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THE EFFECTIVENESS OF PARAMETRIC TECHNIQUES OF HYPOTHESIS TESTING: AN EMPIRICAL ANALYSIS OF DECISION MAKING IN THE PUBLIC SECTOR

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Abstract

This study examined the effectiveness of parametric techniques of hypothesis testing in decision making in the public sector. The study observed that different parametric tools of hypothesis testing could be applied depending on what the manager or decision maker wants to achieve. As a general phenomenon, for a manager to arrive at a reliable decision, there is a need for him to follow systematic process through formulation of hypotheses in line with variables under consideration. The study was based on a survey conducted among a sample of 210 civil servants that cut across Ministries, Departments and Agencies in Ogun State who were randomly selected. Data generated from the field survey conducted were analyzed using some selected parametric techniques such as T-test, Analysis of Variance (ANOVA), Z-test and Regression Analysis. Generally, the results of our analysis in the application of the various tests showed that the decision as to whether to accept or reject the null hypothesis remained unchanged in each situation using the same data. Thus, irrespective of the test employed in the analysis of data, the researcher would still arrive at the same decision. Parametric tests become more effective where the interval and ratio scales of measurement are used and samples are from the population. Also, where the assumptions of normality are satisfied, then parametric tests are most suitable. Although there are some inherent weaknesses associated with the use of parametric tests particularly difficult mathematical or statistical computation often associated with the technique, it was observed that they are often more potent and powerful tool of analysis for decision makers or researchers. Parametric tests are powerful tests because they are probabilistic tests of significance. Also, calculations of parametric tests are rapid and most applicable where two or more variables are identified. Experience has shown that researchers and students prefer non-parametric statistics when it is obvious that parametric statistics are more appropriate. Thus, parametric techniques should be taught more in research methodology so that students and other researchers can be more conversant with the technique.Besides, research supervisors in higher institutions of learning should be more familiar with the application of the various parametric techniques and

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advice their students on which of them should be used in a particular situation.

Keywords: *Parametric Techniques, Hypothesis, Decision making, Statistics, Public Sector*

Background to the Study

The vital position of statistics in research studies over the years has been appreciated and accepted. Statistics did not only help the researcher in analyzing generated data, but also guides him in making a right decision on how to solve a given problem of study. Therefore, the statistical analysis of a management/social sciences research work can be seen as a stepping stone, which the researcher uses in crossing a steam from one bank i.e the research question to the research answer (Luck etal as cited in Osuagwu, 2002).

Scholars have come to accept scientific research as the most prudent method of acquiring new knowledge. This acceptance rests not only on its ability to systematically and critically explain details on research findings/results objectively. The objectively of finding could be cumbersome even elusive, if appropriate statistical tools are not used (Fatile, 2006). This therefore means that researchers must appreciate the various divisions of statistical techniques in order to know which, when, and how each of them should be used in their various statistical analyses. Furthermore, Fatile (2006) noted that over the years, controversies in academics on the most suitable statistical technique a researcher should adopt in statistical analysis have filled the air. The fact remains that; they cannot do without each other and whichever one is adopted in research depend on what the researcher intends to achieve bearing in mind constraints of the approach. There are many statistical tools that can be used to make decision in public sector. These statistical tools can be categorized into inferential statistics and descriptive statistics (Asika, 2010).

Descriptive statistics summarize large numbers and they are solely designed to describe the particulars or features of a large group of number. Types of descriptive statistics for decision making include measures of central tendency, measure of variability, and measure of relationship. With inferential statistics techniques, the research can go beyond a mere description of the numbers obtained in his research work to more generalized statements. The researcher obtains the numbers he wishes to use from group of subjects (or respondents) which is called a sample. The sample for the research is thought of as having comes from a large group of subjects which is called the population. Although, the researcher is interested in the peculiarities or features of the populations he only has data and information from the subjects in the sample. With inferential statistics, the researcher uses the sample data and information to make scientific guesses and generalizations. Some of the inferential statistics used in decision making include: T tests, analysis of variance (ANOVA), multiple comparison procedures, multiple correlation, etc are known as parametric statistics

