# EFFICIENCY IN STATISTICAL METHODS AMONG POST- GRADUATE STUDENTS OF SOCIAL SCIENCES

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**Abstract:** *The present study is an attempt to find out the level of statistical competency among post-graduate students studying in the faculty of Sciences and Social Sciences. A standardized test, constructed by Govil & Others (2015) was administered on a sample of 185 post-graduate students selected through random sampling technique to achieve the objectives of the study. The findings of the study revealed that the level of statistical competency of post-graduate students was below than average and there existed no difference among them with reference to gender and living place. But stream of study caused significant difference among post-graduate students. The post-graduate students performed well on one of the aspects of statistical competency i.e. 'Basic understating of statistical concept' but were very poor on the use of non-parametric statistics'.*

**Key Words:** Statistics; Descriptive Statistics; Inferential Statistics; Statistical Competency

## Introduction

Statistics is a very commonly used term but it is taken into account differently by different people. Originally, the word "statistics" has been derived from the Latin term "statisticum collegiums" ("council of state") and from the Italian word "statista", which means "statesman" or "politician" (Mangal, 2005; Qasem et al., 2015). The first usage of statistics was by states, which collected data on its people for effective administration. Today, some of the people use it to denote a particular entity in a set of numbers or a particular item in a numerical record, sometime it is used to refer to a set of numerical data or numerical records and sometime it refers the techniques and methods, which are used to reduce the element of uncertainty and to make decisions and predictions (Elhance et al., 2009). Basically, the word 'statistics' refers to a set of figures (numerical data) or a set of techniques and methods (Shah, 1990).

According to Horace Secrist," By statistics we mean aggregate of facts, affected to a marked extent by multiplicity of causes numerically expressed, enumerated or estimated according to reasonable standards of accuracy, collected in a systematic manner for a predetermined purpose and placed in relation to each other" (Ostle, 1974). Good & James (2006) defined the term 'statistics' as "statistical procedure for hypothesis testing, estimation, and model building, which is only a part of the decision- making process". In the view of Sheskin (2000) "statistics is a field of

mathematics that includes summary and analysis of data. The field of statistics is divided into two general areas: descriptive statistics and inferential statistics. Miles and Banyard (2007) confirmed that there are two meanings for the word 'statistics' originally statistics as a number and statistics as a subject. Lane (2009) was of opinion that "the term 'statistics' includes math and relies upon calculation of numbers, how the numbers are selected and how they are interpreted".

On the basis of statisticians' views, it can be concluded that statistics as a subject allows students to discover the use of display of diagrams in real-life situations, (for example box-and-whisker diagrams and stem-and-leaf diagrams etc.). It is also all about interpreting data. A good knowledge of mathematics is clearly essential, but statistics also requires good communication skills in order to discuss and interpret data in relation to any problem. It works closely with computing technology (Sheskin, 2000). Today, Statistics is playing a major role in testing the validity of complex models in education, business and medicine etc. where complex statistical packages like AMOS, LISREL and SEPATH are used in model testing to inform policy and decision. Statisticians work with such vast amount of data on such a regular basis that the role of computer technology cannot be ignored in the field of statistics. Now, statistics plays a vital role in every field of human activity. It has important role in determining the position of per capita income, unemployment, population growth rate, housing, schooling medical facilities etc. in a country. Statistics holds a central position in almost every field like Industry Commerce, Trade, Physics, Chemistry, Economics, Mathematics, Biology, Botany, Psychology, Astronomy etc. Therefore, application of statistics is very wide. An understanding of statistical methods is of substantial importance to the people who are working in the field of Psychology and Education. Efficiency in statistical methods and techniques can help the Psychologists and Educators to understand and interpret test's score and to make generalization for the people (Armore, 1966; Govil et al., 2015).

With the emerging importance of statistics, it has become necessary for each student to have complete knowledge or competency in statistic or statistical methods in theoretical as well as practical aspects (Qasem et al., 2015). In this regard, a number of studies have been conducted to know the level of statistical competency among learners. Some of them are given below:

Taylor (1993) conducted a study to know the statistical competencies among future teachers of elementary and middle school. The study revealed that participants were lacking in statistical competencies and were having misconceptions regarding statistical topics. Baloglu (2003) found that older students have more positive attitudes towards usefulness of statistics but they also tended to have higher level of statistical anxiety. Mills (2004) reviewed previous studies and tried to find out the influence of gender on attitudes towards statistics and reported that males had more favorable attitude towards statistics than females. Females were scared of statistics and did not want to achieve mastery in statistical methods. Francis & Lipson (2010) investigated the attitude of students belonging to marketing and psychology departments towards statistics and whether the difference is inherent from the starting of course or develop according to the academic year of course. They found that statistics is equally useful for career in marketing and psychology. Qasem (2012) constructed a criterion reference test to measure the statistical competencies of post graduate students of Education colleges in Yemini Universities through the method 'evaluation of researches'. He found that there was lack of statistical competencies among post graduate students.

