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Is Matric Math a Good Predictor of Student's Performance in the First Year of University Degree? A Case Study of Faculty of Management Studies, University of KwaZulu-Natal, South Africa

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ABSTRACT Ordinarily speaking the performance of students at the first year commerce degree is related to matric total score and other socio-demographic variables. This study asserts that, since mathematical proficiency is a special skill that is necessary for commerce degree, matric (National Senior Certificate, NSC) math score is the key variable which significantly determines the pass rates in the first year university modules. The study tests this hypothesis with the new set of data for the University of KwaZulu-Natal with the help of an econometric model. Empirical results support the hypothesis and the study suggests some far-reaching policy implications for increasing pass rate and student retention in the commerce degree programs in South Africa.

INTRODUCTION

A very high failure rate leading to a very high drop-out rate in the tertiary education is major concern for many South African universities. The average drop-outs rate in South African universities comes to a shocking 40 percent of first year enrolment in the universities (MacGregor 2007). In 2005, some 120,000 students enrolled in higher education; some 30 percent (36000 students) of it dropped out in the first year of the study, another 20 percent (24 000) dropped out during second and third years. Of the remaining 60 000, only 22 percent graduated within the specified 3 year period for a generic bachelors degree; the dropout rate in some places is as high as 80 percent (Letseka and Maile 2008).The major reason for such high drop-out rate is financial health of students which does not permit them to pay the expenses incurred at the university. However, academic ability of the students is an equally important variable as confirmed by several studies (Duff 2004; Millar 2006; Tewari et al. 2008; Yathavan 2008). The concern of this study is specially focused upon the students who enrolled into commerce education in South African universities. For example, the drop-out rate in the Faculty of Commerce at the University of Witwatersrand ranged from 24 to 32 percent and only 47 percent year of first year students passed into their second year (Yathavan 2008). The matric score was found to be the most important predictor apart from others for success at the first year university courses (Yathavan 2008). Tewari et al. (2008) confirmed similar proposition for the first year students in the Bachelor of Commerce program at the University of KwaZulu-Natal.

Historically speaking, many studies have corroborated this hypothesis that success at first year courses in the university is highly correlated with matriculation results (Jawitz 1995; Nobel and Sawyer 1997; Mitchell et al. 1997). Some other studies have related the first year academic performance with marks for Mathematics, Physical Science and English (Eeden et al. 2001). Although the matric score in general has been used as predictor of academic performance at the university, it does mask some special abilities which are specific to a discipline. Eiselen et al. (2007) found that mathematical ability at the high school level is a key predictor of success at the first year bridging program in science, engineering and technology in the tertiary education. Ogbebor (2012) shows a statistically significant relationship between Additional Mathematics students and academic performance at the examinations. Bettinger et al. (2013) also argued that

English and Mathematics are effective predictors of college students' performance in the US. Mattern et al. (2012) indicated that SAT is purposely meant to evaluate a person's capability in academic success at the postsecondary level. Therefore, together with other indicators it has been applied in admission at the college level to measure students' success at various institutions. James and Tunde (2013) found a high correlation between the Cumulative Grade Point Average and the scores in Mathematics. Mathematics is also considered a special skill for students entering into commerce discipline.

This study purports that the matric mathematics score is a better predictor of academic performanceof the students in the first year courses at the Faculty of Management, University of Kwazulu-Natal (UKZN).

Objectives

The major objective of the study is to analyse whether matric mathematics score is a better predictor than matric aggregate score as such for predicting academic performance in the first year courses in the Faculty of Management at UKZN. The material of this study is organized under five sections. Section two provides a brief review of literature; followed by methodology and data in section three. The results and discussions are sketched in section four; subsquently followed by conclusions and recommendations

Discussion on Academic Performance

Voluminous literature exists on how to measure academic performance of students. Our task here however is to focus upon the first year performance in the commerce degree especially at the South African Universities. Generally speaking, the academic performance of students is related to: (1) characteristics of academic/non-academic staff members; (2) characteristics of students (Tewari et al. 2008). At the first year level, two sets of variable are known to affect the academic performance of a student: (1) school related variables which capture the quality of school education and the school achievements of students; and (2) non-school related variables such as personal characteristics of students such as ability, ambition, motivation; and so on. These characteristics may be well-correlated with social variables such as race, schooltype, income, and others. A detailed survey of determinants of academic performance in South African context was done by Parker (2006). Furthermore, Van Der Berg and Hofman (2005) found that approximately 95 percent of variation in a student's performance is attributed to student characteristics The study will hence focus primarily on school related achievements and their impacts at the first year university courses/modules.

