



## Determinants Influencing the Academic Achievement in Statistics Module: A Case Study of Undergraduate Students at the University of Fort Hare, South Africa

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**ABSTRACT** This paper aimed to determine the factors affecting undergraduate students' academic performance at the University of Fort Hare. Multiple logistic regression was used to assess the association factors of students' academic performance such as gender, age, residence, faculty of study, entry points, progenitors' social-economic standing, previous school grounding, class attendance, and study groups among the University of Fort Hare undergraduate students. The results showed that the students residing on campus or off campus 'res' ( $\beta = -1.6198$ ,  $p$ -value = 0.0018) and the predictor level of income of students' parents or guardian 'soc<sub>b</sub>' ( $\beta = 1.162$ ,  $p$ -value = 0.0173 < 0.05) respectively, were statistically significant predictors of success. The findings demonstrated that students' residence and parents' socio-economic status are the two main factors contributing to students' academic achievement. It also showed that University admission points are closely related to the factors that affect students' academic achievement.

### INTRODUCTION

Students are the main assets of Universities. The students' performance play an important role in producing the best quality graduates who will become great leaders and manpower for the country, thus, becoming responsible for the country's economic and social development. The poor performance of students in Universities should be of concern not only to the administrators and educators, but also to corporations in the labour market. Academic achievement is one of the main factors considered by the employer in recruiting workers especially the fresh graduates, thus, students have to be more studious to obtain a good grade in order to meet up with the employer's demands (Yadav et al. 2012).

Students' academic achievement is influenced by a number of determinants such as age, gender, study groups, entry points, social-economic standing, place of residence and class attendance (Ali et al. 2013). Moreover, some studies revealed that the students' academic achievement is influenced by high school grade for University entry, which may determine their performances in the University (Altonji et al. 2016; Bobba and Frisanchi 2016; Attanasio and Kaufmann 2014). In another study, it was observed that a grading pro-

cess was seen as a determinant of students' success for nearly all courses (Moralista 2016). This, however, will help the University to create jobs, increase labour force, as well as economic and social development (Ali et al. 2013; Zahyah and Farukh 2016). Education is a very important determinant in enhancing the economy as it plays a vital role in the expansion of wealth for personal comfort and good lifestyle (Farooq et al. 2011; Battle and Lewis 2002). The growth in education generates and increases the knowledge base of a nation (Saxton 2002). The objective of this study is to find out possible factors associated with poor academic achievement of students at Fort Hare University.

### Research Objectives and Hypothesis

The study was conducted with the following objectives:

1. To test for the statistical association between the following factors: Age, gender, residence, class attendance, social economic status, study group, admission point, previous school background, and faculty of study and students' academic achievement.
2. To fit a multiple logistic model for the factors influencing students' academic performances at the University of Fort Hare.

This hypothesis was formulated in order to achieve the above objectives:

**H0:** Students’ academic achievement is not related to the considered factors

**H1:** Students’ academic achievement is related to the considered factors

**METHODOLOGY**

**Research Design**

This section describes the method and research design used in the study. The study includes random sample of undergraduate students who attended statistics module. A well-structured questionnaire was distributed among the randomly selected undergraduate students, consisting of possible factors influencing their academic achievement and their biographical information was also considered.

**Data Collection**

The primary source of data in this study was collected using two instruments: a well-structured questionnaire and students’ academic results from the statistics module they completed. The questionnaire gathered data on students’ biographic information, level of lecturer competence, teaching methods, and quality of learning materials influencing academic achievements.

**Sample Size and Sampling Strategy**

The sample size for students was determined using the Yamane (1967) formula which is:

$$n = \frac{N}{1 + N(\epsilon)^2} \tag{1}$$

where  $N$  represents the size of the society under investigation and  $\epsilon$  he precision level. The

**Table 1: Estimation of sample size by age group**

Percentage for each age group	Sample size by age group
Less than 20 years: $\frac{149 \times 100}{344} = 43\%$	$n_{(<20 \text{ years})} = \frac{185 \times 43}{100} = 79.55 \approx 80$
From 20 to 25 years: $\frac{178 \times 100}{344} = 52\%$	$n_{(20 \text{ to } 25 \text{ years})} = \frac{185 \times 52}{100} = 96.20 \approx 96$
From 26 to 30 years: $\frac{13 \times 100}{344} = 4\%$	$n_{(26 \text{ to } 30 \text{ years})} = \frac{185 \times 4}{100} = 7.40 \approx 7$
Above 30 years: $\frac{4 \times 100}{344} = 1\%$	$n_{(>30 \text{ years})} = \frac{185 \times 1}{100} = 1.85 \approx 2$
Total sample size	$n = 185$

total number of students who attended the course ( $N$ ) is 344. Using the formula from equation (1), the estimated sample size is calculated as shown below and the probable results according to the students’ age group were summarized in Table 1.

