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ANALYSIS OF ACADEMIC STAFF PROFILES FOR THE ASSESSMENT OF PRODUCTIVITY: A CASE OF AKWA IBOM STATE UNIVERSITY, NIGERIA

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ABSTRACT: *Every educational institution requires a sufficient number of qualified academic staff to deliver on the mandate, which includes, training, research and community development service. The quality of academic staff in a tertiary institution is expected to reflect on its graduates, who should compete favourably in the world labour market and add value to the society. The motivation behind this research was predicated upon the need to assess the productivity of academic staff in Akwa Ibom State University. The aim was to analyse academic staff profiles for possible reclassification on the basis of some performance factors. Information about the qualification, years of experience and research publications for 388 pensionable academic staff of the university was obtained from staff records. Firstly, goodness of fit tests for conformity of academic staff mix with the NUC proportional distributions of 20%, 35% and 45% for Professors/Associate Professors, Senior Lecturers and Lecturer1/Below categories were conducted. The tests results showed conformity of 26 out of 38 departments with the NUC proportional staff mix. 12 departments were affected with non-conformity with the NUC proportional academic staff mix. This is a challenge, not only to the 12 affected departments, but to the university as a whole, and this calls for concern. Secondly, Fisher's and Bayesian Discrminant methods were adopted to analyse the staff profiles for possible reclassification. The analysis using Fisher's method has revealed 100% correct classification of Professors/Associate Professors, 71% correct classification of Senior Lecturers, 68% correct classification of Lecturer1/Below and overall correct classification and misclassification probabilities as 0.71 and 0.29 respectively. Bayesian method has recorded 100% correct classification of Professors/Associate Professors, 61% correct classification of Senior Lecturers, 88% correct classification of Lecturer1/Below and overall correct classification and misclassification probabilities as 0.84 and 0.16 respectively. Comparing the two approaches, there is a higher value of correct classification probability in Bayesian Discriminant approach than Fisher's approach, and a lower misclassification probability in Bayesian method than Fisher's method. Bayesian approach gives more advantage in minimizing the classification error than the Fisher's linear Discriminant method, and therefore, places Bayesian Discriminant Approach on higher comparative advantage than Fisher's Discriminant method. The classification and misclassification probabilities presented in this paper are modifications of Usoro (2015). This paper recommends Bayesian Discriminant Analysis, especially, when carrying out discriminant analysis involving many groups or populations to avert the multiple pairwise Fisher's Linear Discriminant analysis for multiple sample or population distributions. The outcome of this research is a good working instrument for staff assessment, planning and development of academic manpower in Akwa Ibom State University.*

KEYWORDS: Academic Staff, NUC Staff-Mix, Discriminant Analysis.

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INTRODUCTION

Every educational institution requires sufficient number of qualified lecturers. Physical assets are secondary. The quality of an institution is a reflection of the quality of its teaching staff. Consequently, the graduates outperform their peers and are more likely to thrive in their chosen fields and all facets of their lives. It is the extent of the goals of the university and impact on their academic personnel that contributes to their commitment and performance on the job. Conversely, in recent times, there has been growing criticism of academic staff of Nigerian universities about their job performance. It appears that the academic staff of Nigerian universities are no longer dedicated and committed to their jobs. Academic productivity means performance in teaching, research articles and other related functions (Brocato and Mavis, 2005). Effectiveness and productivity are related and both are important in teaching and learning processes. Productivity shows whether the activity of an organisation is efficient and effective in terms of output and input (Saxena, 2014). Effectiveness is the extent to which application of input brings the desired result in output and Quality. It is a function of method, technique, personnel skills, knowledge, attitude and aptitude. The output factors in educational institutions are the students, while input factors include the technology, finance, time, equipment, facilities, energy, materials and lecturers. The need for lecturers' productivity in Nigerian universities cannot be over-emphasized as this ensures the delivery of quality education. According to Udoh (2000), the level of productivity of a teacher at any educational level is determined not only by his/her professional abilities but by other crucial factors such as their physical work environment. He further stated that efficiency of academic staff could be measured in terms of effectiveness of teaching techniques and methods, mastery of subject matter, classroom management, record keeping, student's evaluation, and participation in committees, community development and Research Publications.

Print and Hattie (1997) defined research productivity as *'the totality of research performed by academics in universities and related contents within a given time period'* (p.454). Research productivity in this study means the publications published by academic staff in the research institutes surveyed: such publications include books, journal articles, chapters in books, conference papers and proceedings, technical reports, patents, scientific peer- review bulletin, occasional papers, monographs, co-authored books, theses/dissertations and Journal publications published. Research productivity is very important in the appointment and promotion of academic staff of these institutions as it is spelt out in the Conditions of service governing their appointments and promotions. By virtue of their work and positions, apart from educational qualifications and cognate experience, they are required to have considerable high level of research output for prestige, recognition and career progression. It is expected of them to be carrying out research and publishing such as research output in reputable publishing outlets in and outside the country. The observed low research productivity has been affecting the promotion and career progression of the academic staff as the slogan "*publish or perish*" is practiced (Kwanya, 2020). The importance of research productivity in the career advancement and prestige of researchers in these institutes is quite obvious as such it is not taken with levity by academic staff and employers. Educational institutions are established to produce well-rounded professionals worthy of learning and character. However, the extent to which this objective could be achieved depends greatly on the level of productivity of the academic staff. Odunaga and Agila (2000) defined lecturer productivity as a measure of the efficiency with which the overall process of teaching and learning utilizes its labour force towards the achievement of educational goals and objectives. Lecturers' productivity or ineffectiveness

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could be ascribed to poor funding of Staff development and Research, explosion of universities without recruitment of adequate number of academic personnel. Other factors include: scarce facilities, low staff morale, inadequate supervision and so forth" (Oyibo & Obro, 2020). In view of the university education in Nigeria, Mimiko (2010) stated, quoting the Academic Staff Union of Nigerian Universities (ASUU): "*What we have in terms of academic staff in many Nigerian universities is only about forty per cent (40%) of what is required, which is cause for concern*." Management of some of these universities outsource academic staff from Federal universities so as to remain in business. In order to ensure that quality graduates are produced in the Nigerian Universities and are of a comparable international standard, the National Universities Commission (NUC) in collaboration with the universities and their staff developed minimum academic standards for all the programmes taught in Nigerian Universities as it is contained in the Benchmark for Minimum Academic Standard (2007). It is to guarantee that universities achieve the academic staff mix for all academic programmes. The Benchmark for Minimum Academic Standard by rank structured into acceptable percentages of 20% for Professors/Associate Professors, 35% for Senior Lecturer and 45% for Lecturer I/Below.

Research has been carried out on the distribution and profile of academic staff in institutions purposely to identify the areas of shortcomings in order to proffer solutions for better services. This is important because in some universities, for instance, lecturers irrespective of rank who are holders of Doctorate degrees are assigned enormous responsibilities; some of the duties include teaching, supervision of undergraduate, post graduate level students, members of several committees and holders of various positions. Notwithstanding equality of ranks of the academic staff, the productivity level of individual lecturers varies. Apart from the qualification, what could account for the variability in the productivity among lecturers are the years of cognate experience in the system and research contributions. It is pertinent for management of academic institutions to place high premium on academic staff performance evaluation as a way to addressing the challenges that bedevil academic productivity in the system. It is therefore against this backdrop that this study aims at investigating the conformity of academic staff distribution with the National University Commission staff-mix and analysing the academic staff profile for evaluation of productivity and possible reclassification on the basis of their performance in Akwa Ibom State University (AKSU), Nigeria.

