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WORK FORCE STABILITY AND SUITABILITY

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ABSTRACT

The paper examines workforce stability and suitability. The current measure of the stability of workforce is entropy. There are various versions of this measure. The various versions of entropy assume that the size of the workforce is constant. However, this assumption is difficult to attain in practice. Besides, entropy does not consider the desired size of workforce for an organisation. Hence, the present paper proposes augmented ratio of squares and the recalibrated augmented ratio of squares to determine the stability and desirability of an organizational workforce. These two new measures have major advantages over the entropy measure.

Keywords: Workforce stability, augmented ratio of squares, entropy.

1.0 INTRODUCTION

The concept of stability of a workforce in an organization has received some attention in the literature on manpower planning. Tyler (1986) defines stability of workforce as an indicator of the level of experience existing in a manpower system. McClean and Abodunde (1978), McClean (1986) proposed the use of entropy to measure workforce stability. Entropy is defined as a measure of the degree of disorder, uncertainty or randomness in a system (McClean and Abodunde, 1978). They also see it as a measure of the degree of concentrations and competition within an industry and further maintain that entropy reflects the changes in length of service structure taking place within the firm.

However, the comparison of entropy from one year to the other assumes that the size of the workforce is constant. This assumption is in contrast to what obtains in many organizations where high staff turnover is the order. In fact in many organizations it is very difficult to sustain a constant number of workforce. One reason for this is that from time to time, recruitment may be zero whereas there is attrition in the workforce as a result of resignation, retirement, and death. Another reason why constant work force may not be attainable in some organizations is that they may also undertake an expansion programme which entails a change in the size of the work force. Hence the assumption of constant staff size required in order to use entropy is severe and unrealistic in many organizations. Further, the computation of entropy is based on the size of the available workforce. Therefore, it ignores the desired level of workforce. Consequently, if an organisation has equal number of staff at each level, irrespective of the desired number of staff required for each level, the entropy is one.

The present paper introduces two new measures for workforce stability and desirability to reflect the desirable number of workers that an organization may be interested in having. In most organizations, there is the ideal (expected) number of staff in each grade that is specified by management. No matter the degree of experience present in steady state, in such circumstances, it is much more important for the organisation to have a measure of how close they are to the ideal staff size. In this paper we propose the use of augmented ratio of squares to measure work force stability. We then recalibrate this measure to provide indicators of chaotic situations in the workforce of a manpower system.

2.1 Entropy and Stability of Workforce

There are different versions of entropy as a measure of workforce stability in a manpower system. McClean and Abodunde (1978) stated that the entropy of an organisation is given by

$$H = -\frac{\sum_{i=1}^{\ell} P_i \log P_i}{\log \ell} \qquad (1)$$

where ℓ is constant.

ℓ	is the number of tenure classes
H	the entropy measure
P_i	the probability that a staff belongs to length of service i

McClean (1986) criticizes McClean and Abodunde (1978) and introduces a continuous time version for entropy. This is given by

$$H^* = -\left(\int_0^{\omega} \frac{\mathrm{T}(x)}{\mu} \log \frac{\mathrm{T}(x)}{\mu} dx \right) / \log \omega \qquad (2)$$

where

$\mathrm{T}(x)$	is the survivor function
μ	the complete length of service (CLS)
ω	the maximum possible C. L. S.

Tyler (1989) gives entropy of a manpower system as

$$H_B = \left\{ \log \left[\frac{N!}{N_1! N_2! \ldots N_c!} \right] \right\} \Big/ \log c \qquad (3)$$

where H_B is the Botzmann entropy
c is the number of tenure classes
N the total staff in the system
N_i the number of staff in tenure class i

As stated earlier, these three versions of entropy assume constant workforce. Further, they do not use the ideal size structure of an organizational workforce. In general, entropy is in the interval (0, 1). Zero entropy shows lack of stability and entropy equals one is an indication that all length of service are equally represented in the tenure profile.

2.2 Augmented Ratio of Squares Measure

Consequent upon the inadequacies of entropy to reflect reality in many organizations, we introduce the augmented ratio of squares as a measure of workforce stability and desirability. This measure takes into consideration the ideal (expected) and the observed staff strength in the various grades of an organization. The augmented ratio of square measure is defined as

$$f(x) = \frac{x^2}{1 + x^2} \tag{4}$$

where $x^2 = \sum_{j=1}^{k} \left(\frac{E_j - O_j}{E_j} \right)^2$

k is the highest grade in the organization

E_j is the expected number of workers in grade j in the organization

O_j is the observed number of workers in grade j in the organization.

The assumptions of this measure are:

(i) for each grade j in a manpower system, the ideal (expected) number of workers E_j and the observed number of workers O_j are known;

(ii) the ideal staff strength remain fixed for a given period for which comparison is required.

Clearly, this measure takes into consideration the required and observed staff strength for each level in an organization. The measure therefore reflects reality. Further, $0 \le f(x) < 1$. Notice that $f(x) = 0$ implies $x^2 = 0$. This means that the workforce has the ideal structure. That is, the expected number of staff is available in each grade. Ideally, we expect that for each level j in an organization,

$$0 \le |E_j - O_j| < E_j$$

so that

$$\left(\frac{E_j - O_j}{E_j}\right)^2 < 1$$

If

$$\left(\frac{E_j - O_j}{E_j}\right)^2 = 1 \tag{5}$$

then, one of the following two conditions hold:

(i) $O_j = 0$

(ii) $O_j = 2E_j$

If condition (i) holds for j = 1,2...k, then the organization is yet to commence business or has folded up. On the other hand, if condition (ii) holds for j = 1,2...k, an abnormal situation occurs since this indicates high level of over staffing. If equation (5) holds and $O_j = 0$ for all j then

$$f(x) = \frac{k}{1+k} \tag{6}$$

which tends to 1 as $k \to \infty$. However, it follows from the definition f(x) that $0 \le f \le 1$.