$$n = \frac{344}{1 + 344 \times (0.05)^2} = 184.95 \approx 185$$

**Data Analysis Procedures**

In general, the logistic regression model is used for a classified-type of covariates occurring concurrently in the prognosis of outcome related to one or any of the other two response variables. The logistic modelling concept is used in many of the cases in research to determine the effects of numerous variable classes. Logistic regression can be a binary or multiple regression model with a response variable usually in two categories. Mathematically, the model is:

$$\ln\left(\frac{\pi(x)}{1-\pi(x)}\right) = \beta_0 + \beta_1 x \tag{2}$$

From equation (2), authors deduced this:

$$\begin{aligned} \frac{\pi(x)}{1-\pi(x)} &= e^{\beta_0 + \beta_1 x} \\ \pi(x) &= e^{\beta_0 + \beta_1 x} - \pi(x)e^{\beta_0 + \beta_1 x} \\ \pi(x)(1 + e^{\beta_0 + \beta_1 x}) &= e^{\beta_0 + \beta_1 x} \\ \pi(x) &= \frac{e^{\beta_0 + \beta_1 x}}{1 + e^{\beta_0 + \beta_1 x}} \end{aligned} \tag{3}$$

The explanation of the coefficient of regression  $\beta_1$  is that the log of the odds ratio contrast the odds after a one unit growth in  $x$  to the authentic odds.

$$\pi(x) = P(Y = 1 / X_1, X_2, \dots, X_k) = \frac{e^{\beta_0 + \sum_{j=1}^k \beta_j X_j + \epsilon}}{1 + e^{\beta_0 + \sum_{j=1}^k \beta_j X_j + \epsilon}} \tag{4}$$

SPSS version 23 software was used for the analysis and several statistical techniques were applied, such as t-test, Chi-square test, Analysis of variance (ANOVA), and Linear regression for comprehensive analysis of the same problem. The table also describes the mean, standard deviation, t-values, P-value and significant difference for the two groups.

**RESULTS**

The results in Table 2 revealed the Chi-square test of association between the response and explanatory variables indicate students' residence (res), students' faculty of study (faculty), and level of income of students' parent or guardian (*soc<sub>b</sub>*) are the risk factors, which are statistically and significantly associated with students' academic performance in the introductory statistics module.

The researchers used multiple logistic regression to investigate the effects of the independent variables on the performance of students and the factors affecting it. The results are shown in Table 3. The results showed that the students residing on campus or off campus 'res' ( $\beta = -1.6198, p\text{-value} = 0.0018 < 0.05$ ) and the predictor level of

**Table 3: The estimated coefficients, their standard error, and Wald test for the model**

Parameter	$\beta$	S.E	Wald $\chi^2$	p-value
Intercept	0.9141	2.2207	0.1694	0.6806
Age	-0.5853	0.3431	2.9096	0.0881
Gender	0.8436	0.4325	3.8034	0.0511
year	0.0612	0.2713	0.051	0.8214
res	-1.6198	0.5176	9.7924	0.0018**
faculty	-0.6012	0.4153	2.0951	0.1478
admin	-0.2832	0.6503	0.1897	0.6632
<i>soc<sub>a</sub></i>	-0.1835	0.3397	0.2918	0.5891
<i>soc<sub>b</sub></i>	1.162	0.4882	5.6645	0.0173*
<i>past<sub>a</sub></i>	0.1226	0.234	0.2746	0.6003
<i>past<sub>b</sub></i>	-0.1189	0.2449	0.2358	0.6273
<i>past<sub>c</sub></i>	0.1267	0.2905	0.1903	0.6626
<i>past<sub>d</sub></i>	-0.3233	0.2774	1.3589	0.2437
<i>class-att</i>	0.3333	0.2918	1.3045	0.2534
<i>study-group</i>	0.3013	0.2439	1.5263	0.2167

**Table 2: Chi-square test results**

Factor	Sex	Age	year	res	Faculty	admin	Sa	Sb	Pa	Pb	Pc	Pd	CA	SG
p-value	0.129	0.44	0.089	0.007**	0.029*	0.731	0.69	0.044*	0.457	0.674	0.952	0.632	0.1430	0.323

Key: \* = p-value < 0.05; \*\* = p-value < 0.01

income of students' parents or guardian '*soc<sub>b</sub>*' ( $\beta = 1.162, p\text{-value} = 0.0173 < 0.05$ ) respectively, are statistically significant.

**Model Assessment**

Table 4 displays the Likelihood ratio test for the model assessment, the Log Likelihood for the intercept model is 194.385, and 166.789 for the final model. Hence, the likelihood ratio test (G) value is:  $G = 194.385 - 166.789 = 27.5963$ . The researchers tested hypothesis for the model:

**H<sub>0</sub>:**  $\beta_1 = \beta_2 = \dots = \beta_{14} = 0$  (all the explanatory variables are not statistically significant)

**H<sub>1</sub>:** at least one predictor variable ( $\beta_j$ ) # 0,  $j = 1, 2, \dots, 14$  is statistically significant.