Background of the Study

The conception of the Akwa Ibom State University (AKSU) started in October 2000 as Akwa State University of Technology (AKUTECH). The Akwa Ibom State University is a multi-campus institution, with two campuses; the main campus is located in Ikot Akpaden, Mkpat Enin local government area and Obio Akpa Campus in Oruk Anam Local Government Area. Full academic activities started on 1st November 2010 with admission of 300 students into four faculties. The Akwa Ibom State University has since grown with over 8000 students in 38 departments within 9 faculties including General studies and Library. The University has undergraduate and postgraduate programmes with a total of 466 Academic staff members as at August 2022.

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LITERATURE REVIEW

Related to this research is the *Mathematical Model for Nigerian University Academic Staff Mix by Rank*, Tella and Daniel (2013). The authors formulated a simplified Mathematical model to put forward for appointment and distribution of academic staff in line with the existing NUC bench mark for minimum academic standard.

Ekhosuehi et al (2014) formulated a population-dynamic model consisting of aggregate-fractional flow balance equations within a discrete-time Markov chain framework for the system, the work related the problem to the challenge of universities in Nigeria towards reaching the desired academic staff-mix by rank specified by the National Universities Commission (NUC). The procedure was implemented on a faculty academic staff structure. The utility of the model was illustrated by means of academic staff flows in a university-faculty setting in Nigeria. In the study, an attempt was made to find a recruitment distribution that is capable of generating a desired structure after one or more steps in a manpower system where negative recruitment is not allowed. The model generalizes the existing model in the literature. One of the accomplishments of the study was the capability to figure out a way to avoid the possibility of obtaining negative entries in the recruitment distribution and further illustrated the usefulness of the approach for a faculty in the University of Benin, Nigeria. How be it, the practical challenges of implementing the model in the university system included bottlenecks such as the inadequacy of resources, the possibility of overstaffing, dearth of applicants with the requisite qualifications and cognate experience, etc. Nnaji (2014) study was designed to ascertain the relationship between social work environment and academic staff productivity in universities in Enugu state. Three hypotheses were formulated to guide the study and survey design was adopted for the study. Stratified random sampling technique was used to draw a sample of 223 academic staff from a total population of 1116 academic staff from the two state universities in Anambra and Enugu States (Anambra state University and Enugu state University of science and technology). The results revealed that while group identification was an insignificant determinant of academic staff productivity while organisational identification was not. Thus, it was concluded that group identification was important for the performance of higher education institutions. Therefore, it was recommended that the leadership of higher institutions such as polytechnics should put in place mechanisms to promote group identification. It further showed that there is a significant relationship between social work environment and academic staff productivity. Based on this result, it was recommended, among other things, that Heads of Departments should endeavour to create and maintain cordial social relations between themselves and academic staff and equally encourage academic staff to do the same with students, as this would greatly enhance productivity of academic staff.

Enagbonma and Osagiede (2018) developed a model for determining the ideal number of outsourcing academic staff in privately owned universities in Nigeria, the model is a modification of Tella and Daniel (2013) to meet the desired academic staff- mix by a rank ratio as specified by NUC. The method takes National Universities Commission (NUC) guideline on staff regulation into consideration. The estimated ideal number of outsourcing academic staff which will complement the available academic staff, so as to meet the staff-mix by rank ratio stipulated by the NUC. Osagiede *et al* (2014) gave an instance which is consistent with the theoretical foundation of the university system. The authors observed that wastage and shortages in manpower needs were vital issues in the academic system. The authors determined the financial implication for management of the university to deal with such complications by outsourcing academic staff. Similarly, *Academic staff performance evaluation system based on*

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*rough sets t*heory by Ojokoh and Akinsulire (2019) propounded a single module algorithm used by rough set to determine the status of each academic staff. A model for rating publications was proposed to reduce the sentiments involved in manual rating. Reports were generated as output of each evaluation procedure. One hundred (100) dataset of academic staff of the Federal University of Technology, Akure, Nigeria was used in the experiment to evaluate the performance of the system. The results of the system obtained score were compared with the institution standard and it was found that the system scores were above standard, the average precision of the system shows 60% effectiveness which showed that the proposed system is efficient for academic performance evaluation process. This work presents a mathematical relation and rough set model to effectively evaluate academic staff of an institution for promotion. The system allows users to interact online and presents a faster system void of bias and sentiments for annual performance evaluation. Rough set theory was adopted to evaluate the criteria for promotion vis-à-vis qualifications, research and publications, teaching and professional duties, length of service and contribution to the university and nation. This work particularly proposes a model that could be generally acceptable for evaluating publications to eliminate the stress it takes manually, considering publication venue, number of authors and contribution of each. Experiments were carried out to evaluate the performance of the proposed system. The system obtained score was compared with the institution standard and it was found that the system scores were above standard; the average precision of the system shows 60% effectiveness using precision measurement. Shittu (2022) examined classroom organisation and lecturers' productivity in public tertiary institutions in Lagos State, Nigeria. The study adopted correlation design. The population of the study comprised 3,850 academic staff in the seven public tertiary institutions in Lagos State, Nigeria. Based on the findings, it was recommended amongst other that universities, polytechnic and college of education authorities should provide adequate classroom and conducive learning environment for large population of students admitted in order to achieve academic excellence. Adesola and Ekundayo (2022) investigated the relationship between institutional factors and academic staff job performance in Southwest, Nigeria. The study examined the level of academic staff job performance in public universities. The study also examined the extent to which the institutional factors are favourable in the Universities. The study specifically examined relationship between institutional factors such as physical facilities and staff workload. A descriptive research design of the survey type was adopted. The population of this study consisted of 12,844 Academic Staff of public universities in Southwest, Nigeria. The sample of this study consisted of 90 Heads of Departments and 900 academic staff of public universities. The study revealed that level of academic staff job performance was high in public universities in Southwest, Nigeria. It also revealed that status of institutional factors was favourable. Institutional factors variables such as physical facilities and staff workload largely determined academic staff job performance in public Universities in southwest, Nigeria. In view of the fact that the status of institutional factors was favourable in public universities in southwest, Nigeria, owners of public institutions in Southwest Nigeria was recommended to prioritize adequate physical infrastructure to improve the quality of teaching and research. Also, academic personnel should be assigned assignments based on competency and not overworked.

