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Criteria for Selecting Prospective Students into Higher Institutions Using Discriminant and Artificial Neural Network Analysis

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Abstract: *This research seeksto classify prospective students seeking admissioninto higher institution in Nigeria as fit or unfit using discriminant analysis and artificial neural network analysis. The data is a primary data collected from a sample of 90 second year National Diploma (ND 2) students in various department in Lagos State Polytechnic. Data on students' personal, academic and other information that will accurately classify them as good or bad standing as measured by their first year cumulative grade point average (CGPA)were collected from each student.The data was fitted into discriminating models using discriminant analysis and artificial neural network analysis and the two models complement each other for this purpose. The result of the discriminant analysis was able to classify 60% of the original grouped cases of admitted students correctly as fit or unfit.It was then used to test cross-validated grouped cases of students not used in the model formulation and it shows that 86.7% of these students were accurately predicted as fit or unfit students. The developed artificial neural network model shows that the post universal tertiary matriculation examination (post UTME) score is the most important criteria for selecting studentsfor admission intohigher institution in Nigeria. We therefore recommend that post UTME be used as a major criteria forgiving admission toprospective students into higher institution before UTME score, catchment and educationally less developed states. Hence, the developed modelshould be set as criteria for given admission to prospective students into higher institution.*

Keyword*: Artificial Neural Network, Discriminant Analysis, Post UTME, Chi-square, UTME*

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I. Introduction

The issue of selecting the best prospective students for admission into Nigerian higher institutions is now posing a major problem since the cancellation of post UTME before it was later accepted as a criteria for admission. No higher institution will like to admit students that will not finish well. Thus, the selection process must be critical in order to admit the best set of students into our universities, polytechnics and colleges of education.

The Joint Admissions and Matriculation Board (JAMB) says the point system copied from its website as criteria for admission into tertiary institutions in the country and currently circulating was a mere illustration.This is contained in a statement by the board's Head, Media and Information, Fabian Benjamin, and made available to the News Agency of Nigeria (NAN) in Lagos.Prof.Ojerinde mentioned that on the contrary, Federal Government had approved the re-enforcement of admission guideline as recognised by law.According to him, the admission of candidates into tertiary institutions will be based purely on three pillars namely, merit, catchment and educationally less developed states.He also mentioned that the point system that was wrongfully copied from the board's website and currently being circulated by some media was used for illustration by the Registrar, Prof.DibuOjerinde (2016).

Following the cancellation of the post Unified Tertiary Matriculation Examination (UTME), JAMB demonstrated how a few institutions were using the point system to select candidates while some of their counterparts were subjecting candidates to written test.The illustrations are contained in a paper presented by the registrar and placed on our website and was adopted by the media wrongly as the 2016 guideline for admission. He said candidates are to present their Senior School Certificate Examination (SSCE) results/Advanced Level (AL) results for verification and clearing purposes. He noted that WAEC, NECO and NBTE results or its

equivalent were acceptable as matriculation requirements. He added that each candidate was expected to have a minimum of five credits at SSCE, including English, Mathematics and any other three relevant subjects to his or her discipline.He said that the list of qualified candidates awaiting SSCE/AL results could be kept in view pending the release of their results.Any candidate that does not possess the requirements as listed above is deemed to have failed the screening.Consideration of the recommended list as forward by JAMB should be completed within one month from the date of receipt of the list.Any institution that has a shortfall in the admitted candidates could make-up for candidates from other departments on the institutions list.

Therefore, selecting students from competing applicants is a complex decision making process, which often requires a comprehensive evaluation of the applicant's performance. Multiple selection criteria should be simultaneously considered, and subjective assessments are usually present, resulting in fuzzy and imprecise data.Statistical procedures, such as discriminant analysis and regression analysis are traditionally used for predicting the potential academic success of the applicant (Graham, 1991). The predictive validity study may help make admission or selection procedures more efficient and effective (Lievens&Coetsier, 2002). However, the selection criteria used in higher education admission processes varies widely among programs and no consistent conclusions can be reached on the predictive values of these criteria (Wilson, 1999). This may partly be due to the fact that the predictive validity of the selection instruments is not in itself sufficient for an assessment of the validity of a selection, although it can be a critical factor (Wolming, 1999).

In this research, prediction is not the stated purpose for the student selection problem. The selection of applicants is made on the grounds of the candidates' merits (performance evaluation) assessed by an interview process and his/her academic background, based on a given set of criteria in accordance with the requirements of the academic program of National Diploma (ND). The artificial neural networks have also attracted the attention the last years (Flitman, 1997). However, the effectiveness of these methods is sometimes questioned (Hardgrave et al., 1994), due to the sophistication of the decision process, the rough assumptions required, and the level of accuracy achieved.Thus both discrimant analysis and artificial neural network will be used to develop the needed model. The two models will complement each other.

Denton et. al (2008) determined whether particular biographic and academic characteristics would predict whether an applicant would matriculate into and successfully complete an online secondary teacher certification program for Texas public schools. Their finding reinforces the intensive diagnostic effort the admissions officer invests in reviewing applicant transcripts, administering and scoring a practice certification test and providing feedback to the applicant on their probable success with/without additional remediation before sitting for the state's content certification test. This support is provided to applicants as they consider whether to invest the time and money to become a secondary teacher. Further, if the applicant matriculates into the program, then the best variable to predict completing certification is the variable, program candidate.

According to the research by RP Group Proceedings (2001), most California community colleges collect copious amounts of data on entering students, most often through the assessment process. They used discriminant function analysis, which provide the necessary classification into courses, though the development of a predictive model can prove intimidating. Their research explores the limitations of using multiple regression for placement, the use of discriminant function as an alternative, and one method for using discriminant function to provide a model of future behavior. The ideas associated with discriminant analysis can be traced back to the 1920s and work completed by the English statistician Karl Pearson, and others, on intergroup distances, e.g., coefficient of racial likeness (CRL), (Huberty, 1994). In the 1930s R. A. Fisher translated multivariate intergroup distance into a linear combination of variables to aid in intergroup discrimination. Methodologists from Harvard University contributed much to the interest in application of discriminant analysis in education and psychology in the 1950s and 1960s (Huberty, 1994).

