), and have completed the necessary prerequisite coursework associated with the particular prospective degree program. In addition, transfer students should have fulfilled the University's requirement regarding the College Level Academic Skills, writing and mathematics requirements. All candidates for a baccalaureate degree from the College for Design and Social Inquiry must satisfy the general baccalaureate degree requirements of the University with a minimum of 120 approved credits in academic courses and a 2.0 or above GPA. A minor in the College for Design and Social Inquiry consist of 15 credits in upper-division courses. This option allows students to combine courses from different majors and create customized plans of study.

Based on the information gathered for this research, the average age of students at the time of graduation was 28.656 years. This is higher than the average age of 24 for undergraduates at FAU. Of the total, 176 or 39.55 percent of the graduates were male while269 or 60.45 percent were female. This mirrors the gender composition of the university. With regards to race, 210 or 47.19percent were white, 148 or 33.26 percent were African-American, 69 or 15.51 percent are Hispanic, and 18 or 4.04 percent were Asian. Only 5or 1.01 percent of the sample completed second bachelor's degrees, while 83or 18.7 percent completed a minor, the most popular of which was sociology. Students enter programs in the School of Design and Social Inquiry either as transfers from community college and other institutions or as freshmen. From the sample, 343 or 77.1 percent of the graduates were transfers and 102 or 22.9 percent of the graduates started as freshmen. Although the School of Architecture is included in the College of Design and Social Inquiry, graduates in 2010 were excluded from this sample because their program requires 159 credits hours and takes 5 years to complete. Additional descriptive statistics for the variables available for this study are provided in Table 1.

Table 1: Descriptive Statistics of Variables in the sample
N = 445

CONTINUOUS VARIABLES	MEAN	STANDARD DEVIATION
GPA	2.9914	0.4254
Age at Graduation	28.66	8.9108
Total Hours Earned	136.68	25.209

BINARY VARIABLES	COUNT	PERCENT
DEMOGRAPHICS		
Female	269	60.45
Male	176	39.55
White	210	47.19
African-American	148	33.26
Hispanic	69	15.51
Asian	18	4.04
MINOR	83	18.65
TRANSFERS	343	77.1
NON-TRANSFERS	102	22.9
SECOND BACHELORS	5	1.01
DISTRIBUTION OF MAJORS		
Criminal Justice	264	59.33
Public Administration	35	7.87
Social Work	98	22.02
Urban & Public Affairs	48	10.78

As expected, the sample of ages used in this paper is not normally distributed but is positively skewed. In fact, the Anderson-Darling and Kolmogorov-Smirnov normality tests suggest the rejection of the normality assumption at the 5% level of significance. The plots are shown in Figures 1 and 2. The sample of GPAs used in this paper is normally distributed and this time the Anderson-Darling and Kolmogorov-Smirnov normality tests confirm the normality of the distribution of GPA's at the 5% level of significance. The plots for GPA are shown in Figures 3 and 4.
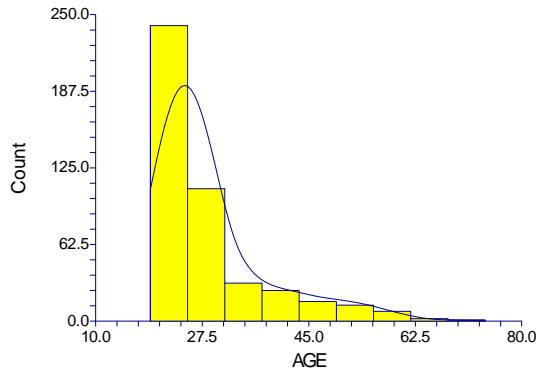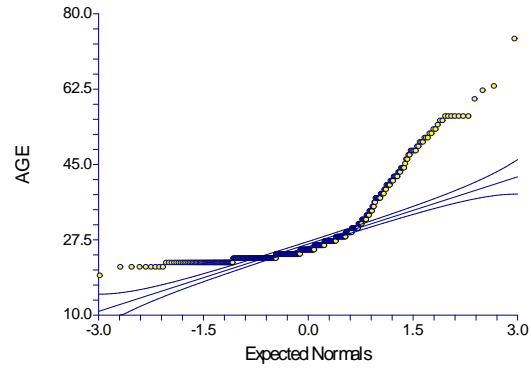
Figure 1: Histogram of Age
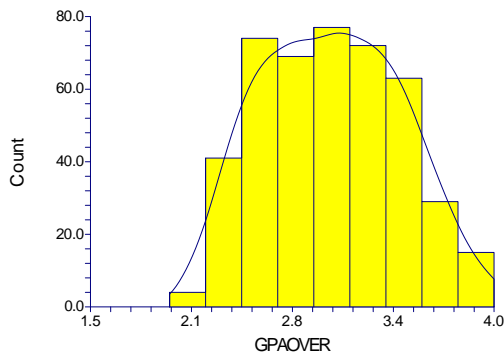