More so, every statistical test concludes with two types of decisions viz: a statistical decision and a practical decision. The statistical decision consist of accepting and rejecting the null hypothesis based on the sample of the decision and the decision rule considered which are designed to look at an individual parameter from a sample and compare it with a known or supposed value from the population. Apart from the statistical decisions that emanates from such process, there is also practical decision that follows a decision to act upon the results of the statistical test (Ferguson, 1981 & Fatile, 2006). Therefore, in order to make scientific full proof decision, it is important to know the kind of parametric techniques of hypothesis testing to use. Because, using the wrong one will not only lead to waste of resources, time, money etc, but could equally prove costly when the time comes for decision making. Not only will it not be effective but also misleading and of no importance in practice. The choice of the right techniques, on the other hand, will not only make the process effective, efficient and result oriented, but also in the field of research, contributes to knowledge and equally reinforce the statistical association as development of a proposition of a link between variables. It is recognized that for an administrator working in the public service, statistics are in many ways, his stock of trade. The work of most ministries and departments according to Lerche (1983:4) is evaluated in terms of figures which show the resources put at the disposal of the ministry, and what was achieved. To be effective in this kind of work, a bureaucrat must keep very careful track of how work under his supervision is progressing, and this is best achieved by constant collection and computation of quantitative information. Statistical information is extremely valuable for official who have to formulate objectives for policy in these areas. They can use such statistical analyses to decide what policy to be followed.

Objectives of the Study

The main objective of this study is to determine the effectiveness of parametric techniques of hypothesis testing and decision making in the public sector, using Ogun state civil service as a case study. The study is also interested in finding out whether the result of analysis and the decision arrived at in the application of the various parametric tests will remain unchanged in each situation using the same data.

Statement of the Problem

Nowadays, most researchers are faced with the problem of how to choose an appropriate statistical technique to solve a particular problem. In fact, some researchers especially neophyte ones only know about the existence of the different categories of research statistical tools and their compartmentalization into sub-categories. They do not know which of these tools are most appropriate for various research situations. They are also vaguely familiar with the required procedures and make valid research decisions.

Decision-making is usually a major task of the society and for the management of any organization and public sector in particular. The quality of decisions made determines the growth or other wise of any public sector organizations. Not only that, social scientists before solving a problem or making a decisions embark on the rigorous and sophisticated processes of gathering analyzing and interpreting data, to enable them make the right decision. The process is not only research based but highly scientific, because all scientific methodology is applied, Thus making social

science, a science and researcher in social phenomena a scientist. The crossroad over parametric and non-parametric has risen out of the question of measuring social phenomena in an attempt to verify and generalize them. The question however is: Can complexity, rigidity and rigorous nature of parametric approach been able to measure and compare behavioural phenomena adequately? This is a complex question. It is important to note that parametric statistical techniques tend to received more attention than their non-parametric counterpart. Parametric techniques are more powerful and relatively robust to violation of assumption (Jaccard & Becker, 1990; Aczed, 1999, Fatile 2006). Asika (2010) added that "parametric techniques are widely taught in schools and are considered the most effective".

Most researchers and students prefer non-parametric statistics because, it does not required any assumptions about the parent population and it is easy to use. The procedures are widely acceptable and data can be analyzed on weak measuring scales, that is, the nominal and ordinal scales. Thus, unlike non\parametric statistics, most researchers and students find it difficult to use because of complexity of its principles. The parametric principles such as: the samples being drawn from normally distributed population with equal variances, the normal distribution with the same standard deviations, a scale of high precision such as interval and ratio scales being used in generating the data for the analysis homogeneity of variance, identification of two or more variables among others. These problems make it difficult for students to know when parametric should be used. Therefore, the use of parametric statistical techniques of hypothesis testing in decision making requires that assumptions limit the validity of parametric test to phenomena or real life problems where variables are normally distributed, for instance, intelligence test, age and height. Owing to this fact, other variables in the behavioural sciences that cannot be described quantitatively, and are measured on the normal or ordinal scales (e.g taste, brand, preference, grades) cannot be effectively tested using parametric techniques but rather can be tested using non-parametric statistics techniques.