On the other hand, the artificial neural network can equally perform the same analysis like the discriminant analysis. Artificial Neural Networks are sophisticated modeling techniques; capable of modeling extremely complex functions. Cascade Correlation Network (CCN) architecture of Artificial Neural Networks is used to deal with this research problem. It is a supervised learning algorithm developed by Fahlman and Lebiere (1990). It is an attempt to overcome certain drawbacks and limitations of popular Back Propagation Learning Algorithm developed by Rumelhart et al. (1986). It is trained using the Quick Propagation Algorithm (QPA) which is the enhanced version of Back Propagation (BP). It is a convenient approach to solve problems since it is an ontogenic neural network that generates its own topology during training. It overcomes the limitation of BP which is slow at learning from examples. A BP network may require many thousands of epochs to learn the desired behaviour from examples. An epoch is defined as one pass through the entire set of training examples. Previous studies involve some researches close to this research. Predicting MBA student performance by evaluating the ability of three different models, namely, logistic regression, probability analysis, and neural networks; is reported by Fahlam and Lebiere (2004). The result was that the neural network model performs better than statistical models. Back-Propagation Neural Network was used in selecting surgical residents via the National Residency Matching Program applied to medical students interested in surgery in their fourth year of

study. It is used to facilitate the surgical residents' selection process using 36 variables. The study showed that neural networks are capable of producing significantly better results than traditional statistical approaches (Aggarwal et. al, 2000). Many other studies (Entwistle, 1988; Ardila, 2001; Busato et al., 1999, Furnham et al., 1999) were undertaken in order to try to explain the academic performance or to predict the success or the failure of students; they highlighted a series of explanatory factors associated to the student (Ardila, 2001).

Puri and Kohli (2007) used of neural networks in predicting the performance of college at the admission counseling, before the actual event takes place, is analyzed. In their model, they aimed to convert this forecasting problem into a classification one, i.e., a college based on its total number of seats filled during the counseling is classified in one of the five output categories chosen. This model can be used as a powerful decision aid by the university management, the individual college management & the anticipating students. They had presented the basic overview of ANN followed by few words on forecasting. The input decision variables & the output classes were clearly laid out.

Asogwa and Oladugba (2015) presented the results of an experimental comparison of two models: Multinomial Logistic Regression (MLR) and Artificial Neural Network (ANN) for classifying students based on their academic performance. The predictive accuracy for each model was measured by their average Classification Correct Rate (CCR). The Average Classification Correct Rate for the Artificial Neural Network was higher than Multinomial Logistic Regression.

Aru et. al (2016) also indicated that students' academic performance is influenced by the socioeconomic background of their parents; as parents that earn high income can take better responsibilities of their children's education compared to parents that earn low incomes. Students whose parents have better jobs and higher levels of educational attainment and who are exposed to more educational and cultural resources at home tend to perform better than their counterparts without such opportunities. Thus, based on their findings and conclusions of their study, they recommended an in-depth study on the reliability and validity of the UTME/PUTME and SSCE result that is used as a major criterion to university admission in the country. They also recommended the design of a more sophisticated intelligent decision support system that will harness the strength of Artificial Neural Network and Fuzzy Logic for admission recommendation and academic prediction in Nigeria.

The scrapping of Post-UTME does not necessarily mean that institutions cannot conduct other forms of screening; it only means they cannot conduct another form of examination similar to UTME. So, schools may decide to use oral interview or verification of documents to screen candidates. Candidates may save cost of purchasing post UTME forms and hassles associated with it, if thepost UTME is scrapped. However, whenASUU, ASUP and NCEE acceptttheoutcome of the2016JAMB Combines Policy meeting, then the right position will be known.

It is based on this argument whether post UTME should be scrapped or not, we have decided to embark on this research to help Lagos State Polytechnic in particular in their admission screening exercise and other institutions in general, could also adopt the same procedure by using the formulated model.

This research is aimed at formulating a discriminating model that will perfectly and adequately predict whether a prospective student will graduate well or not.

II. Materials and Method

2.1 Data Description

This sectionaddressed the issue of how the data is collected and used and the subsequent subsection explains the method of data analysis and the software employed. Primary data was collected via questionnaireadministered to90 students from Lagos State Polytechnic, Ikororodu, Lagos, Nigeria in 2016/2017 academic session.

The studentsare classified in one category if they graduated with a CGPA of 3 and above and to the other groups if he or she graduated with a CGPA less than 3 or refused to graduate at the right time due to carryover. The first group is labelled as good standing and are fit for admission into their department while the second group is labelled poor standing and are unfit for admission into their department. The criterion for the classification is the student's first year CGPA. The students are in their second year, which is expected to be their final semester if all things being equal at their National Diploma (ND) level. As at the time of the survey the students only had access to their first year CGPA. A sample of 90 students from different departments of Lagos State Polytechnic, Lagos were selected for the survey. The survey employed multistage random sampling. The first stage involved the selection of two schools from the seven schools in the Polytechnic using simple random sampling (SRS). The School of Pure and Applied Sciences and School of Technology were selected. The second stage involves selection of 110 students using SRS from the various departments in the two schools from the list of all ND 2 students in these schools. Structured questionnaires were distributed to all the selected students but only 90 were retrieved, accounting for 81.8% response rate. A copy of the questionnaire can be found on AppendixII.

2.2 Methods of Analysis

2.2.1 Discriminant Analysis

Discriminant analysis is used as a statistical technique for classifying the students as fit or unfit for admission. Theproper use of discriminant analysis requires that assumptions underlying the technique be observed. The independent variables need to be interval while the dependent variable, the groups into which observations are classified, need to be nominal. Multivariate normality is assumed, but discriminant function analysis is robust to violations due to skewness rather than outliers (Tabachnick&Fidell, 1989). Discriminant function analysis includes a technique that can be used to identify outliers and Mahalanobis distances. Homogeneity of variance-covariance matrices is another assumption of discriminant function analysis, but like multivariate normality, discriminant function analysis is robust to violations.

Finally, violations of multicollinearity may make the underlying matrix calculations unstable and must be avoided but can be controlled with an option in the program. Generally, violations of these assumptions are conservative; that is, the power of the test is reduced, thereby lessening the chance of finding significance (Klecka, 1980).

Discriminant analysis forms one or more weighted linear combinations of discriminator variables called discriminant functions. Each discriminant function has the general form:

$$D_{ip} = \beta_{0i} + \beta_{1i}x_{1i} + \beta_{2i}x_{2i} \ldots + \beta_{ji}x_{jp},$$

where D_{ip} is the discriminant score of discriminant function i for object p, β_{0i} is the Y intercept of discriminant function i, β_{ji} is the discriminant weight for independent variable j and discriminant function$i$, x_{jp} is the discriminator variable or independent variable j for object k, $j = 1, 2, \ldots, J$, and p is the number of discriminator variables. The Y-intercept is a constant that adjusts the function to account for the scaling differences in the discriminator variables that are present when raw (unadjusted) scores are used for the analysis; this adjustment is unnecessary when standard scores are analyzed.

2.2.2 Artificial Neural Network Analysis

Artificial Neural Network (ANN) commonly called neural network is used in selecting the important factors that are able to classify students as fit or unfit for admission. It is a system composed of many single processing elements operating in parallel, whose function is determined by network structure, connection strength and the processing performed at computing elements or nodes (Diaz, 2003).

