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Predictive validity of SSCE grades and UTME points on final CGPA of students of Bauchi State University Gadau, Bauchi State

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Abstract

Cumulative Grade Point Average (CGPA) is a major indicator of students' academic performance in Nigerian university system and the final class of degree to be awarded to a student solely relies on his final CGPA. The academic entry requirements into the universities are Senior Secondary Certificate Examination (SSCE) grades and Unified Tertiary Matriculation Examination (UTME) points. One may naturally therefore, expect paramount dependency of student's final CGPA on his SSCE grades and UTME points on entry. This study used multiple linear regression based on ordinary least squares with SSCE grades and UTME points on entry as predictors of final CGPA of students. We also used Pearson correlation to ascertain relationships between each predictor variable and the dependent variable. Results for both methods revealed that final CGPA of students in the university is not strongly determined by their SSCE grades and UTME points.

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1.0 Introduction

Very often in practice, a relationship may be expected to exist between two or more variables and one may wish to justify whether such relationship really exist using empirical evidence. If it exists, the question about strength of the relationship, and the variable that depends on the other may likely arise. To accomplish this, one would wish to express this relationship in mathematical form by determining appropriate model connecting these variables. Linear regression model can be used in this situation. Murray *et al*. (2009) reported that If *y* is to be estimated from *x* by means of some equation, we call the equation a *regression equation of y on x* and the corresponding curve a *regression curve of y on x*.

Linear regression model can be used to show dependency of one or more variables on another. It is a statistical method that is used to verify existence (or otherwise) of relationship among variables and to show the variable that depends on the other variable(s) and to provide a model for predicting average value of the dependent variable with a known value of the independent variable. Regression analysis involves using appropriate regression technique such as ordinary least squares (OLS) method to analyze data of the variables involved, by calculating values of regression parameters, performing tests of significance of these parameters and calculating other indicators of reliability of the model such as ***R***-square, regression standard error etc.

Senior Secondary School Certificate Examination (SSCE) is a final examination written by students in Nigerian secondary schools. The SSCE is conducted by different examination bodies like West African

Examination Council (WAEC), National Examination Council (NECO), National Board for Arabic and Islamic studies (NBAIS) etc. The first two (WAEC and NECO) are the most popular and widely known. The SSCE is a necessary requirement for admission into any tertiary institution in Nigeria, a student has to pass some subjects before being admitted. The admission requirement however, varies as the institutions vary. In Nigerian university system, prospective student has to obtain at least 5 credits including Mathematics and English Language in at most 2 sittings before being admitted.

Apart from SSCE requirement, prospective student also has to write matriculation examination known as Unified Tertiary Matriculation Examination (UTME) conducted by another examination body known as Joint Admission and Matriculation Board (JAMB). The minimum UTME points for admission into a Nigerian university is 120. However, each university is at liberty of increasing the minimum UTME cutoff points for its admission. For the last 2 admissions, Bauchi State University Gadau (BASUG) admitted student that scored at least 140 UTME points. Worthy to note that, the minimum required UTME points for entry into Nigerian public universities was 180. The points were scaled down to 140 in 2017.

Cumulative Grade Point Average (CGPA) is a point that indicates overall student's academic performance in Nigerian tertiary institutions. The total point is 5 in some institutions and 4 in some. CGPA is determined by overall performance of a student in each semester examination (apart from his first semester) until the final semester examination. CGPA is used to determine class of degree to be awarded to a student. In BASUG, for example, CGPA of 4.5 and above is first class, CGPA of 3.5-4.49 is second class upper etc. Final CGPA therefore, indicates overall student's academic performance in the university.

Passing the two pre-entrance examinations (UTME and SSCE) for Nigerian university admission, no doubt shows some academic excellence in the part of the student and how well the student fared in the examinations, explains how brilliant the student is. It is expected therefore, that students enrolled with higher grades and/or higher UTME points will also have higher grades in the university. This study will reveal this postulation. The question of whether or not the pre- entry performances (UTME score and SSCE grade) of a student are worthy enough to determine his/her final CGPA will therefore be answered in this study. This study has the following objectives: to establish based on empirical evidence, strength of SSCE grades and UTME points of students in determining their final CGPA in Bauchi State University Gadau, develop a regression model and show whether or not, it is good enough in predicting average final CGPA of a student based on his/her UTME points and SSCE grades and determine the most important predictor of final CGPA between UTME points and SSCE grades

Studies on relating pre-entry qualifications with student's final academic performance have been conducted by different scholars. Adeniyi (2013) examined whether or not entry qualifications will predict success in final year Bachelor of Education degree in Ondo and Ekiti states Nigeria. He obtained data from two universities (one from each of the two states). He used regression and some other statistical methods, and found out that WAEC (as an entry qualification) is an indicator of success in the final year Bachelor of Education degree in the two universities.