From the test related to the statistical significance of all the covariates considered in this study, the results showed that some of the covariates (at least one) or perhaps all of them in the full model are related to the students' academic achievement ( $p\text{-value} = 0.0161$ ) in favour of  $H_1$ .

**Table 4: Likelihood ratio test**

Model	Model fitting criteria	Likelihood ratio tests		
		$\chi^2$	df	p-value
Intercept only	194.385			
Final	166.789	27.5963	14	0.0161*

Key: \* = p-value < 0.05; \*\* = p-value < 0.01

From Table 5, the researchers concluded that 7.1 percent of all students who do not have DP are correctly classified and 92.9 percent are incorrectly classified, 98.6 percent of students who have a DP are correctly classified and 1.4 percent are inaccurately categorised. The all-inclusive accurate proportion was 0.77 (77%) which indicate the prototype's all-inclusive descriptive power.

**Table 5: Classification table for model with all predictor variables**

Observed	Predicted		
	Does not have DP	Have DP	Percent correct
Does not have DP	3	39	7.1
Have DP	2	139	98.6
Overall percentage	1.4	92.9	77

### The Model with Significant Parameters

The focus was on fitting the model with statistically significant parameters using a stepwise selection and results are shown in Table 6. The results indicate that students who reside on campus are most likely to have a good academic progress; students who are in faculty of Science and agriculture have a significant academic progress compared to those who are in the faculty of commerce. Lastly, students with parents or guardians having an annual high level of income stand a chance of having a good academic progress.

The odds of students who reside on campus to those who are residing outside of campus is 0.248. The odds of students who were attending the course and were registered under faculty of Science and agriculture to those who are under the faculty of commerce is 0.469. The odds of students who have parents or guardian having a high rated annual income is 2.078 (Table 6).

### DISCUSSION

The aim of the study was to investigate the influencing factors of academic achievement of undergraduate students in Statistics Module. The study used two analytical methods to examine the factors affecting the students' academic

achievement. The Chi-square test indicated that students' residence, socio-economic status, entry point, and parental information have an impact on student's academic achievement. This result is similar to other studies (Roy and Chadalawada 2014; Mazharul Islam 2014; Jayanthi et al. 2014; Al Shawwa et al. 2015). The multivariate logistic regression results indicated that student's residence, faculty of study and parent's social economic status are major factors contributing to students' academic achievement. These results are also similar to a study by Kenneth et al. (2016). However, the results from this study is dissimilar to a research done by Alos et al. (2015), which identified the level of income of students' parents or guardian as it influences the student's academic performance.

It was observed that previous school background, class attendance and study groups did not affect students' academic achievement. These findings are in agreement with the results of Khat-tab (2015) and Kimaiga (2014). Moreover, the results from this study were in accordance with the findings of Borde (1998) and Amuda et al. (2016). Contrary to the findings of Martha (2009) and Messinis and Sheehan (2015), the researchers found that academic achievement is not influenced by admission points and the reason could be linked to the selection criteria from the University of Fort Hare.

### CONCLUSION

This is a pedagogical study to determine the factors influencing students' academic achievement in statistics module at University of Fort Hare. Based on this study findings, it has been proven that students' residence and parents' socio-economic status are the two main factors

**Table 6: Summarized results for the reduced model**

Parameter	$\beta$	Standard error	Wald	p-value	Exp ( $\beta$ )	95% Confidence Interval for Exp ( $\beta$ )	
						Lower limit	Upper limit
Intercept	1.9272	1.2767	2.2786	0.1312			
Res	-1.3945	0.4716	8.7441	0.0031**	0.248	0.5086	3.2284
Faculty	-0.7559	0.3759	4.044	0.0443*	0.470	0.7657	3.3434
soc <sub>b</sub>	0.7314	0.3587	4.1566	0.0415*	2.078	3.9551	16.1351

Key: \* = p-value < 0.05; \*\* = p-value < 0.01

contributing to students' academic achievement. In short-term, few strategies can only be adopted to minimize the effects of these two factors, but in long-term, much can be done for future research. The study also showed that apart from students' residence and parents' socio-economic status, University admission points are closely related to the factor that affect students' academic achievement.

### RECOMMENDATIONS

From the study findings, the researchers concluded that the University should provide adequate residence with full sponsorship programs to encourage students. Secondly, selection criteria should be a yardstick to select best students. To the admission committee, social economic status should be considered if sponsorships are not available and a development of student loan scheme such as Edu-loan to assist needy students. Finally, the University should consider the students' previous school background in selecting the best students for the program.

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