Artificial Neural Network is considered nonlinear statistical data modeling tools where the complex relationships between inputs and outputs are modeled. It has three layers that are interconnected. The first layer which consist of the input layer. The intermediate layer called the hidden units (layer) or summing junction and the third layer, which is the output layer. The hidden neuron receives data from the input neuron, works on it with the help of the transfer function and sends it to the output layer as the response. The model proposed by Anders (1996)isused. The model is given as:

$$y = f(X, w) = \alpha X + \sum_{h=1}^{H} \beta_h g\left(\sum_{i=1}^{I} \gamma_{hi} x_i\right)$$

Where the transfer function, $g = (1 + e^{-x})^{-1}$

$X = (x_0 = 0, x_1, \ldots, x_I)$; $w = (\alpha, \beta, \gamma)$

y = the output variable; x = the input variables; α = the weight of the input unit(s);

β = the weight of the hidden unit(s); γ = the weight of the output unit(s).

SPSS 22.0was used as a tool to assist in the analysis by importing a variety of factors specific to the independent variables. These factors were; CGPA, Post UTME score, UTME score, SSCE score, number of O'level subjects passed at credit level and other factors that relate to students attitude towards their course of study.

The analysis includes all independent variables into the equation by using discriminant analysis and artificial neural network. Two methods of analysisare ways to know the order of contribution of those factors to the model.

III. Empirical Results and Discussion of Findings

3.1 Exploratory Data Analysis (EDA)

In this section, we explore the data by showing some hidden features within the dataset. The first objective is achieved in this section. Tables 1 to 5 and Figures 1 to 7 are used to explain in descriptive capacity some features of the dataset.

Table 1 shows that 13.3 % of the students fall in the age bracket (18-21), 73.3% fall in the age bracket (22-25), 10% fall in the age bracket (26-29) while the remaining 3.3% are above 29 years old of which 66.7% are male while 33.3% are female. This shows that most of the respondents are students that fall in the age group of 22-25 years. Also, more male than female students are respondents. The result of Table 1 also shows that 16.7%

of the respondents' fathers have no formal education, 10% have primary school education, 23.3% have secondary school education and 50% have tertiary education. It is evident that most of the respondents' fathers are educated up to tertiary level. Also, the table shows that 6.7% of the respondents' mothers have no formal education, 20% have primary school education, 20% have secondary school education and 53% have tertiary education. It is evident that most of the respondents' mothers are educated up to tertiary level. The mothers are relatively educated more than the fathers.

Table 1: Frequency Distribution of Background Information of Respondents

Variables	Attributes	Frequency	Percentage (%)
Age	18-21	12	13.3
	22-25	66	73.3
	26-29	9	10.0
	Above 29	3	3.3
Sex	Male	60	66.7
	Female	30	33.3
Father Education	No school	15	16.7
	Primary	9	10.0
	Secondary	21	23.3
	Tertiary	45	50.0
Mother Education	No school	6	6.7
	Primary	18	20.0
	Secondary	18	20.0
	Tertiary	48	53.3
Ethnicity	Yoruba	72	80.0
	Igbo	15	16.7
	Others	3	3.3

Table 1 also shows that 80% of the respondents are Yoruba students, 16.7% are Igbos while 3.3% of the respondents comes from other ethnic group in Nigeria, since 100% of the respondents are all Nigerians.

Figure 1 shows that most of the respondents are from Ogun State of Nigeria, followed by Osun State and then Lagos State. Lagos State came third out of the 13 states that appeared on the chart instead of first as should be expected by many. This is as a result of the fact that Statistics students were part of the survey and were not given admission in the first list, which has majority of Lagos State indigenes.

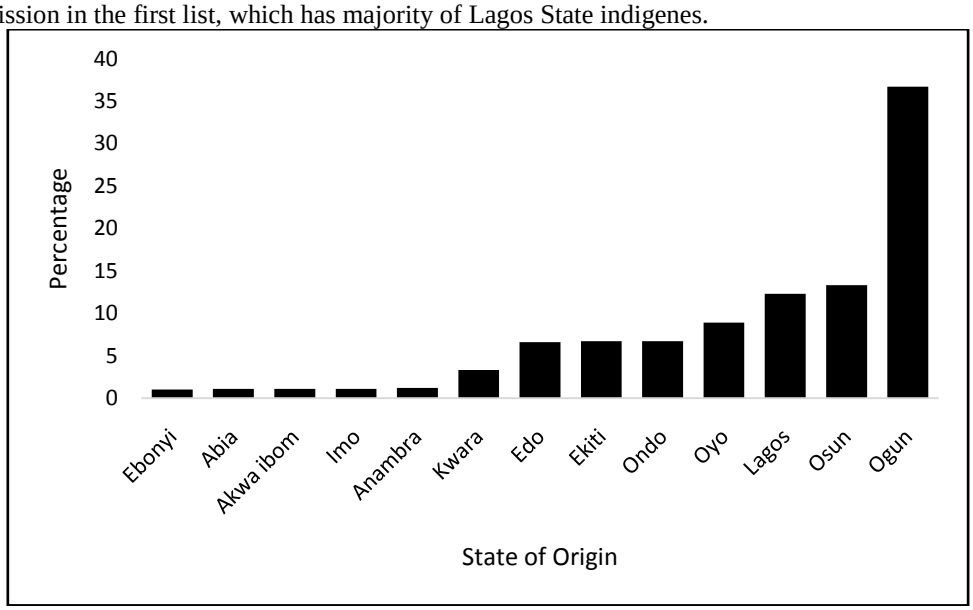

Figure 1: State of Origin of Respondents

Table 2 shows some questions in the questionnaire (necessary information) that are likely to have effect on students' academic standing and the figures in the table are in percentage. Table 2 shows that 5.3% of the

respondents strongly disagree that they will be a professional in their current field of study 5 years from now, 10.5% disagree, 21.1% are neutral, 10.5% agreed and 52.6% strongly agreed.

Table 2: Factors Determining Student Fitness in the Department Admitted (in %)

Code	Question	SD	D	N	A	SA
E53.	I will be a professional in my current field of study 5 years from now	5.3	10.5	21.1	10.5	52.6
E54.	I like to further my education in this department in a university	10	5	10	25	50
E55.	I will encourage my children to pursue a career in this department	15	5	30	45	5
E56.	If I am given an offer to change department, I will reject the offer	15	20	25	25	15
E57.	There is a high prospect in my current field of study	5	0	0	50	45
E58.	I will pursue other profession in the nearest future	15	10	25	35	15
E59.	I hate my current department	50	15	20	0	15
E60.	My parents will not allow me to pursue my career in this department	45	25	10	10	10
E61.	I never liked this department even till now	47.4	10.5	15.8	21.1	5.3
E62.	I would have done better academically if I have gone to other department	31.6	21.1	21.1	10.5	15.8

This follows that at least 63.1% of the respondents agreed that they will be a professional in their current field of study 5 years from now. At least 75% of the respondents agreed that they like to further their education in their current department in a university. At least 50% of the respondents agreed that they will encourage their children to pursue a career in their current department. At least 40% of the respondents agreed that if they are given an offer to change department, they will reject the offer. At least 95% of the respondents agreed that there is a high prospect in their current field of study. At least 50% of the respondents agreed that they will pursue other profession in the nearest future. Just 15% of the total respondents at least agreed that they hate their current department. At least 20% of the respondents at least agreed that their parents will not allow them to pursue their career in their current department. At least 26.4% agreed that they never liked their current department even till now. At least 26.3% of the respondents agreed that they would have done better academically, if they have gone to other department.