The research will help researchers, including students and decision makers to choose the right techniques when developing a statistical theory and testing sample result which is used for decision making. It is expected that the various uses, applications, recommendations and effectiveness of parametric techniques discussed herein will add to the body of knowledge already existing in the field, and improve researcher's knowledge on the subject matter.

Research Method

Survey research design was adopted in this study. Attempt was made to compute and analyze data gathered from eight ministries and departments in Ogun state civil service which include Ministries of Education, Health, Finance, Environment, Works, Agriculture and Rural Development, Women Affairs, and Budget office. A 20 item questionnaire was administered to a total of 210 respondents using simple random sampling technique out of which 200 questionnaires were retrieved and found useful for our analysis. The response rate was 95.2 percent. The data obtained were analyzed using parametric techniques such as Analysis of variance, Regression analysis, Pearson correlation co-efficient, Ztest, Analysis of co variance etc in order to determine the extent of their effectiveness in hypothesis testing and decision making in the public sector.

Conceptual Framework

In this section, attempts were made to explain the major concepts in the study. These includes; statistics, hypothesis, public sector and decision making.

Concept of Statistics

Statistics can be defined as the science and practice of developing knowledge through the use of empirical data expressed in quantitative form. It is based on statistical theory which is a branch of applied mathematics (Osuagwu, 2002). Statistics is the science of collecting, classifying, summarizing and analyzing data. Data can be any set of information. Furthermore, statistics is seen as a mathematical science pertaining to collection, analysis, interpretation and presentation of data. It is applicable to a wide variety of academic disciplines form the physical and social sciences to the humanities and educations as well as to business, government and industry (Olaewe, 2005).

Given a collection of data, statistics may be employed to summarize or describe the data; this use is called descriptive statistics. Basic examples of numerical description include the mean and standard deviation. Graphical summarization includes various kinds of charts and graphs. In addition, patterns on the data may be modeled in a way that accounts for randomness and uncertainty in the observations, this use is called inferential statistics. These inferences may take the form of answers to a Yes/No question (Hypothesis testing), estimate of numerical characteristics (estimation), prediction of observation, description of association (correlation) or modeling of relationship (regression), ANOVA, time series, and data mining (Asika, 2010)

Concept of Public Sector

Eneanya (2014) defined public sector as an arm of government whose primary responsibility is the implementation of government policies and programmes in accordance with established rules and procedures. It includes all government institutions, civil service, corporations or state owned enterprises, agencies, commissions, services of National Assemblies and Extra-ministerial departments. It also includes elective as well as appointed political public office holders, such as the: president, vice presidents, governors, directors of corporations or Agencies, etc. Maduabum (2006) defines public sector with reference to the Nigerian constitution as "the service of the federation in any capacity in respect of...". It proceeds to list a number of officers: clerk or other staff of the National Assembly, members of staff of the courts of Judicature of the federation and states, members of staff of any commission or authority established for the federation or states: staff of any company or enterprise in which the government or its agencies hold a controlling share or interest; members of the Armed forces and the police; staff of a local government council; statutory corporation; educational institutions established or principally financed by government, etc.

Ayeni (2008) identified essential roles of public sector for the society. They include:

1. Assisting in public policy planning, formulation and execution;
2. Advising government on policy options
3. Serving as administrative machinery of government for the implementation of public decisions;

4. Initiating development programmes and drives economic growth; and
5. Serving as lead institution in strategic thinking for the public sector and translation of intention of political leadership to implementable policies capable of delivering improved quality of life to the citizenry.

Hypothesis and Hypothesis Testing

In evaluating and choosing among alternative solutions the manager formulates hypothesis, which could be considered as a tentative generalization concerning two or more variables of interest in the solution of problem under consideration (Fatile, 2006). In the views of Nwadinigwe (2000) and Asika (2010), a hypothesis is a probabilistic statement about the relationship or association between two or more variables. The statement of a hypothesis takes two forms null (H_o) and alternative (H_i) hypothesis. The null indicates that no relationship exist between variables, while the alternative or research hypothesis indicates that there is a relationship between the variables which means that the null hypothesis is a converse of the research hypothesis. Consequently, in testing these two opposing hypotheses, a confirmation or an acceptance of one means the rejection of the other. A quick rule of the thumb according to Ogbeide (1997) for identifying which variable is dependent or independent in the process of testing hypothesis is the concept of causal order. Time priority states that under normal condition, the independent variable must either occur first or change prior to the dependent variable.