Figure 2: Normal Probability Plot of Age
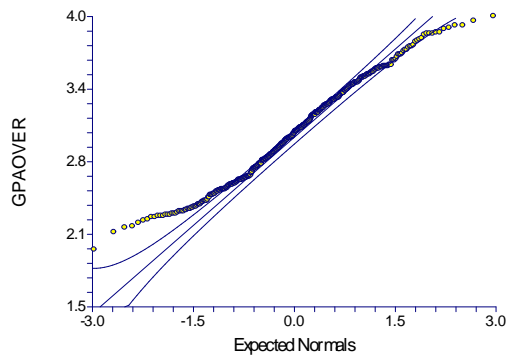

Figure 3: Histogram of GPA

Figure 4: Normal Probability Plot of GPA

The following empirical model provides a method of estimating and comparing the impact of demographic factors on the overall academic success of students:

$$GPA = f\ (age,\ gender,\ ethnicity,\ hours\ earned,\ minor,\ program,\ nontransfers) + e \qquad (1)$$

In Equation (1), GPA is the student's final grade point average at graduation, age is measured in years at graduation, gender is indicated by a dichotomous variable taking the value "1" if the student is female and "0" otherwise, ethnicity is indicated by dichotomous variables taking the value of "1" when the student is African American, Hispanic, Asian, or Native American and "0" otherwise (White is the omitted category). Graduates who entered the program as freshmen (nontransfers) are also represented by a dichotomous variable with the value "1" if the student

started as a freshman and "0" if the student entered the program as transfers from another institution.

The "robust regression" technique is used in recognition of potential outlier observations in the data regarding student age and total student credit hours[2].   Essentially, robust regression conducts its own residual analysis and either down-weighs or completely removes various observations from the data set, thereby minimizing the impact of outliers on the coefficient estimates. The robust regression technique falls into the family of maximum likelihood estimators. This estimator minimizes the sum of a function ρ(.) of the residuals. That is, these estimators are defined as the β's that minimize

$$\min_{\beta} \sum_{j=1}^{N} \rho(y_j - x_j'\beta) = \min_{\beta} \sum_{j=1}^{N} \rho(e_j) \tag{2}$$

The residuals follow the normal distribution as setting $\rho(u) = \frac{1}{2}(u^2)$ results in the usual method of least squares. Because M-estimators are influenced by the scale of the residual, a scale-invariant estimator was found by solving

$$\min_{\beta} \sum_{j=1}^{N} \rho\left(\frac{y_j - x_j'\beta)}{s}\right) = \min_{\beta} \sum_{j=1}^{N} \rho\left(\frac{e_j}{s}\right) = \min_{\beta} \sum_{j=1}^{N} \rho(\mu_j) \tag{3}$$

where "s" is a robust estimator of scale and yields an approximately unbiased estimator of the standard deviation of the residual when N is large and the error distribution is normal. The value of s is given by equation (4).

$$s = \frac{(\text{median})|e_j - \text{median}(e_j)|}{0.6745} \tag{4}$$

The robust regression iterative process that is used to obtain the coefficients starts with the ordinary least squares regression coefficients and continues until there is little or no change in the regression coefficients from one iteration to the next. Although a minimum of 5 iterations is normal, to ensure convergence, we used 30 iterations to find the outliers[3]

Discussion of Results

The robust OLS regression results for the empirical model give insight into the relationships between GPA and the various independent variables discussed above. For the regressions, the R^2 (0.5145) is relatively low, as should be expected in cross-sectional models of this type. However,

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[2]Outliers violate the "normality" assumption in OLS estimation because they receive much more "weight" than they deserve and thus pull the least squares fit too much in their direction.