In an attempt to bridge the gap where the government has failed in public private partnership, Akinwumi and Paul (2022) examined public private partnership in academic staff productivity in Nigerian Universities. The population for the study was 6 Deans and 69 Head of Departments (HOD) making a total of 75 was purposively selected mainly from the departments that have

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benefited from private partnership. The data for the study were analysed by the use of simple descriptive statistics with the aid of tables, graphs, charts and regression analysis. The findings revealed that the government budget for the institution (university of Ibadan) is far more less than the budget required to enhance academic staff productivity. The summary of the regression analysis showed that provision of academic infrastructural facilities through public-private partnership has significant contribution to academic staff productivity. It concluded by stating that academic staff productivity are crucial to higher productivity and quality products of any university, hence, there must be increased funding, provision of academic infrastructure, increase in research grant and increased public-private partnership. Based on the findings of the study, public private partnership has assisted in increasing academic staff productivity through, exchange of academic staff, students and programmes among the partners, exchange in curriculum, increase in endowment funds, availability of research grant and expansion of expenditure on academic infrastructural facilities. The findings also revealed that public private partnership contribution in the provision of infrastructure (internet facility, office space) and fund augmentation have significant relationship with academic staff productivity. Except the learning outcome which shows no relationship with PPP to academic staff productivity. It was observed in the study that there is an imbalance in the partnership in the institution, where some departments and academic units have more partnership, links and research projects (which mean more resources), while others have virtually none. This will eventually create rich and poor departments and academic units as well as rich and poor professors within the same academic system. Simisaye and Popoola (2022) research was anchored on Campbell's performance theory which postulates that the latent structure of job performance can be modelled using the following eight general factors: (1) job-specific task proficiency, (2) non-job-specific task proficiency, (3) written and oral communication, (4) demonstrating effort, (5) maintaining personal discipline, (6) facilitating peer and team performance, (7) supervision or leadership, and (8) management or administration. The second theory was the Goleman emotional intelligence theory.

Usoro (2006) carried out discriminant analysis for reclassification of students on the basis of their academic performance. The two groups considered were Accountancy and Business Students. The fisher's linear discriminant function was estimated with the classification rule to discriminate between the two groups of students. Erimafa *et al* (2009) carried out discriminant analysis to predict the class of degree obtainable in a university system. The data for this study were from student's academic records for 100 level and 200 levels, in the Department of Statistics, from 2004 to 2007 academic session in a university system. The conditions for predictive discriminant analysis were obtained, and the analysis yielded a linear discriminant function which successfully classified or predicted 87.5 percent of the graduating students' class of degrees. The function had a hit ratio of 88.2 percent when generalized, as a valid tool to classify fresh students of unknown group membership. It was also discovered that success in classifying or predicting fresh students of unknown group into classes of degree, was essentially similar to that of the historical sample. The consistent high hit rates for both the analysis sample and hold-out sample, i.e., the overall percentage of correct classifications which is 87.5 and 88.2%, as seen in the confusion matrices for this study shows that discriminant analysis can be used to predict students' graduating class of degree from knowledge of variable(s) that have relationship with performance. This study tends to illustrate the logicality and wisdom in examining related statistical technique useful for the purpose of prediction. Abiodun-Oyebanji (2012) examined the Ekiti State University academic staff distribution in using the National Universities Commission (NUC) guidelines. The works

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adopted the descriptive research design in an attempt to investigate the staff mix. The results from the findings indicate the university fair very well in terms of academic staff in the professorial cadre. Nevertheless, the institution was bottom heavy in terms of staff mix with 15.6 % and 65.1 % of the academic staff being Senior Lecturers and Lecturer I and below respectively. This did not meet the NUC ideal recommendation of 35 % and 45% respectively. It was recommended that more academic staff in the senior lecturer cadre should be recruited; this could simply mean more load for senior lecturer category. Usoro (2015) studied membership of individuals in three heterogeneous groups and discriminated membership based on their measurements. Three linear discriminant models were estimated from the pair-wise analysis. Misclassifications were identified in each group and associated probabilities of misclassification obtained. Fisher's linear discriminant function was applied with six measuring parameters on the three groups. In the three-dimensional case carried out in this work, some individuals, based on their measurements exceeded the next superior group to where they should belong. The process of the analysis was pair-wise, and this ended in estimating three models for discrimination. Onu and John (2016) carried out a discriminant analysis and the rule for discrimination was obtained. The analysis yielded a linear discriminant model used as a function with which some students in Statistics and Computer Science departments of Abia State Polytechnic, Aba were re-classified based on their academic performances. Students' scores from four departmental courses offered together were used to discover their actual performances and then re-classified some either from Statistics department to Computer Science department or vice versa based on their academic performances in the selected courses. The confusion matrix showed that 56 students were correctly classified and retained in Statistics department, while 4 students were discriminated from Computer Science department to Statistics department. Furthermore, 55 students were correctly classified and retained in Computer Science department, while 5 students were misclassified and then discriminated from Statistics department to Computer Science department based on their performances.

The existing literature reviewed indicates that lecturers in some ranks in their parent universities are burnout as result of excess workload, outsourcing these academic staff to stand in prior to accreditation further worsens productivity. This is a major motivation for this paper. It is a novel study to perform discriminant analysis on the academic staff of Akwa Ibom State University, Ikot Akpaden for evaluation of productivity for possible discrimination on the basis of performances.

METHODOLOGY

Source of Data

Data for this research was obtained from the Directorate of Human Resources, Akwa Ibom State University, Ikot Akpaden for all their 388 Academic staff members on pensionable appointment as at August 2022, with respect to the highest qualification denoted by Q, Years of service in Akwa Ibom State University denoted by Y, number of research publications denoted by R respectively (see appendix I).

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Table 1:

FACULTY	PROFESSOR/ASSOCIATE PROFESSOR	SENIOR LECTURER	LECTURER I/BELOW
Agriculture	4	12	42
Arts	3	10	25
Education	2	2	9
Engineering	0	14	63
Biological Sciences	3	3	34
Physical Sciences	9	21	54
Social Sciences	2	5	32
Management Sciences	2	4	23
Others (Library, General Studies)	1	2	7
TOTAL	26	73	289

Source: *Akwa Ibom State University Registry*

Chi-Square Goodness of Fit Test:

Statement of Hypothesis:

H_0: There is no significance in the Academic staff mix.

H_1: There is significance in the Academic staff mix.

The Chi-square goodness of fit will be used to test the conformity of Akwa Ibom State University with the NUC stipulated staff-mix. The **test statistic** is given as:

$$\chi^2 = \Sigma \frac{(\theta i - Li)^2}{Li} \qquad (1)$$

Where, θi are the observed frequencies, Li are the expected frequencies, χ^2 is distributed with K-1 degrees of freedom, K is the categories of Academic staff in the university.

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Test for Normality

Hypotheses:

H_0: The Academic staff mix is normally distributed

H_i: The Academic staff mix is not normally distributed

The Shapiro-Wilk test will be used to check for normality in the distribution. The test statistics is given by:

$$W = \frac{(\sum_{i=1}^{n} a_i x_i)^2}{(\sum_{i=1}^{n} x_i - \bar{x})^2} \quad (2)$$

Where; n is the number of observations, $\bar{x}$ is the mean of the pool score of the categories

x_i is the value of the ordered sample, a_i is the tabulated coeficients

The test has critical value $W_{n,p}$, where n is the number of observations, p is the significance value.

Decision Rule: H_0 is rejected if $W \leq W_{n,p}$.