Babalola (2015), investigated the presence (or otherwise) of relationship between entry qualification and performance in A 'level chemistry at School of Basic and Remedial Studies, Yobe State University Damaturu. He considered relating students' grades in chemistry at WAEC or NECO with their grades earned in the short structured test administered at the end of Basic I. He arrived at conclusion that there is no relationship between performance of the students in the A 'level chemistry and their entry grade (o 'level chemistry) in the Basic programme.

Owan and Ukofia (2017), used Pearson Product Moment Correlation method to investigate relationships between UTME and first year final departmental examination performance and between post UTME and the first year final departmental examination in four departments in University of abuja, Nigeria. In each case, they considered 3 sessions and 4 departments in each session which gives 12 pairs of correlation for UTME and the CGPA and 12 pairs for post UTME and the CGPA. The results obtained for the UTME and the CGPA of first year final departmental examination revealed in general weak relationship. The results for the post UTME and the CGPA in general showed not strong relationship. They recommended that using the students' performance in the two examinations (UTME and post UTME) for university admission be reviewed.

Ogbonnaya *et al*. (2014) also applied Pearson Product Moment Correlation method to examine relationship between O' level GCE/SSCE grades (as entry qualification) and pre-qualifying examination result scores (representing final academic performance) in two basic schools of nursing in Enugu State. The study got the correlation value as $\boldsymbol{r} = 0.48$ which is moderate and positive relationship between the two variables.

Abdulkadir and Ogwueleka (2019), investigated if outstanding academic performance of first year undergraduate students of Faculty of Science, Kaduna State University, can be predicted by any of the entry requirements such as O' Level (OL) results, UTME points or Post UTME scores. They sampled students

from Computer Science, Mathematics and Physics. They used Pearson Product Moment Correlation (PPMC) and Multinomial Logistic Regression methods, They concluded that use OL and UTME as instruments is not enough is not enough to select candidates for admission.

Faleye (2015), investigated relationship between students' performance in entry examination and students' mathematics performance in two colleges of education (one each from Oyo and Ondo States, Nigeria). He finally concluded that neither entry qualification nor entry examination performance could singly predict mathematics performance at the College of Education.

Dauda *et al.* (2020) investigated relationships between CGPA of students of Kaduna State University at various levels using Pearson correlation method. They considered faculties of Arts (FA), Management and Social Sciences (FMSS) and Science (FSC). For each faculty, they investigated correlations for six different variables (two considered at a time) namely CGPA at 100L, CGPA at 200L, CGPA at 300L, UTME Score, O' Level and Secondary School Type. They also for each faculty, carried out Step-wise regression analysis on the six variables. In FMSS, with CGPA at 300L as the dependent variable, they found out that only CGPA at 200L is significant in the model. Same results were found for FA and FSC.

Kolawale *et al.* (2011) studied predictability or otherwise of UTME and Post Universal Tertiary Matriculation Examination (POST-UTME) on students' academic performance in chemistry in Nigerian universities. They considered data of UTME and POST-UTME) scores for chemistry students admitted during 2004-2005/2005-2006/2006-2007. They equally obtained the CGPA for all the sampled students. They found a very low significant relationship between the UTME scores and all levels CGPA in chemistry.

Okobia (2015) examined the predictive ability of UTME, IST (Institution Selection Test) and UTME PLUS on degree students' first year CGPA in the College of Education, Agbor. The study collected data of students admitted into degree programme of the College in 2012/2013 session. The study used correlation and multiple regression. The study found no significant relationship between UTME scores and the first year CGPA and also between scores in UTME PLUS and the CGPA. It also found significant but low relationship between IST scores and the CGPA.