Table 3 shows observed frequencies and expected frequencies in parenthesis ( ). Table 3 shows that out of 80 respondents that like their department, 39 have poor standing while 41 have good standing. It is expected that out of this 80 respondents that like their department, approximately 37 should have poor standing and 43 have good standing. Also, out of 10 respondents that hate their department, 3 have poor standing while 7 have good standing. It is expected that out of this 10 respondents that hate their department, approximately 5 should have poor standing and 5 have good standing.

Table 3: Crosstabulation of Likeness for Department and Academic Standing

		Academic Standing		
		Poor Standing	Good Standing	Total
Like Department	Yes	39 (37.3)	41 (42.7)	80
	No	3 (4.7)	7 (5.3)	10
	Total	42	48	

Pearson Chi-Square = 1.256, ***DF*** = 1, ***P-Value*** = 0.262
Likelihood Ratio Chi-Square = 1.295, ***DF*** = 1, ***P-Value*** = 0.255
MHC statistic= 0.608398 ***DF*** = 1 ***P-Value*** = 0.435391
Common odds ratio= 2.21951

The Chi-square result obtained from the Crosstabulation from Table 3 shows that students' likeness for their departments do not have a significant association with their academic standing at 5% level of significance. It means that students can hate their department and still have good standing. Whether students like their department or not cannot determine if they will have good or poor standing.

Table 4 shows the Chi square result of factors that could determine students' academic standing. Table 4 shows that factors E55, E57, E58, E59 and E62 are significantly associated with students' academic standing.

The responses to these questions by students will determine at 95% confidence their academic standing. The Chi square calculated, degrees of freedom, probability value and decision taken are clearly shown on Table 4.

Figure 2 shows the bar chart of the P-values of the factors depicted in Table 4. The closer the P-value is to zero, the more significant is the association. So, E55 (I will encourage my children to pursue a career in this department) is the most significant factor to determine student academic standing. Students' agreement to this statement can determine their academic standing. The next determining factor is E57 (There is a high prospect in my current field of study), followed by E58 (I will pursue other profession in the nearest future), then E62 (I would have done better academically if I have gone to other department) and then E59 (I hate my current department). Other factors with higher p-values are not significant at 5% level.

Table 4: Chi Square of Factors Determining Student Academic Standing

Code	Question	χ^2	Df	P-value	Decision
E53.	I will be a professional in my current field of study 5 years from now	6.718	4	0.152	Not sig
E54.	I like to further my education in this department in a university	7.5	4	0.112	Not sig
E55.	***I will encourage my children to pursue a career in this department***	***21.806***	***4***	***0.000***	***Sig***
E56.	If I am given an offer to change department, I will reject the offer	9.167	4	0.057	Not sig
E57.	***There is a high prospect in my current field of study***	***18.889***	***2***	***0.000***	***Sig***
E58.	***I will pursue other profession in the nearest future***	***22.619***	***4***	***0.000***	***Sig***
E59.	***I hate my current department***	***12.292***	***3***	***0.006***	***Sig***
E60.	My parents will not allow me to pursue my career in this department	4.722	4	0.317	Not Sig
E61.	I never liked this department even till now	9.140a	4	0.058	Not Sig
E62.	***I would have done better academically if I have gone to other department***	***22.131***	***4***	***0.000***	***Sig***

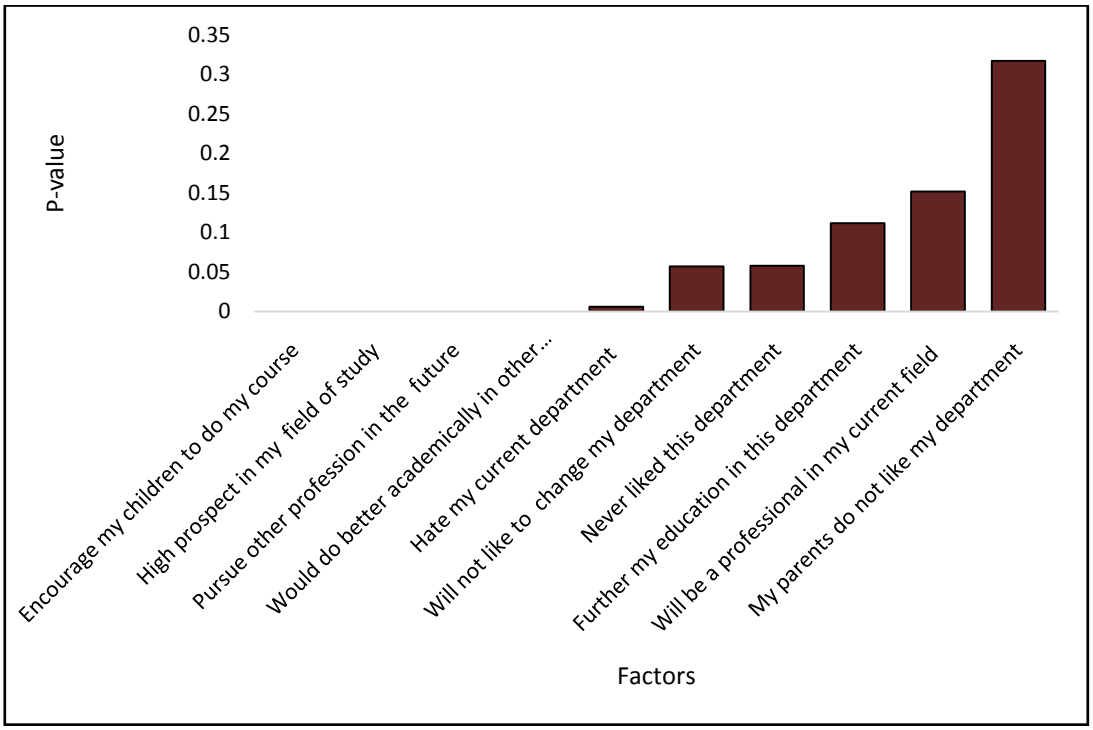

Figure 2: P-value of Factors determining students' academic standing

Figures 3 to 7 shows cluster bar charts of the factors that significantly associate with students' academic standing. Figure 3 shows that out of the 50% of the respondents that will encourage their children to pursue a career in their current department, at least 40% of them have good standing while just 10% have poor standing. This shows that if a student agrees to encourage his or her child to pursue a career in his or her current department, then there is a likelihood that the student will have good standing.