It is appropriate to state at this juncture that the null hypothesis assumes the status quo as the old theory; method or standard is still true. It is the complement of the alternative hypothesis, which is that the researcher is usually interested in proving. A good rule to follow is to view the alternative as the hypothesis upon which the burden or proofs falls. This is the hypothesis the researcher is most interested in demonstrating to be true. After establishing the null and alternative hypothesis, the researcher can set up decision rules to determine whether the null hypothesis is going to be rejected or not (Frank & Steven, 1994). In addition, Ogbeide (1997) observed that in testing hypothesis, it would be nice if we could always make a correct decision. However, this is statistically impossible since we will be making our decision on the basis of sample information; the best we can hope for is to control the risk or probability, with which an error occurs. The most frequently used probability values are 0.01 and 0.05. The probability assigned to each error will depend on the seriousness of the error. The more serious the error, the less confidence we have over the result of our hypothesis testing. Conversely, the smaller the error, the more confidence we have over the result of our analysis.

Parametric and Non-Parametric Techniques

Asika (2010) observed that the assumptions of normal distribution are sine qua non for any valid parametric tests. They are used in probability distributions or any life phenomenon with variables that are known to be normally distributed, e.g. intelligence tests, age, agricultural produce per acre, etc. while parametric statistics include testes based on student t- distribution, analysis of variance (ANOVA), Correlation analysis and regression analysis. Parametric statistical tests are powerful tests because they are probabilistic tests of significance. Non-parametric statistical techniques, on the other hand, test research hypotheses that do not

specify normality or homogeneity of the variance assumptions about the populations from which the research samples are drawn. Generally, it is advised that unless there is substantial evidence to suggest that the variances are heterogeneous, parametric tests should be used because of their additional power (Huck et-al cited in Osuagwu, 2010).

Osuagwu (2002) highlighted that parametric and non-parametric statistical techniques test different research hypotheses involving different assumptions. Parametric statistical techniques test research hypotheses based on the assumption that the samples come from populations that are normally distributed. Also, parametric statistical techniques assume that there is homogeneity of variance.

Concept of Decision Making in Statistical Analysis

A decision is making a choice between alternative courses of action. It can be defined as making a judgment regarding what we ought to do in a certain situation after having deliberated on some alternative course of action. It is a framework that guides those choices that determine the nature and direction of any organization (Bartol and Martin, 1997).

Fatile (2005) revealed that the decisions that managers make have a profound impact on the success of the organization. Hence, managerial approaches to decision making have been the subject of considerable curiosity and research. The rational model of managerial decision making suggests that managers engages in completely rational decision processes, ultimately made optimal decision and possess and understand all information relevant to their decisions at time they make them.

Nwadeiningwe (2000) observed that effective managerial decision is the process of efficiently arriving at the best solution to a given problem. According to him, if only one solution is possible, then no decision problem exists. When alternative courses of action are available, the decision that produces the result most consistent with managerial objective is the optimal decision. Alternative decision must be weighed, that is, appraised quantitatively and qualitatively, so that appropriate decision could be made to formulate hypothesis which is defined as "fingers of knowledge" that guides the whole research which determines all the things the researcher has to do while carrying out the research.

Application of Parametric Techniques of Hypothesis Testing

In making inferences about population based on the behaviour of samples and in testing hypothesis, there are number of different methods or tests of significance which can be applied in research studies. Different tests of significance are appropriate for different sets of data. Factors such as the scale of measurement units, the data of groups, and the number of independent variables determine which test of significance should be selected for a given research design. Parametric statistical methods of analyzing data are more robust with respect to violations of some of their assumption. That is, failure to have a perfectly normal distribution is really not damaging to the accuracy of the probability values obtained with the test or the analysis of variance (ANOVA).

