IMPACT: International Journal of Research in Applied, Natural and Social Sciences (IMPACT: IJRANSS)
ISSN(E): 2321-8851; ISSN(P): 2347-4580
Vol. 3, Issue 8, Aug 2015, 43-48

EFFECT OF SAMPLE SIZE (BY REPEATING THE DATA) ON FACTORIAL CONSTRUCTION OF MEASUREMENT TOOLS

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ABSTRACT

In the study, the purpose was to find out the effect of sample size (by repeating the data) on the number of factors opting from exploratory factor analysis and on the cumulative proportion of the total factors. The statistical comparative method was used in the study. The sample of the study consisted of 100 secondary school teachers of Western Uttar Pradesh (India), which was selected by employing random sampling technique. 'School Climate Scale' developed by (Gupta, 2014) was used in the study to collect the data. The findings of the study revealed that: (1) there was no effect of sample size (by repeating the data) on the number of factors opting from exploratory factor analysis. (2) Cumulative proportion of the total factors was not affected by the sample size (by repeating the data).

KEYWORDS: Factor Analysis, Exploratory Factor Analysis

INTRODUCTION

A common trait running through a number of variables, which can be helpful in performance, is termed as a factor. It may or may not be measurable. In other words, there are certain variables or characteristics, which are responsible for the performance in a particular area. When these variables are co-related to each other, they form a factor. The variables contributing in one factor are co-related to each-other only, not with other factors and the factors are also not co-related to each other. Thus, it can also be said that many factors contribute in an ability or trait. For e.g. language ability is one of the factors responsible for academic achievement (Guilford, 1954). Factor analysis is a statistical technique to study the inter-relationships among the variables under study to make them less in number than the original variables. In factor analysis, a small number of common factors are extracted so that these common factors are sufficient to study the relationships of original variables. According to Hair & others (2006) 'factor analysis is used for turning various interrelated variables into meaningful and independent factors, which are less in numbers'. This technique is also useful to see the nature of tests. It examines the co-relation among a group of tests and explores to what extent they are measuring the same thing or psychological concept. In this way, it is also helpful in factorial purification of psychological tests and a consequent reduction in the degree of overlapping among them (Koul, 2009). Basically, Factor analysis is of two types, which are presented through the below given figure (Figure. No. 1):

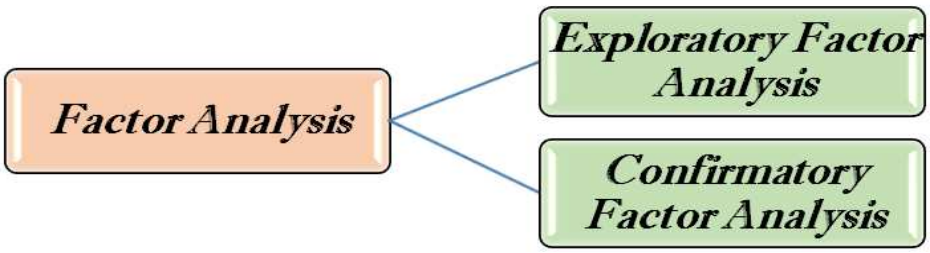

Figure 1: Types of Factor Analysis

EXPLORATORY FACTOR ANALYSIS

Exploratory factor analysis is used in the situation when the researcher does not have clear idea or hypothesis about the number of factors and the relationship between the factors and underlying variables. According to Child (1990) 'Exploratory factor analysis is used to explore the possible underlying factor structure of a set of observed variables without imposing a preconceived structure on the outcome'.

CONFIRMATORY FACTOR ANALYSIS

Confirmatory factor analysis is a statistical technique used to verify the factor structure of a set of observed variables. In other words, it allows a researcher to test the hypothesis about the relationship between observed variables and their latent construct (factor) (SAS, 2008).

AIMS OF FACTOR ANALYSIS

Factor analysis helps the researcher to reduce the number of variables to be analyzed, thereby making the analysis easier. Analysis based on a wide range of variables can be tedious and time consuming. For example, a market researcher at a credit card company who wants to evaluate the credit card usage and behavior of customers by using various variables i.e. age, gender, marital status, income level, education, employment status, credit history and family background. Using Factor Analysis, the researcher can reduce the large number of variables into a few dimensions called factors that will summarize the available data. It aims at grouping the variables into factors, which are underlying the input variables. For example, age, gender, marital status can be combined under a factor called biographic or demographic characteristics. The income level, education, employment status may come under a factor called socio-economic status. The credit history and family background can be combined under a factor called background status.

To sum up, factor analysis is one of the statistical methods which can be used for many situations such as:

- It helps in data reduction e.g. it reduces the data from big numbers of variables to small numbers of factors.
- It helps in grouping the variables which have something common. In other words, each variable has latent relationship with another variable or have something common.
- It is useful to discover the factors, which contribute in any trait or concept.
- It helps to know the domains available in a scale or test. In other words, it is useful in validity testing of the tool.
- It helps to test the hypotheses about the explained variance by the factors in any trait or concept.
- Confirmatory factor analysis is helpful to test the theories in Education.

The concept of construct validity was introduced by Cronbach and Meehl (1955). To know the factorial construction of any concept like intelligence, anxiety, depression or thinking etc. factor analysis can be used through SPSS program (Carole & Winterstein, 2008).