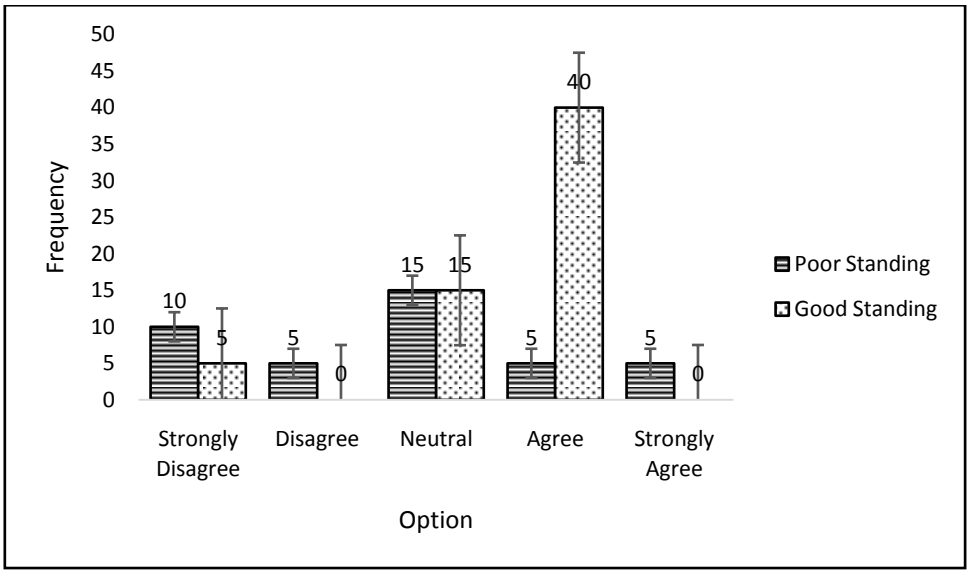

Figure 3: Encourage my children to pursue a career in this department

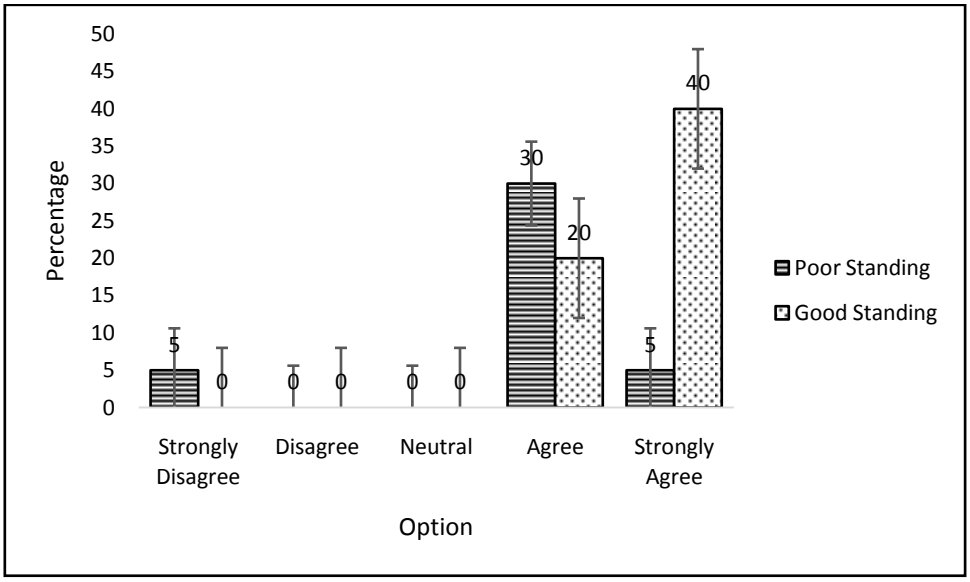

Figure 4: High prospect in my current field of study

Out of the 95% of the respondents that agreed that there is a high prospect in their current field of study, at least 60% of them have good standing while just 35% have poor standing. This shows that if a student agrees that there is a high prospect in his or her current field of study, then there is a likelihood that the student will have good standing.