Furthermore, parametric statistical methods are preferred in that they provide information that non-parametric methods do not. For example, in the two factors analysis of variance, a test for an interaction may be made. It is more difficult to assess. In addition, parametric methods usually have great power efficiency when compared to non-parametric methods. Power efficiency is a technical concept that refers to the probability that the test will reject the null hypothesis when that hypothesis is in fact false. If the difference between the central tendencies of two groups is being considered, a test is more likely to detect a population difference than is an appropriate non-parametric test for the given numbers. Therefore, parametric inferential statistics methods are procedures for statistical hypothesis testing which major assumption is that the distribution of the variable measured is normally distributed or belong to the parameterized families of probability distribution. Parametric statistics require that certain conditions be met in order for them to be valid.

The following are important assumptions of parametric statistics to test hypotheses as identified by Asika (2010). They are;

i. The variable measured is normally distributed in the population.
ii. The samples being drawn from normally distributed population with equal variances.
iii. The normal distribution has the same standard deviations.
iv. The data is taken from an interval or ratio scale.
v. Parametric statistics test of hypotheses are powerful test because they are probabilistic tests of significance.

Agents of Parametric Statistics

Olaewe and Kazeem (2009) identify the following agents of parametric techniques. They are:

The T-Test: The test is used to determine whether two means are significantly different when the sample size is small (i.e. n≥30). When the sample population is more than 30, the adjusted t-test with the aid of computer could be used. When most of the information is contained in the original data in comparison of two groups, there must always exist a difference no matter how identical the groups are. The two types of t-test are the t-test for independent samples and t-test for non-independent samples.

Independent samples are samples which are randomly formed. The members of one group are not related to members of the other than that they are selected form the same population. In a nutshell, the t-test of independent samples is used to determine whether there is probably a significant difference between the means of the independent samples and non independent sample. The formula for independent sample is:

$$T = \frac{\bar{X}_1(SD_1)^2 + \bar{X}_2(SD_2)^2}{\sqrt{n_1 + n_2}}$$

Where
$\overline{X}_1$ = is the mean of the first group
$\overline{X}_2$ = is the mean of the second group
$(SD_1)^2$ = standard deviation square of the first group
$(SD_2)^2$ = standard deviation square of the second group.
n_1 = is the number of population in the first group
n_2 = is the number for population in the second group.

T-Test For Non-Independent Samples: Non-independent samples are samples formed by some types of matching. When samples are not independent, the members of one group are systematically related to the members of the second group. Therefore, the test for the non-independent samples is used to determine whether there is probably a significant different between the means of two matched or non-independent samples at two different times. But for the purpose of this study, the independent sample will be examined.
The formula for t-test for non-independent samples is:

$$t = \frac{\sum d}{\sqrt{\frac{N\sum d^2 - (\sum d)^2}{N-1}}}$$

d = difference between each matched sample
$\sum d$ = sum of difference between the matched samples
d^2 = the square of the difference between the samples
N = total number of matched samples
$N - 1$ = number of degree of freedom

Hypothesis Testing Using Parametric Tests
In a survey conducted among 200 civil servants to determine whether or not there is a significant difference in the use of open performance appraisal method as a new method of appraising employees and performance in Ogun Sate Civil Service. The following set of scores was obtained from two randomly selected groups.
Group A ; 7, 8, 9, 15, 14, 15, 10, 11, 12.
Group B ; 6, 7, 8, 13, 16, 11, 9, 5, 10, 5.

Hypothesis Testing
H_0: The implementation of open performance appraisal method will not affect the performance of employees in the civil service
H_1: The implementation of open performance appraisal method will affect the performance of employees in the civil service

First let us label the Score and then Calculate the Mean X

X_1	X_2
7	6
8	7
9	8
9	13
15	16
14	11
15	9
10	5
11	10
12	5
Total: 110	**90**

$\sum X_1 = 110, \quad \sum X_2 = 90$

$X_1 \frac{110}{10} = 11$

$X_2 \frac{90}{10} = 9$

The next step is to calculate S^2

T. test (Testing of Hypothesis)

Responses	N	Mean	Variance	SD	X1 – X2	S^2	t cal
X1	110	11	7.6	2.76	2.0	0.762	1.44
X2	90	9	11.6	3.41		1.163	

Decision rule
df = $n_1 + n_2$ 2
=10 + 10 2
= 18
Level of significance = 5%
0.05
t tab = 2.101

Research Result
$t^2 c \leq t^2 t$
Therefore, data are statistically significant at 5%. Thus, we accept the null hypothesis, H0 and reject the alternative hypothesis, H1 .We can conclude The implementation of open performance appraisal method will not affect the performance of employees in the Ogun State civil service.