RESEARCH OBJECTIVES

- To examine the effect of sample size (by repeating the data) on the number of factors opting from exploratory factor analysis
- To examine the effect of sample size (by repeating the data) on the cumulative proportion of the total factors

RESEARCH HYPOTHESES

- There is no effect of sample size (by repeating the data) on the number of factors opting from exploratory factor analysis.
- There is no effect of sample size (by repeating the data) on the cumulative proportion of the total factors.

RESEARCH METHODS

To achieve the above mentioned objectivities of the study, the researchers have used statistical comparative method through following steps:

First: Self-constructed standardized scale of 'School Climate' has been administered on a sample of teachers (100 secondary school teachers) in the 'Western Uttar Pradesh' (India).

Second: The data has been repeated one time to make the sample size two hundred then it was repeated three times to enlarge it more (four hundred). Finally, the data has been repeated seven times to extend it in a sample of eight hundred teachers.

Third: The data (original and obtained through all repetitions) has been analyzed by applying exploratory factor analysis (principal component method) through SPSS program.

RESEARCH SAMPLE

The random sampling technique has been used for selecting a sample of 100 secondary teachers from western Uttar Pradesh of India in the academic year (2014- 2015).

Research Tool Used

School Climate Scale self developed by (Gupta, 2014) has been used in the present study. The scale consists of 40 items. The validity of the tool has been ensured by using content validity and construct validity and reliability of the scale is .89 according to Alpha Cronbach method.

STATISTICAL METHODS

Exploratory Factor Analysis (EFA)

RESULTS AND INTERPRETATION

- **First Objective:** ***To examine the effect of sample size (by*** *repeating* ***the data) on the number of factors opting from exploratory factor analysis***

To test the above mentioned objective, the researchers have used factor analysis for each sample size (100, 200, 400 and 800) and the result of this step is as following:

Table 1: Factorial Construction

Sample Size	Number of Factors
100	15
200	15
400	15
800	15

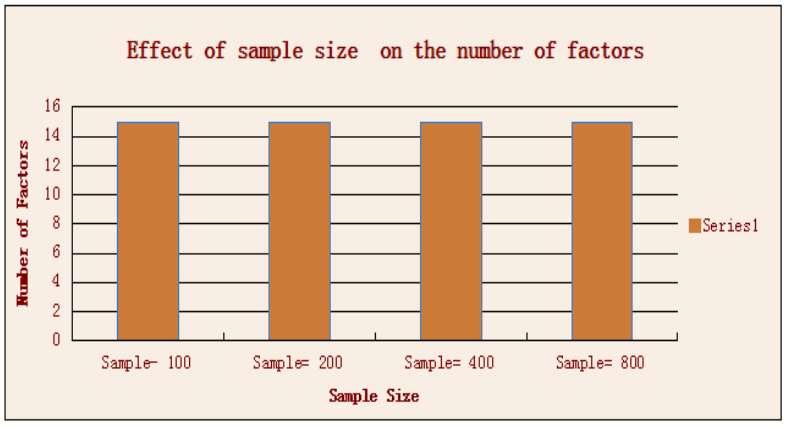

Figure 2: Effect of Sample Size on Number of Factors

The table no.1 and figure 2 show that there is no difference in the number of factors obtained on the different size of samples (sample size= 100, 200, 400, 800) by applying exploratory factor analysis. The numbers of factors are same for each sample therefore, the null hypothesis; "there is no effect of sample size (by repeating the data) on the number of factors opting from exploratory factor analysis" is accepted.

- **Second Objective :** ***To examine the effect of sample size (by repeating the data) on the cumulative proportion of the total factors***

To achieve the above objective, factor analysis for each sample (100, 200, 400 and 800) has been applied and the result is as following:

Table 2: Factorial Construction

Sample Size	Cumulative%
100	74.87
200	74.87
400	74.87
800	74.87

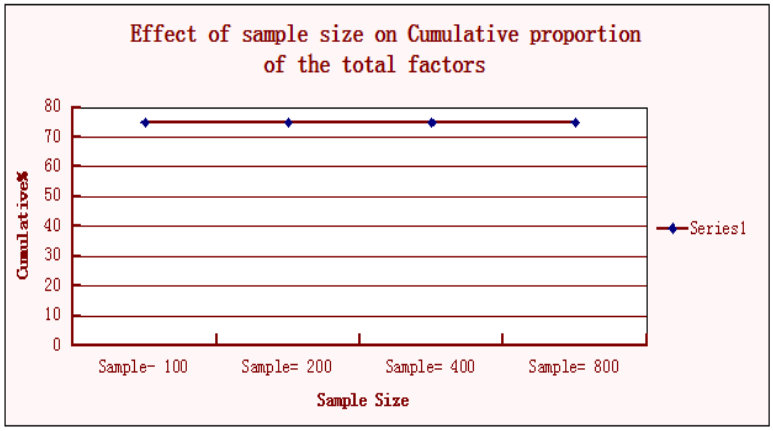

Figure 3: Effect of Sample Size on Cumulative Proportion

The table no. 2 and figure 3 show that there is no difference in the cumulative proportion of all factors calculated by exploratory factor analysis. It means that all factors are explaining the same variance whether the sample size differs. Therefore, the null hypothesis, "there is no effect of sample size (by repeating the data) on the cumulative proportion of the total factors" is accepted.

CONCLUSIONS

- It can be concluded that there is no effect of sample size (by repeating the data) on the number of factors opting from exploratory factor analysis.
- It can be concluded that there is no effect of sample size (by repeating the data) on the cumulative proportion of the total factors.

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