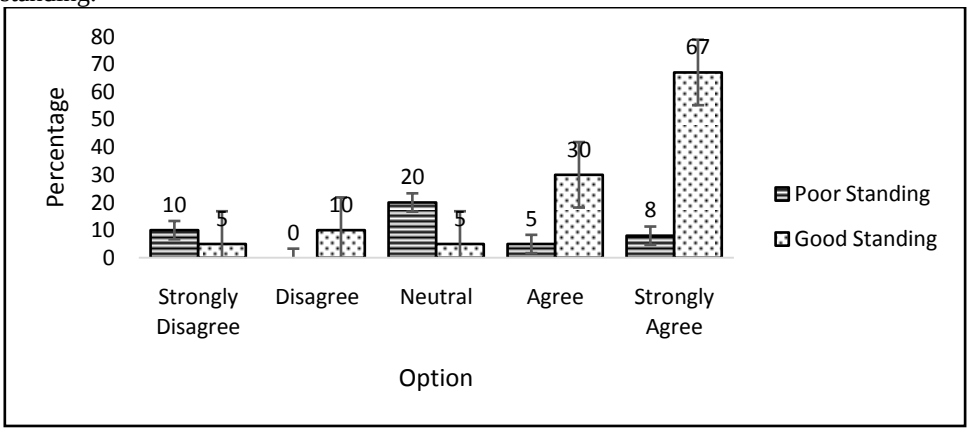

Figure 5: I will pursue other profession in the nearest future

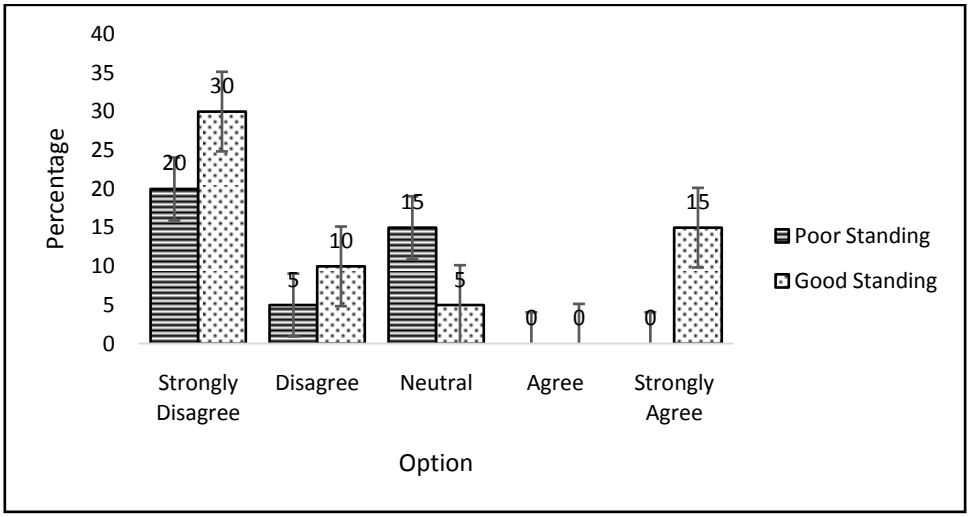

Figure 6: I hate my current department

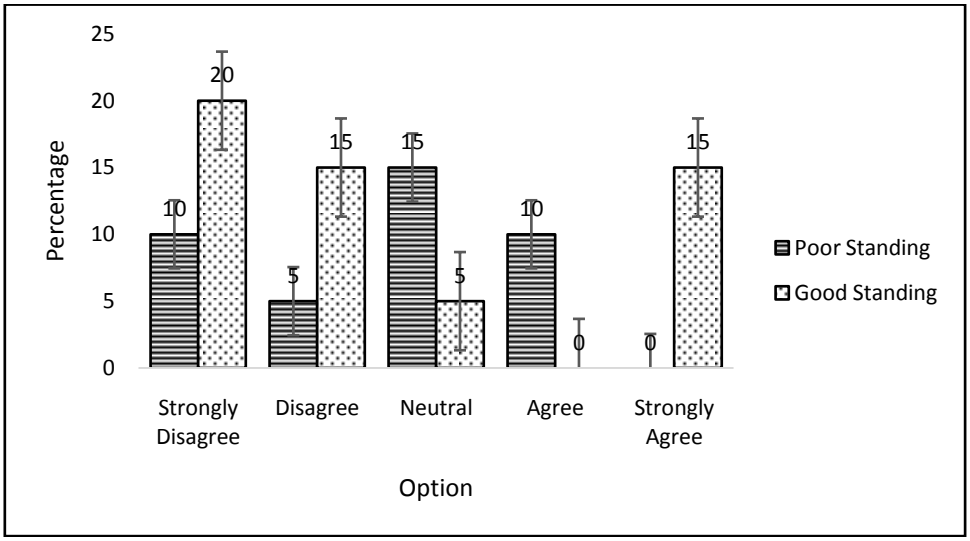

Figure 7: I would have done better academically if I have gone to other department

Table 5: Descriptive Statistics of Factors Determining Student Fitness in a Department

Factors	Mean	Std. Deviation
Current CGPA (CGPAD50)	3.1700	0.03286
UTME Score (B19Total)	212.00	9.859
Post UTME score (B22)	59.20	18.100
Number of O'level subjects passed at credit level (C40)	6.60	1.313

Table 5 shows the descriptive statistics of quantitative factors that can determine students' academic standing. Table 5 shows that on the average, the CGPA of the respondents is 3.17 with standard deviation of 0.03286 and their average UTME score is 212 with standard deviation of 9.859. Their average post UTME score is 59% with 18.1 standard deviation while on the average, they passed approximately 7 subjects in their 0'level examinations at credit level (that is A1, B2, B3, C4, C5 and C6) with standard deviation of 1.313.

3.2Classification Using Discriminant Analysis

In this section, discriminant analysis is used to classify admitted students as fit or unfit. Students with good standing are assumed to be fit for the admission in the department which they gained admission while students with poor standing are assumed to be unfit for the department they are given admission.

Table 6 shows that 60% of original grouped cases are correctly classified, meaning that 60% of the students given admission are actually classified as fit or unfit. Table 6 shows that 27 students out of 48 students with good standing are fit for admission while 21 are unfit for admission into the department they are given admission. Also, out of the 42 students that have poor standing, 15 are fit while 27 are unfit for admission into the department they are given admission.Cross validation is done only for those cases in the analysis.

Table 6: Classification Result from Discriminant Analysis

			Predicted Group Membership		
		Y	Unfit	Fit	Total
Original	Count	Poor Standing	27	15	42
		Good Standing	21	27	48
	%	Poor Standing	64.3	35.7	100.0
		Good Standing	43.8	56.3	100.0
Cross-validated	Count	Poor Standing	39	3	42
		Good Standing	9	39	48
	%	PoorStanding	92.9	7.1	100.0
		Good Standing	18.8	81.3	100.0

In cross validation of the cross-validated grouped cases, each case is classified by the functions derived from all cases other than that case. The table shows that 86.7% of cross-validated grouped cases correctly classified. It is seen that in the cross validated group, 39 students out of 48 students with good standing are fit for admission while 9 are unfit for admission into the department they are given admission. Also, out of the 42 students that have poor standing, 3 are fit while 39 are unfit for admission into the department they are given admission.

3.3 Artificial Neural Network Model

In this section, artificial neural network model is fitted to determine factors that are most important in discriminating students as fit and unfit (good standing and poor standing). Table 7 shows that 9 cases were selected as samples are taken for validation out of which 5 were trained, 5 were used for testing and 2 were held out. A total of 81 cases were excluded.

Table 7: Case Processing Summary

		N	Percent
Sample	Training	5	55.6%
	Testing	2	22.2%
	Holdout	2	22.2%
Valid		9	100.0%
Excluded		81	
Total		90	

Table 8: Model Summary

Training	Sum of Squares Error	0.000001755
	Relative Error	0.0000008773
	Stopping Rule Used	Training error ratio criterion (0.001) achieved
Testing	Sum of Squares Error	0.0000005223
	Relative Error	0.0000004179
Holdout	Relative Error	0.0000004179

Dependent Variable: Y

Table 8: Independent Variable Importance

Factors	Importance	Normalized Importance
B19Total	0.096	65.75%
B20	0.02	13.70%
B22	0.146	100.00%
E53	0.117	80.14%

E54	0.02	13.70%
E55	0.012	8.22%
E56	0.035	23.97%
E57	0.017	11.64%
E58	0.053	36.30%
E59	0.12	82.19%
E60	0.058	39.73%
E61	0.104	71.23%
E62	0.063	43.15%

Table 7 shows the model summary and it shows that the sum of squares error (SSE) is as small as 0.000001755 and the relative error is 0.0000008773 for the training samples. For the testing samples, SSE is 0.0000005223 and relative error is 0.0000004179 while the holdout samples relative error is 0.0000004179, which is not different from that of the testing samples.

