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Mathematical Model for Nigerian University Academic Staff Mix by Rank

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Abstract

In order to ensure quality graduates which are critical to national development and central to the progress of the society are produced in Nigerian Universities, the National Universities Commission (NUC) stipulates a minimum benchmark for academic staff mix by rank and Lecturer/Students' ratio for all degree programmes across the country. However, the NUC accreditation visits for degree programmes has confirmed inaccuracies in the implementation of these guidelines partly due to lack of simplified Mathematical expressions towards this direction. In this paper, a Mathematical model is put forward for appointment and distribution of academic staff in line with the existing academic staff mix and Lecturer/Students' ratio of NUC bench mark for minimum academic standard.

Keywords: National Universities Commission, Academic Staff mix by rank, Lecturer/Student ratio, benchmark for minimum academic standard.

1.0 Introduction

The place of academic staff in any academic institution cannot be overemphasized. The academic staff of any University are equally the intellectual resource pool of the University.

Of course, no University is superior to its teaching staff. The type, quality, and quantity of lecturers in the nation's University system for the achievement of its goals and objectives are very crucial to its success. In particular, the higher the quality, the better the graduates who are often than not better equipped and more likely to excel in their chosen carriers.

In line with the much needed quality of graduates in the nation's University system, the National Universities Commission (NUC) was established in 1985 and

empowered to lay down minimum standards for all programmes taught in Nigerian universities in 1988. Consequently, the Commission in collaboration with the universities and their staff developed minimum academic standards for all the programmes taught in Nigerian universities in 1989.

After due consultations on the need to have a revised version of the minimum academic standards for all the programmes, the commission endorsed the revised version in 2007 currently referred to as Benchmark for Minimum Academic Standard (BMAS).

In line with the BMAS currently enforced, academic staff mix by rank is structured into acceptable percentages of Professors/Readers, Senior Lecturers and from Lecturer I downwards respectively for a given degree programme. Equally important is the acceptable Lecturer/Students ratio which is equal to the total number of students divided by the available number of lecturers for a particular programme. The academic staff mix by rank and the Lecturer/Students ratios are not the same across all degree programmes as contained in the BMAS. In this paper we present the tables for both academic staff mix by rank and Lecturer/students ratio as contained in the BMAS in section 2. Our notations, model formulation and general solution are presented in section 3. Table of particular solutions from the general solution is presented with discussions and recommendations in section 4.

2. Lecturer/ Students Ratio and Academic Staff mix by Rank

In order to ensure that quality graduates are produced in Nigerian Universities and are of a comparable international standard, the NUC stipulates the following guidelines for both Lecturer/Students ratio and academic staff mix by rank as contained in its BMAS (2007).

Table 1. The NUC BMAS for Lecturer/Students ratio and Academic staff mix by rank (see (BMAS, 2007 and Oyebanji, 2012)).

S/N	Faculty	Lecturer/ Students Ratio	Percentage of Professors/ Readers	Percentage Of Senior Lecturers	Percentage of Lecturer I and Below
1	Science	1:20	20	35	45
2	Engineering	1:15	20	35	45
3	Medicine	1:10	20	35	45
4	Vetenary Medicine	1:10	20	35	45
5	Pharmacy	1:10	25	30	45
6	Management Science	1:30	20	30	45
7	Agricultural. Science	1:15	25	35	40
8	Environmental Science	1:15	20	35	45
9	Social Science	1:30	20	35	45
10	Law	1:30	20	35	45
11	Art	1:30	20	35	45
12	Education	1:30	20	35	45
13	Administration	1:30	20	35	45

Notes that the Lecturer/Students ratio and the academic staff mix by rank in each faculty applies to all the degree programmes under it.

3.0 Notations, Model formulation and General Solution.

3.1 Notations.

We generalize the Lecturer/Students ratio and the academic staff mix by rank given in table 1 in the table below:

Table 2. Generalized Lecturer/Students ratio and the academic staff mix by rank

Faculty	Lecturer/ Students Ratio	Percentage of Professors/Readers	Percentage Of Senior Lecturers	Percentage of Lecturer I and Below
Q	R	P	S	L

Notes that by table 1 above, $R, P, S, L > 0$

Furthermore, let

N = The total number of students in a given degree programme under faculty Q.

x_0 = The number of Professors/Readers available for a degree programme under faculty Q.

x = The number of Professors/Readers required for a degree programme in addition to x_0 under faculty Q.

y_0 = The number of senior lecturers available for a degree programme under faculty Q.

y = The number of senior lecturers required for a degree programme in addition to y_0 under faculty Q.

z_0 = The number of lecturer I and below available for a degree programme under faculty Q.

z = The number of lecturer I and below required for a degree programme in addition to z_0 under faculty Q.