Conover Test for Several Population Variances

Suppose g groups each have a normal distribution with possibly different means and standard deviations $\sigma_1, \sigma_2, \ldots, \sigma_g$ and $n_1, n_2, \ldots, n_g$ denote the number of subjects in each group, Y_{ki} denote the individual i scores in each of the k groups, $\bar{Y}_k$denotes the sample average for k^{th} group and N denote the total sample size of all groups. The test assumes that the data are obtained by taking a simple random sample from each of the g groups.

The formula for the calculation of Conover test statistics is

$$T = \frac{1}{Q}\left[\sum_{k=1}^{g} \frac{S_k^2}{n_k} - N\bar{S}^2\right] \quad (3a)$$

Where

$$Q = \frac{1}{N-1}\left[\sum_{k=1}^{g}\sum_{i=1}^{n_k} R_{ki}^4 - N\bar{S}\right] \quad (3b)$$

$$S_k = \sum_{i=1}^{n_k} R_{ki}^2 \quad (3c)$$

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Where $S_k = (S_1, S_2, S_3)$ *are variances of the* R_{ki}

$$\bar{S} = \frac{1}{N}\sum_{k=1}^{g} S_k \qquad (3d)$$

$$Z_{ki} = |Y_{ki} - \bar{Y}_k| \qquad (3e)$$

Where Z_{ki} are the deviation of group means from individual i scores.

$$R_{ki} = Rank\ (Z_{ki}) \qquad (3f)$$

Where $R_{ki}$are ranks of Z_{ki}.

If the assumptions are met, the distribution of this test statistic follows approximately the Chi-squared distribution with degrees of freedom g – 1.

3.5 Statistical Measures

(i) Variance: Calculate the separability between different classes. This is also known as between-class variance and is defined as the distance between the mean of different classes.

$$S_b = \sum_{i=1}^{g} N_i\,(\bar{x}_i - \bar{x})(\bar{x}_i - \bar{x})^T \qquad (4)$$

(ii) Calculate the within-class variance. This is the distance between the mean and the sample of every class.

$$S_w = \sum_{i=1}^{g}(N_i - 1)S_i = \sum_{i=1}^{g}\sum_{j=1}^{N_i}\left(\bar{x}_{i,j} - \bar{x}\right)(\bar{x}_i - \bar{x})^T \qquad (5)$$

(iii) Variance and Covariance Matrix

Let the variance and covaraince matrix for jth category of staff be defined as

$$S_j = \begin{pmatrix} \mathrm{V}(Q_j) & \mathrm{Cov}(Q_jY_j) & \mathrm{Cov}(Q_jR_j) \\ \mathrm{Cov}(Q_jY_j) & \mathrm{V}(Y_j) & \mathrm{Cov}(Y_jR_j) \\ \mathrm{Cov}(Q_jR_j) & \mathrm{Cov}(Y_jR_j) & \mathrm{V}(R_J) \end{pmatrix} \qquad (6)$$

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Where:

Q_j represents Qualifications in the jth category of academic staff

Y_j represents Years of experience in the jth category of academic staff

R_j represents Research publication in the jth category of academic staff

Pooled Variance and Covariance Matrices

Let S represent the pooled variance and covariance matrix.

Therefore,

$$S = \frac{1}{n-m}\sum_{j=1}^{m}(n_j - 1)S_j \tag{7}$$

Where $n = \sum_{j=1}^{m} n_j$

$S_j = S_1, S_2, S_3$ are variance and covariance matrices for Professor/Associate Professor, Senior Lecturer and Lecturer 1/below. The inverse of the Matrix S can be defined as

$$S^{-1} = \frac{1}{Det(M)} Adj(M) \tag{8}$$

Linear Discriminant Analysis:

Linear Discriminant Analysis has two major approaches, which include Fisher's and Bayesian methods. In this work, we propose the two methods for comparison of performance in the analysis of the academic staff profiles.

PAIRWISE FISHER'S APPROACH

Firstly, we will obtain the Vector Means and Covariance Matrix

A. The vector means for the three groups are:

$$\overline{X}_P = \begin{pmatrix} \overline{X}_Q \\ \overline{X}_Y \\ \overline{X}_R \end{pmatrix}, \quad \overline{X}_S = \begin{pmatrix} \overline{X}_Q \\ \overline{X}_Y \\ \overline{X}_R \end{pmatrix}, \quad \overline{X}_L = \begin{pmatrix} \overline{X}_Q \\ \overline{X}_Y \\ \overline{X}_R \end{pmatrix} \tag{9}$$

$\overline{X}_P$, $\overline{X}_S$, and $\overline{X}_L$ are the vector of means for different categories of Academic staff, which include Professor/Associate Professor, Senior Lecturer and Lecturer I/below.

B. The covariance matrix defined in equation (6) is obtained from each of the groups

$$S_j = \begin{pmatrix} V(Q_j) & Cov(Q_jY_j) & Cov(Q_jR_j) \\ Cov(Q_jY_j) & V(Y_j) & Cov(Y_jR_j) \\ Cov(Q_jR_j) & Cov(Y_jR_j) & V(R_J) \end{pmatrix}$$

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Discriminant Condition

The conditions for the pairwise discriminant analysis are:

$^1/_2\,(\overline{X}_P - \overline{X}_S)^I S^{-1}(\overline{X}_P + \overline{X}_S)$ for groups Professor/Associate Professor and Senior Lecturer

$^1/_2\,(\overline{X}_P - \overline{X}_L)^I S^{-1}(\overline{X}_P + \overline{X}_L)$ for groups Professor/Associate Professor and Lecturer I/below

$^1/_2\,(\overline{X}_S - \overline{X}_L)^I S^{-1}(\overline{X}_S + \overline{X}_L)$ for groups Senior Lecturer and Lecturer I/below

Decision Rule:

Professor/Associate Professor and Senior Lecturer: Assign l^{th} individual in Professor/Associate Professor category to Senior Lecturer if

$F_{P,S} = (\overline{X}_P - \overline{X}_s)^I S^{-1}\overline{X} < {}^1/_2\,(\overline{X}_P - \overline{X}_s)^I S^{-1}(\overline{X}_P + \overline{X}_s)$, Otherwise, retain the l^{th} individual.

Assign l^{th} individual in Senior Lecturer category to Professor/Associate Professor if

$F_{P,S} = (\overline{X}_P - \overline{X}_s)^I S^{-1}\overline{X} > {}^1/_2\,(\overline{X}_P - \overline{X}_s)^I S^{-1}(\overline{X}_P + \overline{X}_s)$, Otherwise, retain the l^{th} individual.

Professor/Associate Professor and Lecturer I/below: Assign l^{th} individual in Professor/Associate Professor group to Lecturer I/below if

$F_{P,l} = (\overline{X}_P - \overline{X}_l)^I S^{-1}\overline{X} < {}^1/_2\,(\overline{X}_P - \overline{X}_l)^I S^{-1}(\overline{X}_P + \overline{X}_l)$, Otherwise, retain the l^{th} individual.