2.0 Materials and Methods

The research considered data of students that graduated in 2014/2015, 2015/2016 and 2016/2017 academic session of Bauchi State University, Gadau. The population is therefore, all students that graduated in the university (as at the time of data collection). The university has 3 faculties (that graduated students). The total population of graduated students was 798, out of which 167 students are from faculty of science, 233 students are from faculty of art and education and 398 students are from faculty of social and management sciences. We used stratified sampling technique, Arnab (2017) reported that In stratified sampling, the entire population U of N units is divided into a number (K) of mutually exclusive and exhaustive groups, which are called strata. We considered each faculty as a stratum, from each stratum (faculty), simple random sampling technique was used to draw the required sample using tables of random numbers. We used proportional allocation to determine sample size to be selected from each faculty. Okafor (2002) reported that in proportional allocation, the stratum sample is selected such that the size of the sample is proportional to the total number of units in each stratum. In this case, therefore, the total number of students in each faculty is proportional to the sample size to be chosen from that faculty. Based on this, we randomly selected 42 students from faculty of science, 58 students from faculty of art and education and 100 students from faculty of social and management sciences. This gives a total sample of 200 students out of the 798 graduated students.

The data collected was secondary data that has been documented from the registry section of the university. For each of the 200 sampled students, data on his/her final CGPA, his/her UTME points on admission and grades of his/her SSCE on admission were collected. We considered data on 8 subjects offered by a student in the SSCE and if a student uses two results, we select across the two, best grades in 8 subjects. This is so because we realized that no student within our sample bracket offered less than 8 subjects. We ranked the grades in order to get a single index representing the SSCE grades. The ranking is such that A1 = 8 points, B2 = 7 points, B3 = 6 points, C4 = 5 points, C5 = 4 points, C6 = 3 points, D7 = 2 points, E8 = 1 point and the last and the least F9 = 0 point. For each student, sum of his/her points represents his/her overall score in the SSCE.

We use multiple regression model involving two predictor variables (SSCE grades and UTME points) and one response variable (final CGPA). Ordinary least squares (OLS) method has been employed in order to calculate values of the model parameters (Table 1 – 2). Gujarati (2004) presented the model as:

$$Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i$$

Where, Y is the dependent variable (in this case, final CGPA of the students), X_2 and X_3 are the explanatory variables (in this case, SSCE grades and UTME points respectively) $\beta_1, \beta_2 \; and \; \beta_3$ are parameters of the regression model, u is the regression error and *i* is the *ith* observation

The OLS procedure is such that the residual sum of squares (RSS) is as small as possible, we have

$$min \sum \hat{u}_i^2 = \sum \left(Y_i - \hat{\beta}_1 - \hat{\beta}_2 X_{2i} - \hat{\beta}_3 X_{3i}\right)^2$$

Parameters of the model can be obtained by use of the following normal equations

$$Y = \hat{\beta}_1 - \hat{\beta}_2 \bar{X}_2 - \hat{\beta}_3 \bar{X}_3$$
$$\sum Y_i X_{2i} = \hat{\beta}_1 \sum X_{2i} + \hat{\beta}_2 \sum X_{2i}^2 + \hat{\beta}_3 \sum X_{2i} X_{3i}$$
$$\sum Y_i X_{3i} = \hat{\beta}_1 \sum X_{3i} + \hat{\beta}_2 \sum X_{2i} X_{3i} + \hat{\beta}_3 \sum X_{3i}^2$$

Now manipulating the above equations we have for the parameters

$$\hat{\beta}_1 = \bar{Y} - \hat{\beta}_2 \bar{X}_2 - \hat{\beta}_3 \bar{X}_3$$

Which is the OLS estimator of the population intercept,

$$\hat{\beta}_2 = \frac{(\Sigma y_i x_{2i})(\Sigma x_{3i}^2) - (\Sigma y_i x_{3i})(\Sigma x_{2i} x_{3i})}{(\Sigma x_{2i}^2)(\Sigma x_{3i}^2) - (\Sigma x_{2i} x_{3i})^2}$$

is the OLS estimator of the first regression coefficient (SSCE grades) and

$$\hat{\beta}_3 = \frac{(\Sigma y_i x_{3i})(\Sigma x_{2i}^2) - (\Sigma y_i x_{2i})(\Sigma x_{2i} x_{3i})}{(\Sigma x_{2i}^2)(\Sigma x_{3i}^2) - (\Sigma x_{2i} x_{3i})^2}$$

is the OLS estimator of the second regression coefficient (UTME points).