Z Test
2. The Z-Test: The Z-test is used to determine whether two means are significantly different. It is usually adopted when the sample size is large i.e. when it is equal to or greater than 30.
The formula for calculation Z-tests is:

$$Z = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{Var_1^2}{N_1} + \frac{Var_2^2}{N_2}}}$$

$\bar{X}_1$ = mean of group one (i)
$\bar{X}_2$ = mean of group two (ii)
SD = standard error between means
Var^2 = variance squares of group i and ii
Using the same data as above

Formula:

$$Z = \frac{X - X}{SD}$$

$$= \frac{X - X}{\sqrt{\frac{(2.76)^2}{10} + \frac{(3.42)}{10}}}$$

Test of hypothesis
Z test

Responses	Total	Mean	Variance	SD	Mean 1 – mean 2		Z test cal
X1	110	11	7.6	2.76	2.0	0.762	1.44
X2	90	9	11.6	3.41		1.163	

Assuming we selected P = 0.05, what we need to do is to make reference to the table of z distribution. At 0.05 level of significance, the critical or table value of Z = 1.96. Therefore Z test calculated is $\leq$ Z test tabulated. Accept Ho and reject Hi. We can therefore conclude that the implementation of open performance appraisal method will not affect the performance of employees in the civil service.

From the analysis above, t test and Z test perform similar functions. However, the following differences can be identified between t test and Z test.

i. Z test is applicable when population standard deviation is known, while t test is applicable when standard deviation is unknown.
ii. t test is applicable when n is < 30 while Z test is applicable when n is > 30.
iii. t distribution is flatter and more spread than the standard normal for small samples of the same size
iv. Z test uses the normal distribution while t test uses t distribution
v. Z test is applicable when the distribution is normal, that is, when n is low but if n is > 30, the distribution of the data does not have to be normal while the distribution of t test should be normal for the equal and unequal variance.

Pearson's Correlation Coefficient

Correlation deals with exploring the relationship between the two variables X and Y, correlation can be classified in terms of Spearman's rank correlation and Pearson's correlation coefficient. But for the purpose of parameter hypothesis, Pearson's correlation coefficient is more relevant (Esan and Okafor, 2007) There are two cases of this depending on whether we are computing the coefficient using all possible N pairs of observation sin the population or just a few n pairs of observation in the chosen sample. The Pearson's coefficient is defined as

$$r = \frac{n\sum Xy - \sum X\sum Y}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2[\sum Y)^2]}}$$

Using the Same Data as above;

Variables	n	Mean	Variance	SD	Df	r-cal	r-tab	Remark
X	200	11	7.6	2.76	198	0.49	0.195	Positive correlation
Y		9	11.6	3.41				

Level of significance = 5%

r_t= 0.195

The calculated Pearson coefficient table of value 0.49 is greater than Pearson coefficient table value of 0.195 at 0.05 level of significance, Therefore, we accept H_1 and reject H_0. We can therefore conclude that there is a significant relationship between implementation of open performance appraisal method and the performance of employees in Ogun State civil service.

Analysis of variance (ANOVA): The analysis of variance (ANOVA) is used to determine whether there is a significant difference between means of three or more groups concurrently at a selected probability level. ANOVA always detects the difference and brings out the cause and causes of such difference. Analysis of variance is a way of partitioning sum of squares by the source. It allows a wide range of research designs involving one, two or more independent variables to be studied simultaneously. The analysis of variance as an inferential parametric statistical method is adopted for use if the following conditions prevail:

i. Random sampling and independent of groups
ii. Group concerned are more than two
iii. Homogeneity of group variance
iv. Normality of population distribution
v. There exist fixed factors.
vi. The group of interest are interval or ratio
vii. When there is equivalent covariate

There are two main types of ANOVA; One way ANOVA and TWO-way ANOVA. All calculations of analysis of variance end up with the calculation of F-ratio. For the purpose of this study one-way ANOVA is adopted.

