Integrated Solutions for Infrastructure Development
Edited by Lau, H. H., Tang, F. E., Ng, C. K., and Singh, A.

ISBN: 978-0-9960437-3-1

CROSS TABULATION ANALYSIS: DETERMINANTS OF MATHEMATIC SUCCESS AMONG CIVIL AND BUILT ENVIRONMENT STUDENTS

JUSTUS N. AGUMBA

Dept of Construction Management and Quantity Surveying, University of Johannesburg, Johannesburg, South Africa

The socio-economic and demographic factors have been indicated to predict mathematics success. However, there is paucity of research to verify if these factors correlate with mathematics success at university level in South Africa. Hence, this paper reports on the socio-economic and demographic factors that correlate with mathematics success for civil and built environment students at a comprehensive university in South Africa. The data was obtained through, questionnaire survey from 197 students who were purposive sampled. The data was analysed using Statistical Package for the Social Sciences (SPSS) version 22. The study found that the correlation between the dependant variable and the independent variables that did not violet the assumption of each cell having more than five counts were insignificant. The cross tabulation results on frequencies should be interpreted with caution. The result indicates arithmetic difference in most of the independent variables. Male students performed better than female students in mathematics. However, the differences between the groups are not statistically significant as indicated with the Chi-square test.

Keywords: Biography, Construction, Elements, Examining, Factors, Undergraduate.

1 INTRODUCTION

South Africa fared poorly on the quality of mathematics and science education. The country was ranked 143 out of the 143 countries surveyed. On the quality of its education system it was ranked 139 out of 143 countries surveyed (World Economic Forum 2015). MacGregor (2009), indicated that vice-chancellors warned the South African government to expect more student drop outs, following shocking results of pilot National Benchmarking Test (NBT) in 2009.

Higher education institutions face greater challenges in relation to mathematics. The NBT results in 2009 revealed that only 7% of students were found to be proficient, therefore ready to study first year mathematics at the university. It was also suggested that majority of students would find it difficult to pass mathematics at university level without additional support (Dennis *et al.* 2012). With the reforms in academia since 1994, after the abolition of apartheid the government has engendered equity and access to higher education to deserving students after completing high school.

The objective of this research was therefore to undertake a prospective investigation of socio-economic and demographic factors that predict mathematics success in the current diverse student

population in the department of civil engineering and the department of construction management and quantity surveying.

2 LITERATURE REVIEW

Murray (2013) found that prior academic achievement, learning styles and academic resources led to mathematics success. Rajandran *et al.* (2015) revealed that gender and place of origin as insignificant determinants, the entry qualification was a weak factor, and the student's Cumulative Grade Point Average (CGPA) of entry qualification as the strongest variable that determines the CGPA of first year students' academic performance.

Mlambo (2011), implied, gender, age, learning preferences, and entry qualifications did not cause any significant variation in the academic performance of students. The researcher suggested further research on other factors that are known to influence academic performance such as: student motivation, socio-economic status and attendance. Whannell (2013) indicated that, the background information (gender, age, ethnicity, disability, secondary school, work status, and early enrolment) gathered during the enrolment process, does not contain sufficient information for an accurately separation of successful and unsuccessful students.

According to Tewari (2014) their findings indicated 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. In a study by Vanthournout *et al.* (2012) they found that academic success is predicted by relating and structuring, lack of regulation, and lack of motivation on students at the end of the year.

It is evident from this discussion that studies have been undertaken to identify and analyze the numerous factors that affect academic performance in various centers of learning. However, few studies have focused on separate disciplines of studies especially in the field of engineering and the built environment. This study fills this gap in South Africa context. This study purports that socio-economic and demographic factors are predictors of mathematics success for civil engineering and the built environment students. This is a major gap in the current study.

3 RESEARCH METHODOLOGY

The research philosophy was deductive. A survey method was adopted and purposive sampling was used. The study population consisted of students from the department of civil engineering technology third years and construction management and quantity surveying third and second years. These were students registered in the 2015 academic year in the Faculty of Engineering and Built Environment. The students had been assessed in mathematics in their previous years. 199 students completed the questionnaire in the middle of the first semester of 2015. Two of the questionnaires were not suitable for analysis. The questionnaire included personal questions; age, gender, students' accommodation, education sponsor, entry to the university, final high school maths result, citizenship, parents' highest education level and weekly allowance. The outcome variable was whether students passed mathematics at first attempt in the first major assessment at the end of the first semester. SPSS version 22 was used to perform the statistics.