The correlation analysis method used is Pearson Product Moment Correlation which Spiegel and Stephens (2008) presented as

$$r = \frac{\Sigma xy}{\sqrt{(\Sigma x^2)(\Sigma y^2)}}$$

Here, $x = X - \bar{X}$ and $y = Y - \bar{Y}$. The formula will then become $r = \frac{\Sigma(X-\bar{X})(Y-\bar{Y})}{\sqrt{\Sigma(X-\bar{X})^2 \Sigma(Y-\bar{Y})^2}}$

The first stage is to collect data related to the variables, next we use the data to obtain values of the parameters and test for the significance of each parameter in the model using ***t***-test and the significance of all the parameters together in the model using ***f***-test. The values of $\boldsymbol{R^2}$ and the regression standard error are obtained. If all the tests of reliability of the model are satisfied, the model can then be used for prediction.

3.0 Results and Discussion

In this study, multiple regression model with two predictor variables (UTME points and SSCE grades) and one response variable (final CGPA) are used. For the purpose of the analysis, an open access statistical software known as "**R**" is used.

The model as fitted is:

CGPA = -1.28680 + 0.01802 (UTME) + 0.02611 (SSCE)

The intercept ($\boldsymbol{\beta_0}$) stands for the average final CGPA a student can have even without any score in UTME and without any credit in SSCE. Younger (1986) reported that the parameter β_0 can have a meaning only

i. When it is practically possible for $X_2$and X_3 to be zero.
ii. When we have values around X_2 = 0 and around X_3 = 0.

In this case β_0 cannot be interpreted as such because the two conditions are not fulfilled here.

The parameters β_1 and β_2 both show the net effect/contribution of its associated variable on Y. In this case, β_1 = 0.01802 means for every 1 point increase in the UTME points, the final CGPA will increase by 0.01802. Also, β_2 = 0.02611 means for every 1 unit increase in the SSCE grade, the final CGPA will increase by 0.02611.

The ***t*** test shows if value of any parameter obtained in the model is significantly not zero. The idea is, if a parameter is zero, then its associated predictor variable will also be zero; and as such not worthy to consider as a predictor of the response variable (Y).

The *t*-tests of the parameters β_1 and β_2 have shown *p* – values of 0.0000153 and 0.000212 respectively. This means in each case the null hypothesis is rejected. Therefore each parameter is significantly different from zero. In other words, the UTME points and SSCE grades are relevant in determining the final CGPA.

The standard error shows how good the model is in prediction. The higher the standard error the wider the range/bound in the error of regression prediction, and the lower the standard error, the lower the range/bound in the error of the prediction. In this study, the standard error obtained as 0.6821 means whenever this fitted model is used in predicting final CGPA of a student having his or her UTME point and SSCE grades, the prediction will be off the actual value by 0.6821. But as to how far the variation in the standard error is, the coefficient of determination is used to show the standard error in percentage. The coefficient of variation is calculated as 21.54%. This means the prediction error of this model is 21.54%.

The $\mathbf{R^2}$ shows percent variation in the final CGPA caused by UTME points and SSCE grades. In other word, R^2 shows the percent effect of the UTME point and the SSCE grades of the students on their final CGPA. We obtained R^2 as 0.1896, which means the UTME point and the SSCE grade of a student account for only 18.96 variation in his final GGPA. In other words, the two variables determine the CGPA by only 18.96%.

The ***F*** test tests the joined statistical significance of the model parameters. If even only parameter is significantly not zero, the test will be significant. Here the *p* – value of the test is 0.000000001016, this means the parameters together are significantly not zero.

Table 1: Ordinary Least Squares (OLS) regression analysis with two predictor variables

	Estimate		Std. Error	*t* value	Pr(>|*t*|)
(Intercept)	-1.286802	.	0.763660	-1.685	0.093563
X_1	0.018021		0.004063	4.435	1.53e-05 ***
X_2	0.026112		0.006918	3.775	0.000212 ***
Residual standard error: 0.6821 on 197 degrees of freedom					
Multiple R-squared: 0.1896, Adjusted R-squared: 0.1814					
F-statistic: 23.04 on 2 and 197 DF, p-value: 1.016e-09					