Assign l^{th} individual in Lecturer I/below group to Professor/Associate Professor if

$F_{P,l} = (\overline{X}_P - \overline{X}_l)^I S^{-1}\overline{X} > {}^1/_2\,(\overline{X}_P - \overline{X}_l)^I S^{-1}(\overline{X}_P + \overline{X}_l)$, Otherwise, retain the l^{th} individual.

Senior Lecturer and Lecturer I/below: Assign l^{th} individual in Senior Lecturer group to Lecturer I/below if

$F_{s,l} = (\overline{X}_s - \overline{X}_l)^I S^{-1}\overline{X} < {}^1/_2\,(\overline{X}_s - \overline{X}_l)^I S^{-1}(\overline{X}_s + \overline{X}_l)$, Otherwise, retain the l^{th} individual.

Assign l^{th} individual in Lecturer I/below group to Senior Lecturer if

$F_{s,l} = (\overline{X}_s - \overline{X}_l)^I S^{-1}\overline{X} > {}^1/_2\,(\overline{X}_s - \overline{X}_l)^I S^{-1}(\overline{X}_s + \overline{X}_l)$, Otherwise, retain the l^{th} individual.

BAYESIAN APPROACH

Here, we assume that $S_1 = S_2 = \ldots = S_r = S$, and so each D_i is differentiated by the mean vectorμ_i. Discriminant scores are calculated for each observation for each class based on these linear combinations. The scores are calculated using the equation below:

$$d(X) = -\frac{1}{2}\mu_i{}^T S^{-1}\mu_i + \mu_i{}^T S^{-1} X \qquad (10)$$

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Where

- $d(X)$ is the discriminant score for each X individual
- μ_i is a matrix of means
- S is the covariance matrix of the variables (assumed to be the same for all classes)
- π_i is the prior probability that an observation belongs to i^{th} class (i=1,2,3).

We use a Bayesian analysis approach based on the maximum likelihood function. In particular, we assume some prior probability function

$$\pi_i(X) = P(X \in D_i) \quad (11)$$

We can then define a posterior probability function

$$\mathrm{p(x)} = \frac{\exp(\mathrm{s(X)})}{\sum_{\mathrm{i=1}}^{k} \exp(\mathrm{s_i(X)})} \quad (12)$$

The best category is the maximum linear score. The **linear score** is defined as

$$s(X) = d(X) + \mathrm{LN}(\pi_i). \quad (13)$$

where $d(X)$ is the discriminant score as defined above and $\mathrm{LN}(\pi_i)$ is the natural logarithm of prior probabilities.

The proposed discriminant functions for the three categories of academic staff are:

$$X_{pi} = \alpha_0 + \alpha_q Q + \alpha_y Y + \alpha_r R + \epsilon_{pi} \quad (14)$$

$$X_{Sj} = \beta_0 + \beta_q Q + \beta_y Y + \beta_r R + \epsilon_{Sj} \quad (15)$$

$$X_{Lk} = \gamma_0 + \gamma_q Q + \gamma_y Y + \gamma_r R + \epsilon_{Lk} \quad (16)$$

Where, $X_{pi(i=1,\dots,26)}, X_{Sj(j=1,\dots,78)}, X_{Li(k=1,\dots,286)}$ are the different categories of academic staff. $\alpha_0, \beta_0, \gamma_0$ are the constants of the models, $\alpha_s', \beta_s', \gamma_s'$ are the coefficients of the models, $\epsilon_{pi}, \epsilon_{Sj}, \epsilon_{Lk}$ are the error associated with the categories of academic staff.

CLASSIFICATION PRBABILITIES

In this paper, we present correct classification and misclassification probabilities using the classification matrix below

$$M = X_{(ij)} = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{1k} \\ X_{21} & X_{22} & \dots & X_{2k} \\ \vdots & \vdots & & \vdots \\ X_{m1} & X_{m2} & \cdots & X_{mk} \end{bmatrix}, i = 1, 2, \dots, m; j = 1, 2, \dots, k$$

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a. Correct Classification Probability: From "M", the overall correct classification probability is obtained as,

$$P_C = \frac{\sum_{i=1}^{m}\sum_{j=1}^{k} X_{ij(i=j)}}{\sum_{i=1}^{m}\sum_{j=1}^{k} X_{ij}} \qquad (17)$$

This is the sum of probabilities in the row categories. The correct classifications are the entries in the principal diagonal of matrix "M".

b. Misclassification Probability: Here, misclassification probability is obtained for each row.

i. (R_1): The misclassification probability is presented as,

$$P_{MR_1} = \frac{\sum_{j=2}^{k} X_{1j}}{\sum_{j=1}^{k} X_{1j}} \qquad (18)$$

ii. (R_2): The misclassification probability is presented as,

$$P_{MR_2} = \frac{\sum_{j=1}^{k} X_{2j(j\neq 2)}}{\sum_{j=1}^{k} X_{2j}} \qquad (19)$$

iii. (R_m): The misclassification probability is presented as,

$$P_{M_m} = \frac{\sum_{j=1}^{k-1} X_{mj}}{\sum_{j=1}^{k} X_{mj}} \qquad (20)$$

iv. Cumulative of the misclassifications: The overall misclassification probability is presented as,

$$P_{M_{R1,R2\,\ldots,Rm}} = \frac{\sum_{i=1}^{m}\sum_{j=1}^{k} X_{ij(i\neq j)}}{\sum_{i=1}^{m}\sum_{j=1}^{k} X_{ij}} \qquad (21)$$

The presentation of misclassification probabilities in this paper is a modification of Usoro (2015).

RESULTS

Chi-Square Goodness of Fit Test

The Chi-square goodness of fit test was used to test the conformity of Akwa Ibom State University with the NUC staff-mix. The hypothesis formulated was tested at 0.05 probability level. Observed counts are the Q, Y, R of the individual department which is the variable. The proportions specified by historical counts are the expected values which are twenty percent for Professors/Associate Professors, thirty-five percent for Senior Lecturers and forty-five percent for Lecturer I below.

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Table 2: Chi-square goodness of fit test result

DEPARTMENT	CHI SQ	P-VALUE	DECISION
1	4.09448	0.129	Non-significant
2	3.9752	0.137	Non-significant
3	0.998016	0.607	Non-significant
4	11	0.004	Significant
5	1.71429	0.424	Non-significant
6	4.2963	0.117	Non-significant
7	5.14286	0.076	Non-significant
8	5.14286	0.076	Non-significant
9	0.0714286	0.965	Non-significant
10	3.73545	0.154	Non-significant
11	3.26374	0.196	Non-significant
12	7.4709	0.024	Significant
13	13.0295	0.001	Significant
14	9.46176	0.009	Significant
15	6.02521	0.049	Significant
16	7.11993	0.028	Significant
17	5.13832	0.077	Non-significant
18	13.4444	0.001	Significant
19	3.11111	0.211	Non-significant
20	0.426304	0.808	Non-significant
21	0.483673	0.089	Non-significant

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22	8.5	0.014	Significant
23	3.18367	0.204	Non-significant
24	6.4026	0.041	Significant
25	4.33234	0.115	Non-significant
26	0.244898	0.885	Non-significant
27	7.18182	0.028	Significant
28	1.17108	0.557	Non-significant
29	7.35802	0.025	Significant
30	4.83673	0.089	Non-significant
31	4.36861	0.113	Non-significant
32	5.00794	0.082	Non-significant
33	1.71429	0.424	Non-significant
34	11.8352	0.003	Significant
35	3.73545	0.154	Non-significant
36	1.14286	0.565	Non-significant
37	0.539683	0.764	Non-significant
38	2.98214	0.225	Non-significant

Test for Normality:

The Shapiro-Wilk Test is presented as

$$W = \frac{(\sum_{i=1}^{n} a_i x_i)^2}{(\sum_{i=1}^{n} x_i - \bar{x})^2}$$

$(\sum_{i=1}^{n} a_i x_i)^2 = 5892.79$

$(\sum_{i=1}^{n} x_i - \bar{x})^2 = 7604.3$

$W = 0.77$

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The critical value $W_{27,0.05} = 0.923$. The null hypothesis is rejected since $W \leq W_{27,0.05}$. Thus, we conclude that the academic staff data is not normally distributed.