3.2 Model formulation and General solution

From table 2, and the definitions given in the BMAS (2007), we have :

$$\frac{x_0 + x}{(x_0 + y_0 + z_0) + (x + y + z)} \times 100 = P$$

i.e $100(x_0 + x) = P(x_0 + y_0 + z_0 + x + y + z)$ and

$$100x_0 + 100x = P(x_0 + y_0 + z_0 + x + y + z) \quad \text{(i)}$$

$$\frac{y_0 + y}{(x_0 + y_0 + z_0) + (x + y + z)} \times 100 = S$$

i.e $100(y_0 + y) = S(x_0 + y_0 + z_0 + x + y + z)$ and

$$100y_0 + 100y = S(x_0 + y_0 + z_0 + x + y + z) \quad \text{(ii)}$$

$$\frac{z_0 + z}{(x_0 + y_0 + z_0) + (x + y + z)} \times 100 = L$$

i.e $100(z_0 + z) = L(x_0 + y_0 + z_0 + x + y + z)$ and

$$100z_0 + 100z = L(x_0 + y_0 + z_0 + x + y + z) \quad \text{(iii)}$$

$$\frac{N}{(x_0 + y_0 + z_0) + (x + y + z)} = \frac{R}{1}$$

i.e $N = R(x_0 + y_0 + z_0 + x + y + z)$ and

$$\frac{N}{R} = x_0 + y_0 + z_0 + x + y + z \quad \text{(iv)}$$

Now substituting (iv) in (i) we have

$100x_0 + 100x = P \times \frac{N}{R} = \frac{PN}{R}$. i.e $100x = \frac{PN}{R} - 100x_0$.

Therefore $x = \frac{PN}{100R} - x_0$

Similarly, substituting (iv) in (ii) we have

$100y_0 + 100y = S \times \frac{N}{R} = \frac{SN}{R}$ i.e $100\text{y} = \frac{SN}{R} - 100y_0$.

Therefore $\text{y} = \frac{SN}{100R} - y_0$

Furthermore, substituting (iv) in (iii) we have

$100z_0 + 100z = L \times \frac{N}{R} = \frac{LN}{R}$ i.e $100z = \frac{LN}{R} - 100z_0$.

Therefore $z = \frac{LN}{100R} - z_0$

4 Particular solutions of the generalized solution

The table below describes the various solutions for x, y and z for the various values of P, S, L and R as shown in table 1.

Table 3. Particular solutions of the general solution

S/NO	*P*	*S*	*L*	*R*	*x*	*y*	*z*
1	20	35	45	20	$\frac{N}{100}-x_0$	$\frac{7N}{400}-y_0$	$\frac{9N}{400}-z_0$
2	20	35	45	30	$\frac{N}{150}-x_0$	$\frac{7N}{600}-y_0$	$\frac{9N}{600}-z_0$
3	20	35	45	15	$\frac{N}{75}-x_0$	$\frac{7N}{300}-y_0$	$\frac{9N}{300}-z_0$
4	20	35	45	10	$\frac{N}{50}-x_0$	$\frac{7N}{200}-y_0$	$\frac{9N}{200}-z_0$
5	25	30	45	10	$\frac{N}{40}-x_0$	$\frac{3N}{100}-y_0$	$\frac{9N}{200}-z_0$
6	25	35	40	15	$\frac{N}{60}-x_0$	$\frac{7N}{300}-y_0$	$\frac{2N}{75}-z_0$

Notes that if the value of x, y or z is a mixed fraction of the form $m\frac{a}{b}$ where $\frac{a}{b}$ is proper with $b>0$, then the following remarks holds for the fraction $m\frac{a}{b}$:

(i) For $m\geq 0,$ and $\frac{\mathrm{a}}{\mathrm{b}}>\frac{1}{2}$, we have $m\frac{a}{b}\square m+1$.

(ii) For $m<0,$ and $\frac{\mathrm{a}}{\mathrm{b}}>\frac{1}{2}$, we have $m\frac{a}{b}\square m-1$.

(iii) For $m\geq 0,$ and $\frac{\mathrm{a}}{\mathrm{b}}\leq\frac{1}{2}$, we have $m\frac{a}{b}\square m+\frac{1}{2}$

(iv) For $m<0,$ and $\frac{\mathrm{a}}{\mathrm{b}}\leq\frac{1}{2}$, we have $m\frac{a}{b}\square m-\frac{1}{2}$

The conditional approximation above is from the fact that two visiting lecturers are assessed as equivalent to a full time lecturer. In particular a visiting lecturer is assessed equivalent to half a full time lecturer (BMAS (2007))

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