The independent variable (IV) and the dependent variable (DV) relationship were tested using the Pearson Chi-Square. In order for the relationship to be significant the *p*-value should be less than 0.05 at 95% confidence. In order to interpret the relationship of the variables, they should not violet the assumption of having more than five expected counts per cell.

4 RESULTS AND DISCUSSIONS

Results in Table 1 indicate arithmetic differences between the different independent variables and the dependent variable. However, these arithmetic differences should be interpreted with caution. The Chi-square results should also be taken into consideration. However, based on the arithmetic differences 24.4% of female students did not succeed in mathematics in their first attempt compared to 15.1% of male students. This is an indication that female students underperformed in their first major mathematics assessment in the first semester of their study. Students who are 21 years and below outperformed students who were in the age bracket 22-25 years and those who were 26 years and above. The students who were accommodated in the university residence performed better than those who lived at home.

86.6% of Civil engineering students passed their mathematics at the end of the first semester compared to 78.5% of building students. This may suggest that civil engineering students are better equipped in mathematics than building students. Students who had allowances from R600.00 and above performed better than the students who had allowances less than R600.00. In relation to mathematics results in high school, those who got less than 50% during admission to the university 26.9% of students them did not pass at their first attempt. In line with the students who attained more than 50% in mathematics in high school 17.2% of the students did not succeed in their first attempt at the university.

Table 1. Cross tabulation demographic variables & mathematics success.

		Mathematics No	**Mathematics Yes**	**Total**
Gender	Male	15.1% (18)	84.9% (101)	100% (119)
	Female	24.4% (19)	75.6% (59)	100% (78)
Age group	18-21 years	13.7% (10)	86.3% (63)	100% (73)
	22 - 25 years	27.1% (19)	72.9% (51)	100% (70)
	26 years and above	16.7% (2)	83.3% (10)	100% (12)
English First Language	No	17.8% (34)	82.2% (157)	100% (191)
	Yes	50.0% (3)	50.0% (3)	100% (6)
Major course	Building construction	21.5% (28)	78.5% (102)	100% (130)
	Civil engineering	13.4% (9)	86.6% (58)	100% (67)
Entry to university	High school	16.6% (28)	83.4% (141)	100% (169)
	College	34.6% (9)	65.4% (17)	100% (26)
Ethnicity	Asian/Indian	33.3% (1)	66.7% (2)	100% (3)
	Black	18.6% (35)	81.4% (153)	100% (188)
	Colored[1]	0.0% (0)	100.0% (3)	100% (3)
	White	33.3% (1)	66.7% (2)	100% (3)
Citizen	South African	19.2% (34)	80.8% (143)	100% (177)
	Permanent South African resident	14.3% (1)	85.7% (6)	100% (7)
	Non-South African	15.4% (2)	84.6% (11)	100% (13)
Accommodation	Home	25.0% (11)	75.0% (33)	100% (44)
	On campus	17.0% (9)	83.0% (44)	100% (53)

[1] A people Mixed ethnicity in South Africa.

Table 1. (Continued) Cross tabulation demographic variables & mathematics success.

		Mathematics No	**Mathematics Yes**	**Total**
	Off campus	17.3% (17)	82.7% (81)	100% (98)
Highest education level of parent/guardian	No schooling	21.4% (3)	78.6% (11)	100% (14)
	Elementary school	0.0% (0)	100.0% (5)	100% (5)
	Secondary/high school	16.9% (10)	83.1% (49)	100% (59)
	College	20.0% (9)	80.0% (36)	100% (45)
	University	20.3% (13)	79.7% (51)	100% (64)
	Do not know	25.0% (2)	75.0% (6)	100% (8)
Education sponsor	Myself	10.5% (2)	89.5% (17)	100% (19)
	Parent/guardian	21.9% (21)	78.1% (75)	100% (96)
	Government/bursary	17.1% (37)	82.9% (68)	100% (82)
Weekly income	Less than R200	19.2% (20)	80.8% (84)	100% (104)
	Between 200 and 399	17.8% (8)	82.2% (37)	100% (45)
	Between 400 and 599	29.2% (7)	70.8% (17)	100% (24)
	600 and above	0.0% (0)	100.0% (18)	100% (18)
Final mark high school	Less than 50	26.9% (7)	73.1% (19)	100% (26)
	50 and above	17.2% (29)	82.8% (140)	100% (169)

*The number in the parenthesis indicates the actual number of respondents.