Conover Test for Several Population Variances

Similarly, the Conover test for several populations is calculated using the Academic staff Qualifications, Years of experience, Research Publication merged as one group for Professors/Associate Professors, Senior Lecturer, and Lecturer I/below respectively to obtain the mean and difference (See appendix). Where n_j (j = 78, 219, 867), N = 78+219+867=1164. The statistical measures obtained from appendix VI are presented as follows;

$$R_{k1} = 41642,\ R_{k2} = 131514,\ R_{k3} = 504874$$

$$S_1 = 30025291,\ S_2 = 102447770.5, S_3 = 392022061$$

Estimates of $Z_{ki(i=1,2,3)} = |Y_{ki} - \bar{Y}_k|$ are extracted from columns "D", "E", "F" in appendix IV.

$$S_k = \sum_{i=1}^{n_k} R_{ki}^2 = 524495122.5, S_k = \sum_{i=1}^{n_k} R_{ki}^4 = 4.23224\text{E} + 14,$$

$$\bar{S} = \frac{1}{N}\sum_{k=1}^{g} S_k = 450597.1843, \text{Q} = \frac{1}{N-1}\left[\sum_{k=1}^{g}\sum_{i=1}^{n_k} R_{ki}^4 - N\bar{S}\right] = 1.60694\text{E} + 11$$

$$T = \frac{1}{N}\left[\sum_{k=1}^{g}\frac{S_k^2}{n_k} - N\bar{S}^2\right] = 2.508874947$$

The T statistic follows approximately Chi-squared distribution with g-1 degrees of freedom. The critical value of $\chi^2_{g-1,\ \alpha}$ = 5.99. Hence, we cannot reject the null hypothesis for equality of variances.

Pooled Variance and Covariance Matrices

Recall in section 4.3 that Conover test for multiple variances was conducted, and the null hypothesis of equality of variances was accepted, which gives basis for the choice of method for the computation of pooled variance. The covariance matrices for Professor/Associate Professor, Senior Lecturer and Lecturer I and below are calculated as shown below.

PROFESSOR/ASSOCIATE PROFESSORS

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$$S_{p/Ass} = \begin{pmatrix} 0.00 & 0.00 & 0.00 \\ 0.00 & 3.4871795 & 1.0769231 \\ 0.00 & 1.0769231 & 6.7692308 \end{pmatrix}$$

SENIOR LECTURER

$$S_{SL} = \begin{pmatrix} 0.574787 & -0.281007 & -0.098852 \\ -0.281007 & 4.550167 & -0.101444 \\ -0.098852 & -0.101444 & 6.842651 \end{pmatrix}$$

LECTURER I/BELOW

$$S_{L1/below} = \begin{pmatrix} 2.42095 & 0.09307 & 1.28648 \\ 0.09307 & 3.53103 & 0.20809 \\ 1.28648 & 0.20809 & 4.18089 \end{pmatrix}$$

Discriminant Analysis

This section adopts the discriminant methods earlier mentioned.

Pairwise Fisher's Approach

The mean vector and covariance analysis of the Pairwise Fisher's approach are obtained:

$$\overline{X}_P = \begin{pmatrix} 10 \\ 10 \\ 10 \end{pmatrix}, \quad \overline{X}_S = \begin{pmatrix} 10 \\ 7.4247 \\ 8.5205 \end{pmatrix}, \quad \overline{X}_L = \begin{pmatrix} 7.9688 \\ 5.4740 \\ 5.0450 \end{pmatrix}$$

$$\overline{X}_{P,S} = (\overline{X}_P - \overline{X}_S) = \begin{pmatrix} 10 - 10 \\ 10 - 7.4247 \\ 10 - 8.5205 \end{pmatrix} = \begin{pmatrix} 0 \\ 2.5753 \\ 1.4795 \end{pmatrix}$$

$$\overline{X}_{P,L} = (\overline{X}_P - \overline{X}_L) = \begin{pmatrix} 10 - 7.9688 \\ 10 - 5.4740 \\ 10 - 5.0450 \end{pmatrix} = \begin{pmatrix} 2.0312 \\ 4.526 \\ 4.955 \end{pmatrix}$$

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$$\overline{X}_{S,L} = (\overline{X}_S - \overline{X}_L) = \begin{pmatrix} 10 - 7.9688 \\ 7.4247 - 5.4740 \\ 8.5205 - 5.0450 \end{pmatrix} = \begin{pmatrix} 2.0311 \\ 1.9507 \\ 3.4755 \end{pmatrix}$$

$$\overline{X}_{P,S} = (\overline{X}_P + \overline{X}_S) = \begin{pmatrix} 10 + 10 \\ 10 + 7.4247 \\ 10 + 8.5205 \end{pmatrix} = \begin{pmatrix} 20 \\ 17.4247 \\ 18.5250 \end{pmatrix}$$

$$\overline{X}_{P,L} = (\overline{X}_P + \overline{X}_L) = \begin{pmatrix} 10 + 7.9688 \\ 10 + 5.4740 \\ 10 + 5.0450 \end{pmatrix} = \begin{pmatrix} 17.9188 \\ 15.4740 \\ 15.0450 \end{pmatrix}$$

$$\overline{X}_{S,L} = (\overline{X}_S + \overline{X}_L) = \begin{pmatrix} 10 + 7.9688 \\ 7.4247 + 5.4740 \\ 8.5205 + 5.0450 \end{pmatrix} = \begin{pmatrix} 17.9689 \\ 12.8987 \\ 13.5655 \end{pmatrix}$$

$$S = \begin{pmatrix} 1.92373 & 0.02763 & 0.95747 \\ 0.02763 & 3.68843 & 0.14387 \\ 0.95747 & 0.14387 & 4.81512 \end{pmatrix}$$

$$S^{-1} = \begin{pmatrix} 0.57692 & 0.00015 & -0.1147 \\ 0.00015 & 0.27143 & -0.0081 \\ -0.1147 & -0.0081 & -0.0081 \end{pmatrix}$$

Linear Discriminant Function

A. **Professor/Associate Professor and Senior Lecturer,** the estimate of the model is obtained as:

$$(0,\ 2.5753,\ 1.4795) * \begin{pmatrix} 0.57692 & 0.00015 & -0.1147 \\ 0.00015 & 0.27143 & -0.0081 \\ -0.1147 & -0.0081 & -0.0081 \end{pmatrix} = (-0.2213,\ 0.71638,\ 0.20810)$$