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

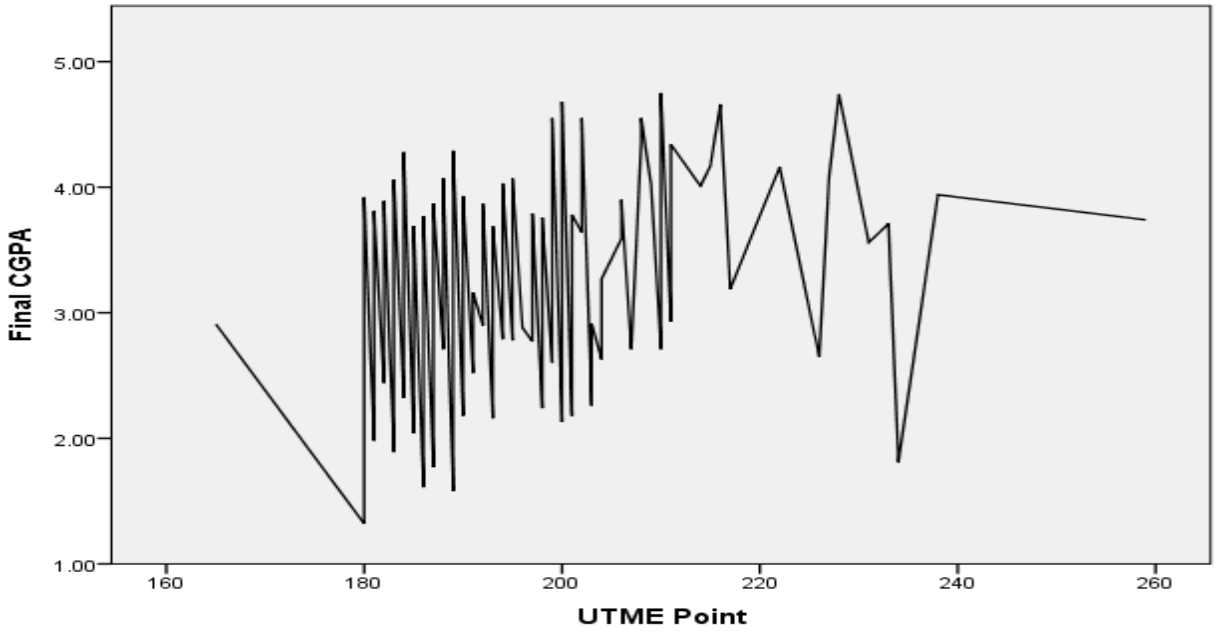

Figure 1: Correlation plot between final CGPA (y) and UTME points (x) of sampled graduated students of BASUG

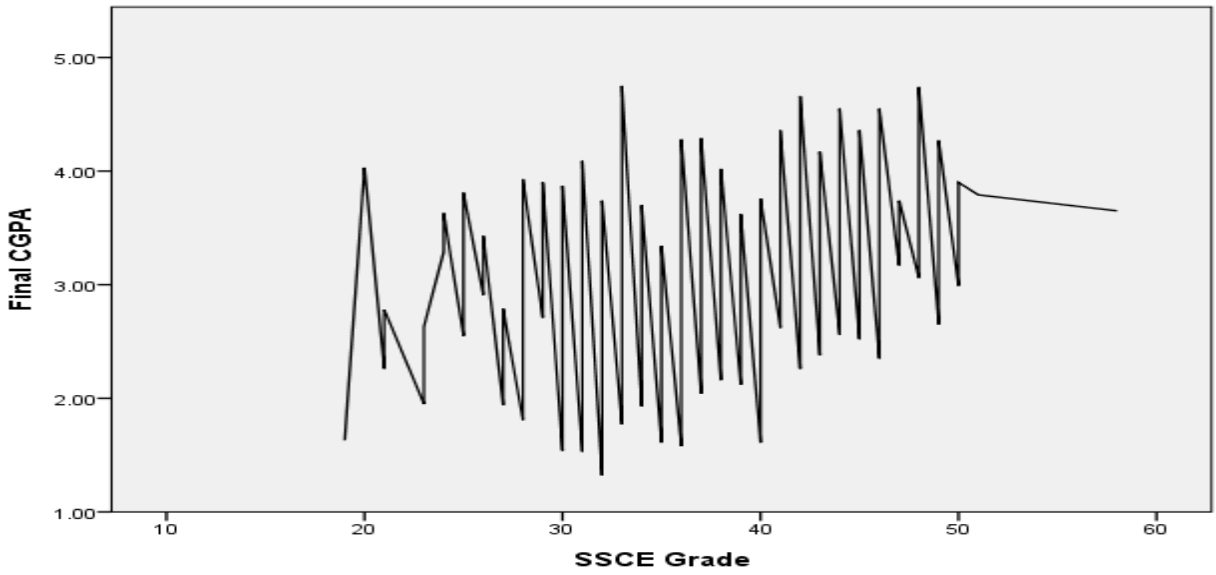

Figure 2: Correlation plot between final CGPA (y) and SSCE grades (x) of sampled graduated students of BASUG