In this case, Data was obtained from Senior, Middle and Junior Cadres of the Civil Service

$X_{1(senior)}$	$X_{2(Middle)}$	$X_{3(Junior)}$
7	8	6
8	7	9
13	9	16
14	15	11
15	14	10
11	12	15

Hypothesis Testing

Ho:

There is no significant relationship between the responses of the three groups as regards the extent to which the implementation of open appraisal method will affect performance of employees in the civil service

Hi:

There is a significant relationship between the responses of the three groups as regards the extent to which the implementation of open appraisal method will affect performance of employees in the civil service

The analysis of variance consists of the following operations;

a. The variance of the scores for three groups is combined into one composite group, known as the total group's variance (V_t).
b. The mean value of the variances of each of the three groups, computed separately is known as the within groups variance (V_W).
c. The difference between the total groups variance and the within groups variance is known as the between-groups variance ($V_t V_W = V_b$)
d. The F ratio is computed as $\frac{V_t}{V_w}$

$= \frac{\text{between groups variance}}{\text{Within Groups' variance}}$

In order to compute an ANOVA, we need to each term, but since C = A+B, or C (SS_{total}) = A (SS b + w) + B (SS_{within}), we only have to compute any two terms and we can easily get the third. Since we only have to calculate two, we might as well do the two easiest. SS_{total} and $SS_{between}$. Over we have these we can get SS within by subtraction, SS_{within} will equal SS_{total} SS between is as follows;

$SS_{total} = SS_{btw} + Ss_{within.}$

$$SS_{btw} = \frac{(\sum X_1)^2}{n_1} + \frac{(\sum X_2)^2}{n_2} + \frac{(\sum X_3)^2}{n_3} - \frac{(\sum X)^2}{N}$$ (depending on number of group)

$$SS_t = \sum X^2 - \frac{(\sum X)^2}{N}$$

$$SS_w = \sum X_1^2 - \frac{(\sum X_1)^2}{n_1} + \sum X_2^2 - \frac{(\sum X_2)^2}{n_2} + \frac{(\sum X_1)^2}{n_1} - \frac{(\sum X_1)^2}{n_1}$$

Next step is to add the scores in each group for the first three terms in the formula, square the total and divide by the number of scores in the group. For the fourth term, all we have to do is add up all the scores ($X_1 + X_2 + X_3$), square the total and divide by the N i.e ($n_1 + n_2 + n_3$)

X_1	X_1^2	X_2	X_2^2	X_3	X_3^2
7	49	8	64	6	36
8	64	7	49	9	81
13	169	9	81	16	256
14	196	15	225	11	121
15	225	14	196	10	100
11	121	12	144	15	225
68	**824**	**65**	**759**	**67**	**819**

Now $\sum X = X_1 + X_2 + X_3 = 68 + 65 + 67 = 200$

$$\sum X^2 = X_1^2 + X_2^2 + X_3^2 = 824 + 759 + 819 = 2402$$

$$N = n_1 + n_2 + n_3 = 6 + 6 + 6 = 18$$

The next step is to determine the degrees of freedom. The formula for the degree of freedom (df) is as follows:
Df between = 3 1 = 2
Df within = N K, where N is the total sample size and K is still the number of groups;
Df within = 18 3 = 15
Df total = N 1 = 18 1 = 17
The next step is to determine the mean square

Mean Square = sum of degrees K
Degrees of freedom

$$Ms = \frac{ss}{df}$$

for between, $Ms_{btw} = \frac{SS_{btw}}{df}$

$$= \frac{0.79}{2}$$

$$= 0.395$$

For within, $MS_{within} = \frac{SS_{within}}{df}$

$$= \frac{178.99}{15}$$

$$= 11.93$$

Now all we need is F ratio. The F ratio is a ratio of MS_{btw} and MS_{within}

$$F = \frac{MS_{btw}}{MS_{within}}$$

$$= \frac{0.395}{11.93}$$

$$= 0.033$$

Summary of One Way Anova

Source	SS	Df	MS	F	P
Between groups	0.79	2	0.395	0.033	0.05
Within groups	178.99	15	11.93		
Total	**179.78**	**17**			