Chan (2013) aimed to determine the statistical reasoning ability in descriptive statistics among $X^{th}$ grade students from Malaysian secondary schools and found that statistical reasoning ability of $X^{th}$ grade students was at a poor level. Qasem et al. (2015) carried out a comparative study about the level of statistical competency of post graduate students belonging to faculty of Education in Universities of Yemini and India. The investigators found that the level of statistical competency of Yemini post graduate students was significantly higher than their counterparts of India and male post graduate students were better than female post graduate students.

On the basis of above mentioned studies, it can be concluded that the level of statistical competency is below average among learners, and male students are better in statistics than female

students (Taylor, 1993; Mills, 2004; Qasem et al., 2015) but there have been very few studies to know the level of statistical competency among post graduate students. In order to arrive at more empirical conclusions, the present study was undertaken to investigate the level of statistical competency among post- graduate students.

**OBJECTIVES OF THE STUDY:** The present study seeks to find out the level of statistical competency among post-graduate students therefore, the main objectives of the study are:

1. To know the level of statistical competency among post graduate students
2. To know the difference in the level of statistical competency among post- graduation students according to subject of the study
3. To know the difference in the level of statistical competency among post graduate students according to the gender
4. To know the differences in the level of statistical competency among post-graduate students according to their place of living
5. To know the weakest aspect of statistical competency among post- graduate students

## METHODOLOGY

To achieve the predetermined objectives, '*descriptive survey method'* was used in the study. Descriptive research involves 'collecting data in order to test the hypotheses or answer questions concerning current status of the subject of study' (Gay, 1992 p. 217; Gupta & Jan, 2013). All the post-graduate students of India studying in different faculties were determined as the population for the study. The sample of the research was selected by employing stratified random sampling technique. It comprised of 185 post graduate students belonging to Science and Social Science faculties of Aligarh district for the academic year 2014-15. The level of statistical competency was measured by administering 'Statistical competency test' constructed by Govil and Others (2015). The tool of the research consisted of 60 objective type questions within seven dimensions. It has good validity, which was determined by employing three methods 'content validity, discrimination validity and construct validity'. The reliability of the tool was 0.89, which was ensured by using Alpha Cronbach. The obtained data was tabulated and analyzed with the help of SPSS 22.

## Results & Interpretation

The following paragraphs present the analysis and subsequent interpretation of results according to the objectives:

**OBJECTIVE No. 1**

***To know the level of statistical competency among post graduate students***

**Table No.1: Descriptive measures to know the level of statistical competency among post-graduate students**

| N | Mean | Mode | Median | s.d. | Skewness | Kurtosis | Std. error of Mean | Z Value | Z Standard |
|---|---|---|---|---|---|---|---|---|---|
| 185 | 23.74 | 36 | 22 | 10.12 | 0.32 | -0.80 | 0.74 | 0.43 | ±1.96 |