[3]See Hamilton (1991) and Montgomery, Peck, and Vining (2001) for more discussion of robust regression.

the *F*-statistics (34.4956) suggest rejection of the null hypothesis that all coefficients in the models are zero.

From Table 2, the coefficient for the gender variable indicates that females are about 16% more likely to graduate with a higher GPA than males. This of course is quite disconcerting because of the emphasis that is placed on ensuring that both males and females have equal opportunities. The results also show that GPA is an increasing function of age: an additional year of age increases final GPA by approximately 0.03 GPA points. Because age is a factor, the hypothesis that the older students who bring a wealth of knowledge acquired through employment and or life experience to the program should perform better in the business program, was not rejected. This differs from previous research by Author (2009) that concluded that age was not a factor in the performance of undergraduate business major.

TABLE 2

Table 2: Robust Regression Results for Entire Model

Dependent Variable: GPA

Independent Variable	Regression Coefficient	Standard Error	T-Value (Ho: B=0)	Probability Level
Intercept	3.025981	0.08755	34.5620	0.000000
Criminal Justice	0.041280	0.03921	1.0528	0.293162
Pub Administration	0.034709	0.05778	0.6007	0.548387
Social Work	0.067932	0.04526	1.5011	0.134223
MINOR	0.136066	0.03159	4.3077*	0.000021
FEMALES	0.160398	0.02618	6.1268*	0.000000
BLACKS	-0.101774	0.02688	-3.7856*	0.000180
HISPANICS	0.341974	0.03636	9.4042*	0.000000
ASIANS	-0.147289	0.05600	-2.6301*	0.008904
AGE	0.029350	0.01380	2.1026*	0.036203
NONTRANSFERS	-0.326271	0.02955	-11.0421*	0.000000
TOTALHRS	-0.001747	0.00046	-3.8403*	0.000145
R-Squared	0.514545			

Analysis of Variance Section

Source	DF	Sum of Squares	Mean Square	F-Ratio	Probability Level
Intercept	1	2085.55	2085.55		
Model	11	11.93418	1.08492	34.4956	0.000000
Error	358	11.25949	0.03145		
Total (Adjusted)	369	23.19368	0.06285		

Root Mean Square Error	0.17734	R-Squared	0.514545
Mean of Dependent Variable	2.96974	Adj R-Squared	0.499629
Coefficient of Variation	0.05971		

The coefficients for African American, Hispanic, and Asian students were significantly different from zero. However, whereas the negative coefficients for African American and Asian students suggest that they do not perform as well as white students, the positive coefficient for Hispanic students indicates that they outperform white students in this population. For African American students and Asian students, the results indicate that they are about 10% and 15% respectively less likely to graduate with a higher GPA than White students respectively, but for Hispanic students, the coefficients indicate that they are 34% more likely to graduate with a higher GPA than White students. Furthermore, the coefficients indicate that the performance of Asian students is the worst compared to all other ethnic groups.

The insignificance of the coefficients for criminal justice, public administration, and social work majors, indicate that there is no difference between their performance and the performance of urban planning (the control group) majors. However, students completing minors are 14% more likely to graduate with higher GPA that those not pursuing minors. Incoming freshmen (NONTRANSFERS) are 33% less likely to outperform transfer students, and the longer students spend in school in terms of the number of credit hours completed (TOTALHRS), the lower their GPA.

Conclusion

These results support the contention that older students with a wealth of knowledge acquired through employment and or life experience perform better in public administration program than younger students. Other nonintellectual variables were also significant determinants of academic success.

Determining the relationship between non-intellectual factors and academic success could prove useful for educators who are developing and designing programs in universities. The knowledge gained by research of this nature could better facilitate guidance and career planning decisions aimed at improving the student's overall chances of academic success.

The research could have benefitted by the inclusion of other variables like high school GPA and SAT scores. However, these were not available because of the difference in the mode of entry to the university. Students that entered as freshmen had SAT scores while those that entered as transfers from community colleges did not. The same was true for high school GPA.

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