Table 2: Correlation analysis

	Y	X1	X2
Y	1.0	0.3619187	0.329658
X1	0.3619187	1.0	0.2660381
X2	0.329658	0.2660381	1.0

Correlation measures the extent of relationship among variables. If two variables are related, correlation shows the degree and the direction of the relationship. In this research, we measure correlation between the three variables in pairs. That is CGPA and UTME, CGPA and SSCE and UTME and SSCE.

Correlation coefficient between final CGPA and UTME obtained as 0.3619187 indicates weak positive relationship between the two variables; correlation coefficient between final CGPA and SSCE obtained as 0.329658 indicates weak positive relationship between the two variables (These can be clearly seen from Figures 1 and 2). Correlation coefficient between SSCE and UTME obtained as 0.2660381 also indicates weak positive relationship between the two variables.

The study also considered taking simple regression of each explanatory variable and the response variable in turn. That is to say, regression of CGPA and UTME point separately and regression of CGPA and SSCE grades are done separately. This is in order to confirm the results obtained by the multiple regression model. The results of modelling the final CGPA and the UTME gives almost same conclusion as that of the multiple regression model. For example, β_1 = 0.018021 (UTME) in the multiple regression model and β_1 = 0.022102 (UTME) in the simple regression model. The standard error in the multiple regression model is 0.6821 and that of the simple regression model is 0.7045. In the multiple regression, $\boldsymbol{R^2}$ = 0.1896 and $\boldsymbol{R^2}$ = 0.131 in the simple regression.

In modeling the final CGPA and the SSCE grades, we got almost same conclusion with that of the multiple regression model. For example, β_1 = 0.026112 (SSCE) in the multiple regression model and β_1 = 0.034274 (SSCE) in the simple regression model. The standard error in the multiple regression model is 0.6821 and that of the simple regression model is 0.7135. In the multiple regression, $\boldsymbol{R^2}$ = 0.1896 and $\boldsymbol{R^2}$ = 0.1087 in the simple regression.

The results obtained from the two separate simple regressions therefore, vindicate that of the multiple regression, that in general, the final CGPA of student of BASUG is not strongly determined by their UTME points and SSCE grades on entry.

4.0 Conclusion

In this research, multiple regression model has been used to check the presence (or otherwise) of dependency of final CGPA of BASUG students on their UTME points and their SSCE grades. The study has found that the SSCE grades and the UTME points are not stronger predictors of the final CGPA of the students. The model standard error of prediction (about 21.54%) is too high, this means SSCE grades and UTME points cannot be reliably used to predict the CGPA. The model has revealed that UTME points and SSCE grades of a BASUG student accounts for only about 19% of the variation in his/her final CGPA, this confirms further how unreliable the model is in prediction of the final CGPA. Correlation between the CGPA and the UTME (0.3619187) is a bit higher than that between the CGPA and the SSCE (0.329658). Also, $\boldsymbol{R^2}$ of UTME (0.131) is a bit higher than $\boldsymbol{R^2}$ of SSCE (0.1087). One can say that UTME is slightly stronger related with the final CGPA than the SSCE grades in BASUG.

5.0 Recommendation

Based on the findings, the study has come up with the following recommendations: The management of BASUG, for the purpose of planning and decision making, should note the general conclusion, that the entry requirements of prospective students (UTME point and SSCE grades) have less effect in their overall academic performance. There is need for a general research involving all the Nigerian universities, concerning the predictability of all these entry requirements (including post UTME) in students' performances. This may have to start with checking prediction of level by level CGPA until the final CGPA. This will reveal more general results that can help the authorities in improving the Nigerian university system.

Declarations

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Consent for publication

All authors have read and consented to the submission of the manuscript.

Availability of data and material

Not Applicable.

Competing interests

All authors declare no competing interests.

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