Du Plessis et al. (2005) noted that the success in an introductory accounting course in UNISA was primarily related to proficiency in English language and prior experience in accounting and mathematics at the high school level. Age and student's positive attitude to accounting also enhanced the performance in the financial accounting course (Lane and Porsch 2002). Visser and Hanslo (2005) suggested that a high matric score raises the probability of success in the first year modules at the university. Prior exposure and proficiency in a module at the high school level also improves the student performance in that course done at the university level (Attiyeh et al. 1971). Increasing the mathematics requirements helped students to pass economics courses with a greater success (Kasper 2001). However, Cohn and Geske (1998) did not find any link in the pass rates in economics and math proficiency of students. Anderson et al. (1994) found that knowledge of calculus at school level determined how one did in the introductory economics at the university. Bargate (1991) confirmed that good mathematics score in high school as an indicator of success in accounting programs at Technikon, Natal. Miller (2006) found that matric total score and matric maths were highly correlated with performance in accounting modules in the first and second year at the ex-University of Natal based on two cohorts of data (1999-2003 and 2000-2009). Parker (2006) identified student characteristics on achievement on introductory microeconomics in South African universities; the study suggested that greater verbal and mathematical abilities had large and significant positive effects on student performance. Many other variables which capture student's psychological aspects are also a determinant in explaining the academic performance. For example, statistics anxiety and attitude and computer experience impact the

academic performance in statistics related courses (Zimmer and Fuller 1996).

MATERIAL AND METHODOLOGY

The data for the study were obtained from the Division of Management Information (DMI) of UKZN for two years 2009 and 2010. The analysis was done by correlating the pass rates in individual first year courses against the matric math score (math score 3 to 8 under the National Senior Certificate examination). In similar fashion, pass rates were correlated against the total matric score. A comparison between the two sets of data was done. The relationship were further tested by using regression analysis in which pass rate was specified as function of level of high school mathematics and matric scores.

RESULTS AND DISCUSSION

A perusal of Tables 1 and 2 is warranted. Two important tends are visible in both semesters (S1 and S2) in both years 2009 and 2010. One, as the level of mathematics score rises, the pass rate in each course, except the management courses (MGNT 101 and 102), increases. This trend can be seen consistently happening for both years. Two, pass rate in management courses is not related to matric math score at all—a very reasonable expected outcome as these courses do not require mathematical skills as such. The average pass rate in MGNT 101 was 94.5 percent in 2009 and 96.3 percent in 2010 (Tables 1 and 2); similarly, the pass rate in MNGT 102 was 88.3 percent in 2009 and 98.5 percent in 2010 (Tables 1 and 2) A crude measurement of pass rate increase and mathematics score is done in Table 3, using the following formula:

$$R = \frac{PB\text{-}P3}{5}$$

where,

P8 is pass rate when matric score is 8.

P3 is pass rate when math score is 3

R is the increase in pass rate for a unit increase in the mathematics score.

Table 1: Pass rate in individual first year courses vs matric math score, Faculty of Management Studies, UKZN, 2009

First year modules	*Matric math score*						*Average pass rate percent*
	3	*4*	*5*	*6*	*7*	*8*	
ACCT101	11	36	53	71	86	94	58.5
ACCT102	0	26	72	73	86	100	59.5
ECON101	9	14	25	47	65	94	42.3
ECON102	11	28	43	51	63	91	47.8
ISTN101	0	34	42	65	79	95	52.5
ISTN102	0	50	34	63	89	100	56
MGNT101	100	85	90	96	98	98	94.5
MGNT102	87	75	85	93	91	99	88.3
MATH134	0	10	33	60	84	97	47.3

Source: Author's calculations from data from UKZN

Table 2: Pass rate in individual first year courses vs matric math score, Faculty of Management Studies, UKZN 2010