Table 8 shows the independent variable importance and normalized importance. This values are better depicted by the bar plot in Figure 8. Figure 8 shows that B22 is the most important factor, which is used as a base for normalization. Table 8 shows that if B22 has 100% contribution, E59 has 82.1% contribution, E53 has 80.14% contribution, E61 has 71.23% contribution, B19Total has 65.75% contribution, B62 has 43.15% contribution, E60 has 39.73%, E58 has 36.3% contribution, E56 has 23.97% contribution, E54 has 13.7% contribution, B20 has 13.70% contribution, E57 has 11.64% contribution and E55 has 8.22% contribution to students' academic standing.

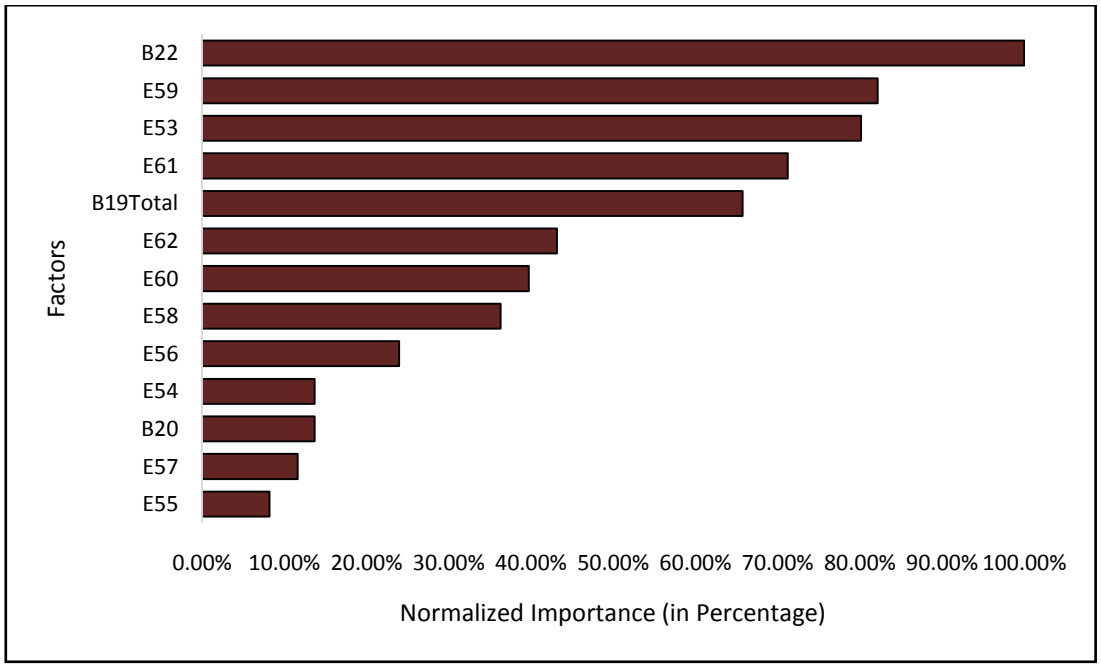

Figure 8: Bar Plot of Normalized Importance

The artificial neural network model shows that for a student to be selected into a department, he or she must complete a form that contains all the questions. The 5 most important questions in this order that should be used for selection basis into any department into higher institutions include:

1. ***Post UTME score***
   How strongly agree or disagree a student is to the following statement
2. ***I hate the department I am given admission***
3. ***I will be a professional in this field of study 5 years from now***
4. ***I never liked this department even till now am about to go into it***
5. ***Aggregate UTME score***

IV. Conclusion and Policy Implications

The post UTME score is the most important criteria for selecting a student into a department, followed by the student likeness for the department, if he is going to be a professional in the course of study in the nearest future and if he had never liked the department, before considering the UTME score. The discriminant analysis was able to classify 60%of the original grouped cases of admitted students correctly as fit or unfit. The developed artificial network model shows that the post UTME score is the most important criteria for selecting a student into a department in any higher institution. Other questions as stated in the analysis should be asked and then the UTME score is also an important factor to be considered but not as important as the post UTME score. The model was used to test final year graduating students not used in the model formulation, that is, the cross-validated grouped case, and it is discovered that 86.7% of these students were accurately predicted to as students with good or poor standings (performance) as measured by their final CGPA.

We therefore strongly advised school authority to consider post UTME as a major criteria for students' selection into their various programme of interest and ask questions relating to their likeness for the department and if they are going to be professionals in their field of interest.

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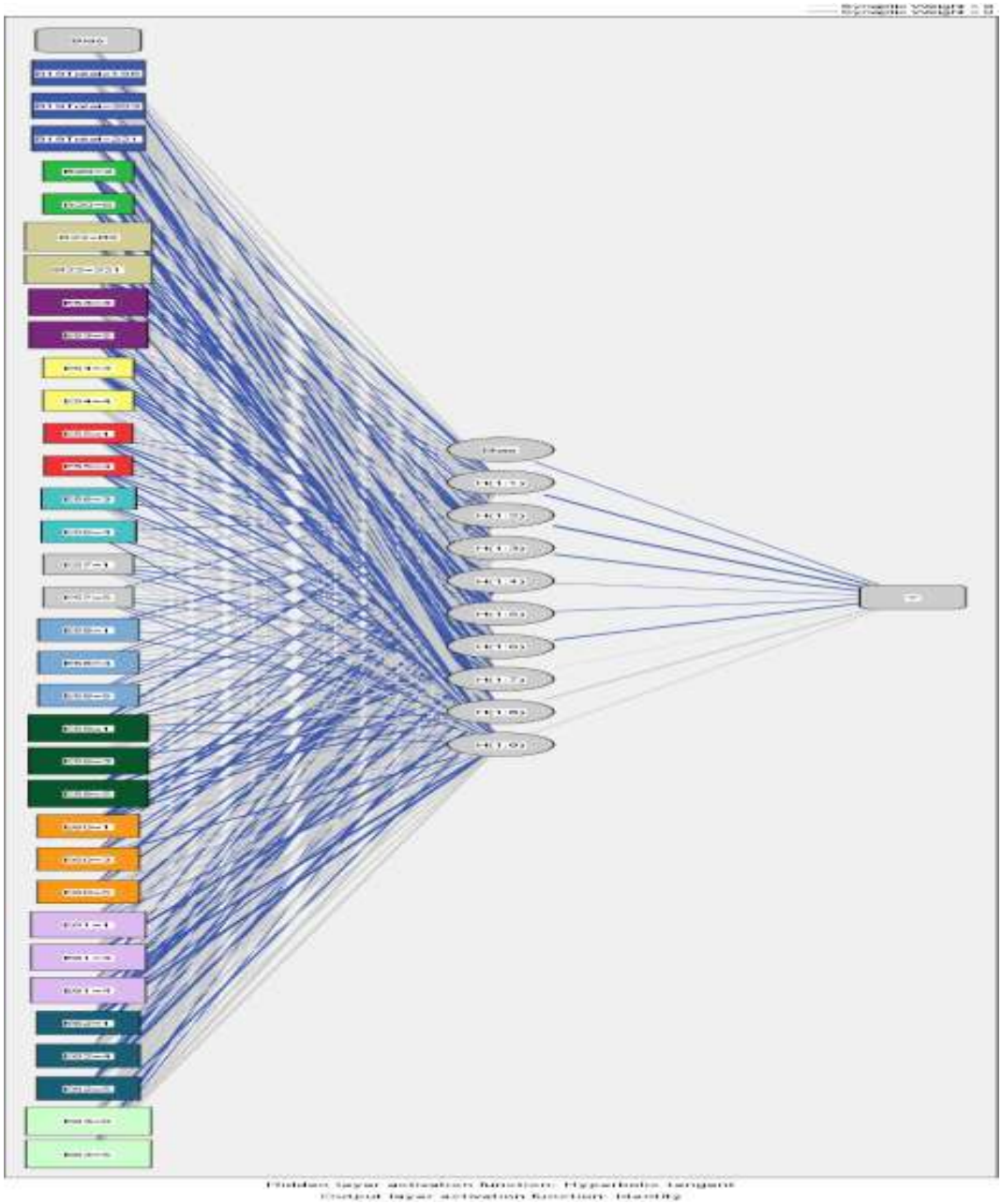