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The estimated model is

$$Y_{P,S} = -0.2213Q + 0.716388Y + 0.208103R$$

The discriminant figure is obtained as:

$$= \frac{1}{2}(-0.2213,\ 0.716388,\ 0.208103) * \begin{pmatrix} 20 \\ 17.4247 \\ 18.5250 \end{pmatrix}$$

$$= \frac{1}{2} * \ 11.91184$$

= 5.95592

B. **Professor/Associate Professor and Lecturer I/below,** the estimate of the model is obtained as:

$$(2.0312, 4.526, 4.955) * \begin{pmatrix} 0.57692 & 0.00015 & -0.1147 \\ 0.00015 & 0.27143 & -0.0081 \\ -0.1147 & -0.0081 & -0.0081 \end{pmatrix} = (0.6443,\ 1.21936,\ 0.46216)$$

The estimated model is

$$Y_{P,L} = 0.64436Q + 1.219365Y + 0.462162R$$

The discriminant figure is obtained as:

$$= \frac{1}{2}(0.64436, \quad 1.219365, \quad 0.462162) * \begin{pmatrix} 17.9188 \\ 15.4740 \\ 15.0450 \end{pmatrix}$$

$$= \frac{1}{2} * \ 37.36783$$

= 18.683915

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Senior Lecturer and Lecturer I/below, the estimate of the model is obtained:

$$(2.0311, 1.9507, 3.4755) * \begin{pmatrix} 0.57692 & 0.00015 & -0.1147 \\ 0.00015 & 0.27143 & -0.0081 \\ -0.1147 & -0.0081 & -0.0081 \end{pmatrix} = (0.8655, 0.50297, 0.2540)$$

The estimated model is

$$\mathrm{Y_{S,L}} = 0.86559\mathrm{Q} + 0.502979\mathrm{Y} + 0.25407\mathrm{R}$$

The discriminant figure is obtained as:

$$= \frac{1}{2}(0.86559, 0.502979, 0.25407) * \begin{pmatrix} 17.9689 \\ 12.8987 \\ 13.5655 \end{pmatrix}$$

$$= \frac{1}{2} * \ 25.31506$$

= 12.65753

Discriminant Rule: The discrimination rules are:

Professor/Associate Professor: Assign l^{th} individual to Senior Lecturer group, if l^{th} score from model $F_{P,S}$ < 5.95592, otherwise, retain membership. Also, assign l^{th} individual to Lecturer I/below group, if l^{th} score from model $F_{P,L}$< 18.683915, otherwise, retain membership.

Senior Lecturer: Assign l^{th} individual to Professor/Associate Professor group, if l^{th} score from model $F_{P,S}$ > 5.95592, otherwise retain membership. Assign l^{th} individual to Lecturer I/below group, if l^{th} score from model $F_{S,L}$ < 12.65753, otherwise retain in Senior lecturer category.

Lecturer I/below: Assign l^{th} individual to Professors/Associate Professors group, if l^{th} score from model $F_{P,L}$ > 18.683915, otherwise, retain the membership in the group. Assign l^{th} individual to Senior Lecturer group, if l^{th} score from model $F_{S,L}$ > 12.65753, otherwise retain the membership in the group.

The Classification (Confusion) table:

The estimated models when the values of the variable (Q, Y, and R) are substituted are obtained (see appendix V) and it is used to apply the discriminant rule. The summary is shown in the

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Classification table which contains both correct and reclassified values from which the percentages of misclassification are obtained and shown in *table 3*.

Table 3: Classification (Confusion) Table

CATEGORY	PROF./ASSO. PROF.	SNR. LECTURER	LEC. I/BELOW	TOTAL
PROF./ASSO. PROF.	26	0	0	26
SENIOR LECTURER	15	52	6	73
LECTURER I/BELOW	25	67	197	289
TOTAL	66	119	203	388

The computations of classification and misclassification probabilities are presented in “3.6.3”. Thus,

Probability of Correct Classification for the three categories: From table 3,

$$P_{C(P,S,L1)} = \frac{26 + 52 + 197}{388} = \frac{275}{388} = 0.71$$

Probability of Misclassification of Professors/Associate Professors:

$$P_{M(P)} = \frac{0}{26} = 0$$

Probability of Misclassification of Senior Lecturers:

$$P_{M(S)} = \frac{15 + 6}{73} = \frac{21}{73} = 0.29$$

Probability of Misclassification of Lecturer1/Below:

$$P_{M(L1)} = \frac{25 + 67}{289} = \frac{92}{289} = 0.32$$

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Misclassification probability for the three categories:

$$P_{M(P,S,L1)} = \frac{0+21+92}{388} = \frac{113}{388} = 0.29$$

Table 4: Means

Bayesian Discriminant Analysis

This approach adopts the methodology presented in the previous section.

Means

CATEGORY	Q	Y	R
PROF./ASSO. PROF.	10	6.384615385	7.923076923
SENIOR LECTURER	9.794520548	7.424657534	5.890410959
LECTURER I/BELOW	7.968858131	5.474048443	3.363321799

Next, all three categories of proportional prior probabilities obtained as 0.07, 0.19 and 0.74 for Professors/Associate Professors, Senior Lecturers and Lecturer1/below respectively. Their corresponding Natural logarithms (LN) are shown in Table 5 below.

Table 5: Prior Probabilities

π	LN(π)
0.07	-2.659
0.19	-1.660
0.74	-0.301

Next, the constant of the discriminant coefficients was obtained using

$$Di(X) = -\frac{1}{2}\mu i^T S^{-1} \mu i + \mu i^T S^{-1} X + Ln(\pi_i)$$

The constant of the coefficient for Professor/Associate Professor:

$$= -\frac{1}{2} * (10 \quad 6.3846 \quad 7.9230) * \begin{pmatrix} 0.57692 & 0.00015 & -0.1147 \\ 0.00015 & 0.27143 & -0.0081 \\ -0.1147 & -0.0081 & -0.0081 \end{pmatrix} * \begin{pmatrix} 10 \\ 6.384615385 \\ 7.923076923 \end{pmatrix}$$

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$$= -\frac{1}{2} * (10 \quad 6.3846 \quad 7.9230) * \begin{pmatrix} 4.8612 \\ 1.6700 \\ 0.6289 \end{pmatrix} = -\frac{1}{2} * (64.2577) = -32.1289$$

The constant of the coefficient for Senior Lecturer:

$$= -\frac{1}{2} * (9.7945 \quad 7.4246 \quad 5.8904) * \begin{pmatrix} 0.57692 & 0.00015 & -0.1147 \\ 0.00015 & 0.27143 & -0.0081 \\ -0.1147 & -0.0081 & -0.0081 \end{pmatrix} * \begin{pmatrix} 9.7945 \\ 7.4246 \\ 5.8904 \end{pmatrix}$$

$$= -\frac{1}{2} * (9.7945 \quad 7.4246 \quad 5.8904) * \begin{pmatrix} 4.9760 \\ 1.9688 \\ 0.1750 \end{pmatrix} = -\frac{1}{2} * (64.3868) = -32.1934$$