First year modules	*Matric math score*						*Average pass rate percent*
	3	*4*	*5*	*6*	*7*	*8*	
ACCT 101	0	32	46	64	86	90	53
ECON101	21	36	48	59	83	95	21
ISTN101	33	45	55	65	80	89	57
MGNT101	93	94	96	97	100	98	96.3
MATH134	0	47	51	64	100	100	60.3
ACCT102	0	70	89	87	95	98	73.2
ECON102	57	47	63	69	84	97	69.5
ISTN102	67	48	71	81	80	85	72
MGNT102	97	99	98	98	99	100	98.5

Source: Author's calculations from data obtained from UKZN

Table 3: Percent increase in pass rate in first year university courses for a unit increase in Matric Math score, 2009-10, Faculty of Management Studies, University of KwaZulu-Natal

Course	*Percent increase in pass rate in response to unit increase in matric Math Score*		
	2009	*2010*	*Average*
ACCT 101	16.6	18.0	17.3
ECON 101	17.0	19.8	15.9
ISTN101	19.0	11.2	15.1
MGNT 101	-0.9	1.0	0.3
MATH 134	19.4	20.0	19.7
ACCT102	20.0	19.6	19.8
ECON102	16.0	11.9	11.90
ISTN102	20.0	3.0	11.8
MGNT 102	2.4	0.7	1.5
AVERAGE	14.4	11.2	12.8

Source: Estimation

A perusal of Table 3 reveals that an unit increase in the mathematics score led to an increase on the average in the pass rate of 12.8 percent in 2009 and 2010. But when the researchers excluded management courses, as their pass rates were not correlated with level of math score, the pass rate increased to 16.2 percent. In other words, on an average, one unit level of increase in math score led to 16 percent increase in the over-all pass rate in the first year courses except management modules. To further test the hypothesis, the following regression model was specified:

$$Y_i=\beta_0+\beta_1X_i+\beta_2X_{2i}+\beta_3X_{3i}+\mu_i$$

Y =Pass rate in percentage point;

X_{1i} =mathematics score in the matric examination (3-8)

X_{2i} =subject-dummy which takes a value of 0 for management modules and 1 for other modules.

X_{3i} matric total score

Because of high multicollinearity between the matric maths score and the matric total score, it was decided to drop the matric total score variable. The estimated results are presented in Table 4. The estimated regressions are highly significant and explain about 70-80 percent variation in the pass rate. The regression coefficients on matric mathscore and subject-dummy appear with right expected signs too. It is estimated that one unit increase in mathscore adds to the pass rate on the average by 12.5 percent (ranging for 10.64 in 2010 to 19.42 in 2009). The subject-dummy indicates that pass rate in other modules compared to management modules given the mathematics score is about 37 (36.54) percent lower in general. In other words, a good level of math score in the National Senior Certificate (NSC) assures a good pass rate in the first year courses in the bachelor of commerce program at the UKZN.

CONCLUSION

Based on the data analysis, it is argued that matric math score is a better predictor of academic performance of the first year courses at the Faculty of Management, University of Kwazulu-Natal. An unit increase in matric mathematics score added to about 12 to 14 percent pass rate in the first year courses in the Faculty of Management Studies, UKZN.

RECOMMENDATIONS

The major policy implications of this finding will be in terms of the setting admission requirements and retention strategy. Students with high maths score have a higher probability of passing first year modules and hence it would lead to high retention rate and lower academic exclu-

Table 4: Pass rate regressions for first year students, Faculty of Management Studies, University of KwaZulu-Natal

Equation	*Matric Maths score*	*Subject dummy*	*Constant*	*Adjusted R-square*	*N*	*F*
2009	19.42	-39.92	12.12	0.80	54	105.8
	(12.11)*	(-8.1)*	(1.0)			
2010	10.64	-33.68	38.86			
	(8.36)*	(-6.44)	(4.63)*	0.67	54	55.70
Aggregate	12.53	-36.54	25.49	0.72	108	136.41
	(13.44)	(-9.56)*	(9.16)*			

*Significant at 5 percent level of significance.
Source: Estimation

sion rates. If students are admitted with lower score in matric math, it is suggested that supplementary/augmenting courses in mathematics be offered to enable students to cope well in the degree program and thus help increase student retention. Such a strategy of augmenting mathematical skills in the first semester at the university will have far-reaching implications in terms of pass rate and academic exclusions. The study can be replicated at other universities to produce countrywide consensus on this issue.

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