Appendix A

Appendix B

QUESTIONNAIRE

Sir/Ma, this questionnaire is intended to evaluate criteria for selecting students into Nigerian tertiary institutions. Please your candid response is needed. Your personal information will be kept confidential and combined with that of others. Only the aggregate result will be reported and it is meant for purely academic purpose.

Please tick the most appropriate option and fill blank spaces where necessary. Thank you.

SECTION A: Background Information of Respondents

1. Age: below 18 [ ] 18 – 21 [ ] 22 – 25 [ ] 26 – 29 [ ] Above 29 [ ]
2. Sex: Male [ ] Female [ ]
3. Nationality: Nigerian[ ] Non Nigerian[ ]
4. Level: ND 1 [ ] ND 2 [ ] HND 1 [ ] HND 2 [ ]
5. Father's highest qualification: No schooling [ ] Primary [ ] Secondary [ ] Tertiary [ ]
6. Father's Discipline: _____
7. Mother's highest qualification: No education [ ] Primary [ ] Secondary [ ] Tertiary [ ]
8. Mother's Discipline: _____
9. State of origin: _____
10. Ethnicity: Yoruba [ ] Igbo [ ] Hausa [ ] Others [ ]
11. Are your parents still alive? Yes, both are alive [ ] Yes, one is alive[ ] No, both are not alive [ ]
12. What is your dream profession? _____
13. Who is your childhood hero? _____
14. Do you like your present department? Yes [ ] No [ ]

15. If you are given the chance to choose, which department will you choose? _____
16. Where will you be in ten years' time to come? _____

SECTION B: UTME Information

17. First choice: Institution: _____
    Course: _____
    Second choice: Institution: _____
    Course: _____
18. UTME score: Subject1: _____ Score 1: _____
    Subject2:_____ Score 2: _____
    Subject3:_____ Score 3: _____
    Subject4:+_____ Score 4: _____
19. Total: _____ (out of 400)
20. How many O'level subjects did you pass at credit level: _____
21. O'level subject grade: Subject 1: _____ Grade 1: _____
    Subject 2: _____ Grade 2: _____
    Subject 3: _____ Grade 3: _____
    Subject 4: _____ Grade 4: _____
    Subject 5: _____ Grade 5: _____
22. Post UTME score: _____
23. How many times have you done JAMB/UTME? _____
24. How many times have you done Post UTME? _____
25. UTME/JAMB should be scrapped by government: Yes [ ] No [ ]
26. Post UTME/JAMB should be scrapped by government: Yes [ ] No [ ]
27. Which of the following examinations is the best criteria for selecting students into tertiary institution?WAEC [ ] NECO [ ] UTME/JAMB [ ] Post UTME [ ] Others, please specify _____

SECTION C: Primary and Secondary school Information

28. Age started Primary School: Younger than 4 [ ] 4-5 years [ ] 6 years [ ] 7 years [ ] Above 7 [ ]
29. Primary school grade: Pass [ ] Merit/Credit [ ] Distinction [ ] I don't know [ ]
30. Years spent in primary school: _____
31. Name of examination passed in primary school (e.g G2, National common entrance, etc): _____
32. Age started Secondary School: Younger than 10 [ ] 10-12 years [ ] Above 12 years [ ]
33. Name of Secondary School:_____
34. Year graduated from secondary school: _____
35. Classify ownership of your secondary school: Federal[ ] State[ ] LGA[ ] Private[ ] Mission [ ]
36. Classify your secondary school type: Boys only [ ] Girls only [ ] Boys and girls [ ]
37. Have you ever been in boarding school? Yes [ ] No [ ]
38. O'Level examination passed: WAEC [ ] NECO [ ] Others [ ]
39. School passed O'level examination: Internal/WAEC/NECO [ ] External/GCE [ ]
40. How many O'level subjects did you pass at credit level: _____
41. How many sittings: One [ ] Two [ ]
42. O'level subject grade: Subject 1: _____ Grade 1: _____
    Subject 2: _____ Grade 2: _____
    Subject 3: _____ Grade 3: _____
    Subject 4: _____ Grade 4: _____
    Subject 5: _____ Grade 5: _____
43. Class in secondary school: Science [ ] Commercial [ ] Art/Social Science [ ] Others
44. Society you belong to in secondary school: _____
45. I attended extra-moral lessons in secondary school: Yes [ ] No [ ]
46. Which award did you receive in the past: _____

SECTION D: Undergraduate information

47. Year admitted to LASPOTECH: _____
48. Current course of study: _____
49. First year CGPA: _____
50. Current CGPA: _____
51. Do you like your department? Yes [ ] No [ ]
52. Approximately when did you decide on this field of study? In primary school [ ] During JSS [ ] During SSS [ ] After secondary school [ ] During admission [ ] After studying something else [ ] I don't know [ ]

SECTION E: Necessary information

S/N	Question	SD	D	N	A	SA
53.	I will be a professional in my current field of study 5 years from now					
54.	I like to further my education in this department in a university					
55.	I will encourage my children to pursue a career in this department					
56.	If I am given an offer to change department, I will reject the offer					
57.	There is a high prospect in my current field of study					
58.	I will pursue other profession in the nearest future					
59.	I hate my current department					
60.	My parents will not allow me to pursue my career in this department					
61.	I never liked this department even till now					
62.	I would have done better academically if I have gone to other department					

63. Leave a comment:……