F table with 2 and 15 df, and at 0.05 level of significance. The F table = 3.68
F value = 0.033
F table = 3.68
F value F table,

Then accept null hypothesis. There is no significant relationship between the responses of the three groups as regards the extent to which the implementation of open appraisal method will affect performance of employees in the civil service.

Findings of the Study

The study was based on a survey conducted among a sample of 200 civil servants that cut across Ministries, Departments and Agencies in Ogun State who were randomly selected. Data generated from the field survey conducted were analyzed using some selected parametric techniques such as T-test, Analysis of Variance (ANOVA), Z-test and Pearson Product Moment Correlation Coefficient. Generally, the results of our analysis in the application of the various tests showed that the decision as to whether to accept or reject the null hypothesis remained unchanged in each situation using the same data. Thus, irrespective of the test employed in the analysis of data, the researcher would still arrive at the same decision. Parametric tests become more effective where the interval and ratio scales of measurement are used and samples are from the population. Also, where the assumptions of normality are satisfied, then parametric tests are most suitable. Although there are

some inherent weaknesses associated with the use of parametric tests particularly difficult mathematical or statistical computation often associated with the technique, it was observed that they are often more potent and powerful tool of analysis for decision makers or researchers. Parametric tests are powerful tests because they are probabilistic tests of significance. Also, calculations of parametric tests are rapid and most applicable where two or more variables are identified. Experience has shown that researchers and students prefer non-parametric statistics when it is obvious that parametric statistics are more appropriate.

Conclusion

From the discussions and analysis presented in this paper, we have been able to discover that parametric procedure is a statistical procedure that has certain principles and properties that hold under relatively certain assumptions, regarding the under population (s) from which the data are obtained. The rapid development of parametric statistical procedure include the fact that the procedures encourage the traditional assumption that the population distribution are normal and distribution of the variables measured belongs to a parameterized families of probability distribution. Although, the procedures are quite complex, but through application of parametric techniques of hypothesis testing, the condition is that the data should be measured on interval and ratio scales.

In view of the relevant and nature of research work as a springboard upon which other developments (economics, social, educational, technological, scientific, etc) revolved, concerted efforts should be made by every stakeholder to promote a genuine culture of research among people especially the policy and decision makers so that the country at large would benefit profusely from the rewards of enquiry knowledge by extension, our country can take her position among the technologically advanced countries of the world in terms of data development and generalizations.

Recommendations

Based on the explanation of the concepts above and based on the findings from the literature, it is here by recommended that: Parametric techniques should be taught more in research methodology so that students and other researchers can be more conversant with the technique. Besides, research supervisors in higher institutions of learning should be more familiar with the application of the various parametric techniques and advice their students on which of them should be used in a particular situation. All tertiary institution and public organizations (University, Polytechnics and colleges of education, Technology and ministries etc) should encourage their staffers to attend national and international conferences, workshops, and seminars to update their knowledge and skills in research works most especially in the application of appropriate tool of analysis in order to improve the quality of decisions in public sector management research and to make them relevant to the global dynamic change in the world of academy.

Trained, experienced, and well-exposed researchers and administrators/policy makers should be allowed to teach courses or handle research works at both undergraduate, graduate levels and various training institutes. With the emergence of information and communication technology (ICT) into research, every undergraduate students, post-graduates students, and administrators should be

encouraged to become computer illiterate during and after their course of study so as to make their work more relevant in data collection, analysis, and interpretation especially those aspects that has to do with ICT. Manual calculations of various statistical methods should be encouraged among doctoral students and senior staff personnel's. This is an era of advance technology no doubt, but manual dexterity in calculating those statistics will improve the quality of those processed data so as to decode correctly and interpret appropriately all those clumsy data research work.

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