Table 2 presents the results of the relationship of the students' socio-economic and demographic characteristics of the students' and mathematics performance. Chi-square test on mathematics performance with student characteristics was performed. The researchers only made inferences to the results where the expected observation counts per cell were 5 counts and over. Hence, no violation of the statistical assumption set for the study. The results interpreted here were: gender, accommodation and major course the students are attending.

The relationship of this independent variables with the dependent variable were insignificant as there *p*-value was greater than 0.05. This is an indication that no relationship exists in mathematics success whether you are male or female. However, Table 1 indicates that male students outperformed female students in mathematics by a difference of 9%. Civil engineering students performed better than building students as indicated in Table 1. However, the corrected Chi i.e., continuity correction indicated an insignificant value of $p > 0.05$. These results therefore suggest that the arithmetic differences in Table 1 were minimal to conclude that differences exist. In other words, the difference is not statistically significant.

Table 2. Correlation between demographic & mathematics success.

Variables	**Pearson chi-square**	**Asymp. Sig. (two-sided)**	**Observations**
Gender	2.063	0.151	a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 14.65.
Age group	4.127	0.127	a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 2.40.
English first language	2.125	0.145	a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.13.
Ethnicity/Race	1.530	0.675	a. 6 cells (75.0%) have expected count less than 5. The minimum expected count is .56.
Citizenship	0.212	0.899	a. 2 cells (33.3%) have expected count less than 5. The minimum expected count is 1.31.

Table 2. (Continued) Correlation between demographic & mathematics success.

Variables	Pearson chi-square	Asymp. Sig. (two-sided)	Observations
Major course	1.410	0.235	a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 12.58.
Highest education level of one parent/guardian	1.677	0.892	a. 4 cells (33.3%) have expected count less than 5. The minimum expected count is .95.
Entry level to university	3.672	0.055	a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.93.
Education sponsor	1.608	0.448	a. 1 cells (16.7%) have expected count less than 5. The minimum expected count is 3.57.
Weekly income/allowance	5.989	0.112	a. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 3.30.
High school final mark in mathematics	0.852	0.356	a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 4.80.

*Independent variable significance at 95% confidence interval

5 CONCLUSION AND RECOMMENDATION

The study found that the relationship of the independent variables and dependant variable i.e., mathematics success were insignificant based on the socioeconomic and demographic factors that did not violet the assumption of the number of expected counts per cell. These factors were; gender, major course the student is pursuing and accommodation. Gender was insignificant in relation to mathematics success. However, in relation to percentages, the findings suggest that female students were less likely to pass mathematics at their first attempt in the university compared to male students. Further, civil students' outperformed building students in mathematics success at this university. Contrary to accommodation being insignificant, it can be suggested that students' living on campus perform better than those living out of campus especially those living at home. Based on these findings, the researchers recommend that:

Despite insignificant relationship based on the Chi-square test. The percentage difference suggests that, the university should inform the female students to be studious in the quest to pass mathematics at their first attempt in their course. Support is required for female students in order to succeed in mathematics. The additional support to female students will ensure timely completion of their studies and not to waste their finances. This will assist students to operate in close proximity to their study environment and hence not waste time in travelling to the university. Furthermore, building students will need more support than civil students in order to pass mathematics at their first major examination.

This study is timely considering the history of South Africa higher education. There is demand for education among high school learners, hence the diversity of the number of students registered at the university has increased. To fully support the diversity of these students, universities must implement strategies and interventions based on sound research studies that will ensure students are given a fair chance to succeed. Hence, the need to continue to identify factors that would influence student academic performance in mathematics and other disciplines is crucial. The researcher suggests the need to use other determinants in relation to the socio-economic and demographic factors as these factors are not exhaustive. A further study is also recommended for all Engineering and Built Environment courses at this University.

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