There are cases where some organisations are unusually overstaff. This is undesirable and such situations can be regarded as chaotic It is important to have a measure that will detect such situations easily. Such measure is introduced in the next section.

2.3 The recalibrated Augmented Ratio of Squares Model

The augmented ratio of squares f(x) given in equation (4) cannot be effectively used to detect the development of a chaotic situation in a manpower system. Hence we need to recalibrate it. The recalibrated augmented ratio of squares is given by

$$F(x) = \frac{1+k}{k} f(x) \tag{7}$$

If F = 0, we have a stable and desired workforce since the required number of staff in each grade of the organization are available, i.e. the expected and the observed number of staff are exactly equal. On the other hand, F = 1 means that either of the conditions of equation (5) holds for all j. Whatever the case, none of the two conditions for F to be equal to 1 is normal. Further, if $F > 1$, a chaotic situation develops in the workforce of the organization. $F > 1$ occurs

when $x^2 > k$. This is the case when the observed staff strength in at least one of the grades of the establishment is more than twice the expected staff strength. This is shown in the following example.

Example

Consider an organisation with two grades. In grade 1, let the expected number of staff and the observed number of staff be equal. In grade two, let the observed number of staff be equal to three times the expected number of staff. Thus in this manpower system, $k = 2$, $E_1 = O_1$ and $O_2 = 3E_2$. Hence

$$x^2 = \sum_{j=1}^{2}\left(\frac{E_j - O_j}{E_j}\right)^2 = 4$$

$$f(x) = \frac{x^2}{1+x^2} = 0.8$$

and $F(x) = \frac{1+k}{k} f(x) = 1.2$

The recalibrated augmented ratio of squares model takes into consideration the number of levels in a manpower system. If $0 < F < 1$, the recalibrated augmented ratio of squares model is a good measure of workforce stability of an organization. In particular, the introduction of F enables management to know when the manpower structure becomes chaotic Also it can be used to evaluate stability on a yearly basis with reference to the desirable staff strength of an organisation.

3.0 APPLICATION

We illustrate the concept of workforce stability with a case study. We apply the version of entropy due to McClean and Abodunde (1978) to the data obtained from Edo State Civil Service (ESCS). For the same data we calculate f and F and then compare the results. The data on the manpower structure of ESCS for 1988, 1989, 1990 and 1992 are given in Table 1. These are the only data available. It is however sufficient to illustrate the application of our proposed measures. Also shown in Table 1 is the expected staff strength for each level based on the 1992 figure. Observe that the total workforce vary from year to year and there is no grade 11. Table 2 shows entropy (based on McClean and Abodunde (1978), f and F for the data shown in Table 1.

In using the entropy given in equation (1) as $H = -\sum_{i=1}^{\ell} \frac{p_i \log p_i}{\log \ell}$, the p_i 's are the proportion of staff in grade i and $l = 15$ since there is no grade 11. To obtain f and F, we assume that the approved staff strength of 1992 is applicable to all the years. The results of the computation of H, f and F are presented in Table 2.

Table 1:Distribution of Staff by Salary Grade and Expected Staff Size (ESS)

Staff cadre	Grade		Year			
	j	ESS	1988	1989	1990	1992
Junior	1	2556	2696	2628	2201	1479
	2	1724	1304	1295	1403	1149
	3	2033	1740	1771	1474	956
	4	2336	1960	1916	1564	1041
	5	2202	1584	1538	1380	935
	6	2060	943	923	1357	1016
Supervisory	7	1675	793	864	1027	1027
	8	1386	478	578	743	537
	9	910	613	513	504	255
	10	821	410	408	431	296
	12	637	393	377	391	231
Managemen t	13	475	230	253	315	189
	14	296	180	161	174	127
	15	185	103	63	118	93
	16	123	10	79	74	34
Total		19419	13437	13367	13156	9365

Source: Report of the Bendel State Civil service Commission 1988, 1989, 1990 and Edo State Civil Service Commission Digest of Statistics 1992.

Table 2: Entropy, augmented ratio of squares and recalibrated augmented ratio of squares for workforce structure shown in Table 1.

Year	H	$f(x)$	$F(x)$
1988	0.86	0.76	0.81
1989	0.87	0.73	0.78
1990	0.90	0.67	0.71
1992	0.89	0.83	0.88

4. DISCUSSION

Using equation 1, the entropy of the ideal staff size (ESS) is 0.91. However, if the observed staff strength is the same for all grades, then the entropy will be 1. This is one of the disadvantages of entropy defined by Mcclean and Abodunde (1978). It has no relationship with the desired staff strength. H given in table 2 are not comparable since the staff size is not the same for all years. Further, the computation of these values ignore the expected or ideal staff size. The values of f and F given in Table 2 shows that there is deviation from the ideal staff size. The nearer the value of f is to zero, the closer the observed staff distribution is to the desired staff distribution. Thus, Table 2 shows that for the four years, the staff distribution for 1990 is closer to the desired staff distribution shown since 1990 has the lowest f value. It is noteworthy that the computation of f and F takes into consideration the desired staff size. This is one of the major advantages of the measures introduced in this paper over entropy.

5. CONCLUSION

The present paper examines the use of entropy to measure stability of a manpower system. The disadvantages of using entropy are stated. Two new measures namely, augmented ratio of squares and recalibrated augmented ratio of squares are introduced to deal with the disadvantages of entropy. These measures have the advantage of taking the ideal grade sizes into consideration vis – a – vis the observed staff strength. Hence they also indicate suitability of available workforce. The use of the two measures is illustrated in the paper.

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