The constant of the coefficient for Lecturer I/below:

$$= -\frac{1}{2} * (7.9688 \quad 5.4740 \quad 3.3633) * \begin{pmatrix} 0.57692 & 0.00015 & -0.1147 \\ 0.00015 & 0.27143 & -0.0081 \\ -0.1147 & -0.0081 & -0.0081 \end{pmatrix} * \begin{pmatrix} 7.9688 \\ 5.4740 \\ 3.3633 \end{pmatrix}$$

$$= -\frac{1}{2} * (9.7945 \quad 7.4246 \quad 5.8904) * \begin{pmatrix} 4.2123 \\ 1.4596 \\ -0.1827 \end{pmatrix} = -\frac{1}{2} * (40.9436) = -20.4718$$

The coefficient for Professor/Associate Professor:

$$Q = (10 * 0.5769) + (6.3846 * 0.00015) + (7.9230 * -0.1147) = 4.8612$$

$$Y = (10 * 0.00015) + (6.3846 * 0.27143) + (7.9230 * -0.0081) = 1.67004$$

$$R = (10 * -0.1147) + (6.3846 * -0.0081) + (7.9230 * 0.23073) = -0.6289$$

The coefficient for Senior Lecturer:

$$Q = (9.7945 * 0.5769) + (7.4246 * 0.00015) + (5.8904 * -0.1147) = 4.9760$$

$$Y = (9.7945 * 0.00015) + (7.4246 * 0.27143) + (5.8904 * -0.0081) = 1.9688$$

$$R = (9.7945 * -0.1147) + (7.4246 * -0.0081) + (5.8904 * 0.23073) = 0.1750$$

The coefficient for Lecturer I/below:

$$Q = (7.9688 * 0.5769) + (5.4740 * 0.00015) + (3.3633 * -0.1147) = 4.2123$$

$$Y = (7.9688 * 0.00015) + (5.4740 * 0.27143) + (3.3633 * -0.0081) = 1.4596$$

$$R = (7.9688 * -0.1147) + (5.4740 * -0.0081) + (3.3633 * 0.23073) = -0.1827$$

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Table 6: Discriminant function (Coefficients)

CATEGORY	CONSTANT	Q	Y	R
PROF./ASSO. PROF.	-32.12887189	4.861217568	1.670042161	0.62892122
SENIOR LECTURER	-32.19343006	4.976026202	1.96886179	0.17502085
LECTURER I/BELOW	-20.47183638	4.212381395	1.459691092	-0.182741

Table 6 displays constants and variable coefficients of each category of staff.

The discriminant coefficients in Table 6 above, the estimated discriminant models are:

$$X_{pi} = -32.1289 + 4.8612Q + 1.6700Y + 0.6289R$$

$$X_{Si} = -32.1934 + 54.9760Q + 1.9688Y + 0.1750R$$

$$X_{Li} = -20.4718 + 4.2123Q + 1.4596Y - 0.1827R$$

From the above models, the discriminant analysis is carried out using the prior probabilities. The variable score that is the highest is obtained as the best category (VI).

Table 7: Classification (Confusion) Table

CATEGORY	PROF./ASSO. PROF.	SNR. LECTURER	LEC. I/BELOW	TOTAL
PROF./ASSO. PROF.	26	0	0	26
SENIOR LECTURER	10	44	19	73
LECTURER I/BELOW	2	32	255	289
TOTAL	38	76	274	388

Table 7 presents reclassification of group membership. Out of 26 Prof/Assoc Prof, none is classified in Senior Lecturer and Lecturer1/below categories. Out of 73 senior lecturers, 10 and 19 are regrouped into Prof/Assoc Prof. and Lecturer1/Below categories respectively. Out of 289 lecturer1/below, 2 and 32 are reclassified into Prof/Assoc Prof and Senior lecturer categories respectively.

The computations of classification and misclassification probabilities are presented in “3.6.3”. Thus,

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Probability of Correct Classification for the three categories: From table 7,

$$P_{C(P,S,L1)} = \frac{26 + 44 + 255}{388} = \frac{325}{388} = 0.84$$

Probability of Misclassification of Professors/Associate Professors:

$$P_{M(P)} = \frac{0}{26} = 0$$

Probability of Misclassification of Senior Lecturers:

$$P_{M(S)} = \frac{10 + 19}{73} = \frac{29}{73} = 0.40$$

Probability of Misclassification of Lecturer1/Below:

$$P_{M(L1)} = \frac{2 + 32}{289} = \frac{34}{289} = 0.12$$

Misclassification probability for the three categories: From table 4,

$$P_{M(P,S,L1)} = \frac{0 + 29 + 34}{388} = \frac{63}{388} = 0.16$$

CONCLUSION

Every educational institution requires a sufficient number of qualified academic staff to deliver on the mandate, which includes, training, research and community development service. The quality of academic staff in a tertiary institution is expected to reflect on its graduates, who should compete favourably in the world labour market and add value to the society. The motivation behind this research was predicated upon the need to assess the productivity of academic staff in Akwa Ibom State University. The aim was to analyse academic staff profiles for possible reclassification on the basis of some performance factors. Information about the qualification, years of experience and research publications for 388 pensionable academic staff of the university was obtained from staff records. Firstly, goodness of fit tests for conformity of academic staff mix with the NUC proportional distributions of 20%, 35% and 45% for Professors/Associate Professors, Senior Lecturers and Lecturer1/Below categories were conducted. The tests results showed conformity of 26 out of 38 departments with the NUC proportional staff mix. 12 departments were affected with non-conformity with the NUC proportional academic staff mix. This is a challenge, not only to the 12 affected departments, but to the university as a whole, and this calls for concern. Secondly, Fisher's and Bayesian Discrminant methods were adopted to analyse the staff profiles for possible reclassification. The analysis using Fisher's method has revealed 100% correct classification of Professors/Associate Professors, 71% correct classification of Senior Lecturers, 68% correct classification of Lecturer1/Below and overall correct classification and misclassification

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probabilities as 0.71 and 0.29 respectively. Bayesian method has recorded 100% correct classification of Professors/Associate Professors, 61% correct classification of Senior Lecturers, 88% correct classification of Lecturer1/Below and overall correct classification and misclassification probabilities as 0.84 and 0.16 respectively. Comparing the two approaches, there is a higher value of correct classification probability in Bayesian Discriminant approach than Fisher's approach, and a lower misclassification probability in Bayesian method than Fisher's method. Bayesian approach gives more advantage in minimizing the classification error than the Fisher's linear Discriminant method, and therefore, places Bayesian Discriminant Approach on higher comparative advantage than Fisher's Discriminant method. The classification and misclassification probabilities presented in this paper are modifications of Usoro (2015). This paper recommends Bayesian Discriminant Analysis, especially, when carrying out discriminant analysis involving many groups or populations to avert the multiple pairwise Fisher's Linear Discriminant analysis for multiple sample or population distributions. The outcome of this research is a good working instrument for staff assessment, planning and development of academic manpower in Akwa Ibom State University.

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