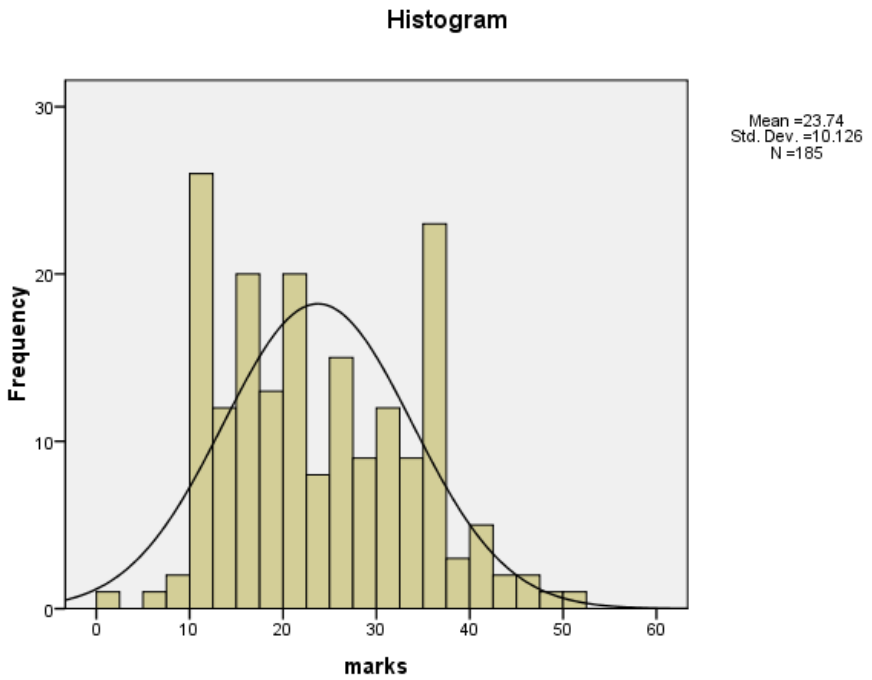


**Figure No.1: Graphical representation of normality of data on statistical competency**

The above given table (No. 1) presents descriptive measure of statistical competency scores attained through the application of statistical competency test. An average student in the sample has low level of statistical competency according to the standards of the test (mean value=23.74<29-34[average level as per test]) therefore, it can be concluded that an average learner studying at post graduation level possesses lower level of statistical competency. The values of skewness (0.32) and kurtosis (-0.80) are lower than ±1 and within the acceptable limit. Along with this Z value (0.43) (Z = Skewness/ Std. error of Mean) is not significant according to the z standard (±1.96) (Doane & Seward, 2011) therefore, it can be concluded that data is approximately normally distributed and various parametric statistics can be applied on it.

**OBJECTIVE No.: 2**

***To study the difference in the level of statistical competency among post graduate students according to their subject of study***

**Table No.2: Descriptive statistics showing the difference in the level of statistical competency among post graduate students with reference to stream of the study**

| Group | N | Mean | s.d. | df | t | Sig. |
|---|---|---|---|---|---|---|
| Science | 77 | 26.65 | 11.21 | 183 | 3.39** | 0.01 |
| Social Science | 108 | 21.66 | 8.74 | | | |

** Significant at 0.01 level

It is depicted from the above given table (No. 2) that the mean score of the post-graduate students belonging to science faculty is 26.65 with s.d. 11.21 and the mean score of post-graduate students belonging to social science faculty is 21.66 with s.d. 8.74. The calculated t- value for the stream of study (3.399, P<0.01), which is significant at specified level reveals that there is significant difference between post- graduate students of science and social science faculty in the level of statistical competency. The post-graduate students of Science faculty have significantly better competency in statistics in comparison to their counterparts of Social Science faculty. The bar graph given below (Fig. 1) also clarifies the difference between the post-graduate students belonging to science and social science faculty.

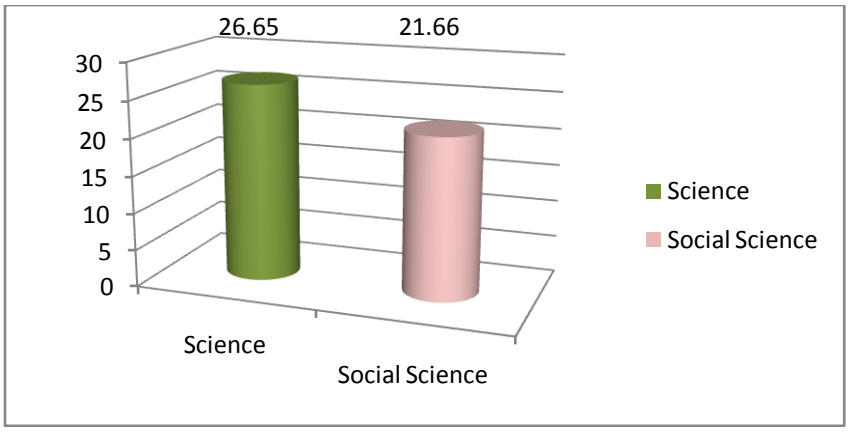


**Figure No.2: Graphical representation of mean difference between science and social science students in statistical competency**

**OBJECTIVE No. 3**

***To know the difference in the level of statistical competency among post -graduate students according to their gender***

**TABLE No. 3: Statistical competency among post- graduate students according to gender**

| Group | N | Mean | s.d. | df | t | Sig. |
|---|---|---|---|---|---|---|
| Male | 93 | 25.28 | 10.12 | 183 | 2.10 | 0.58 |
| Female | 92 | 22.17 | 9.94 | | | |

The perusal of table (No. 3) reveals that the descriptive statistics of statistical competency of male and female post-graduate students. Mean score of male students is 25.28 with s.d. 10.12 and mean scores of females is 22.17 with s.d. 9.94. The obtained t-value for the gender (2.105, P>0.05) is not significant at the specified level, which means that there is no significant difference in the level of statistical competency among male and female students. The graph (No.2) also depicts the level of statistical competency among male and female students.

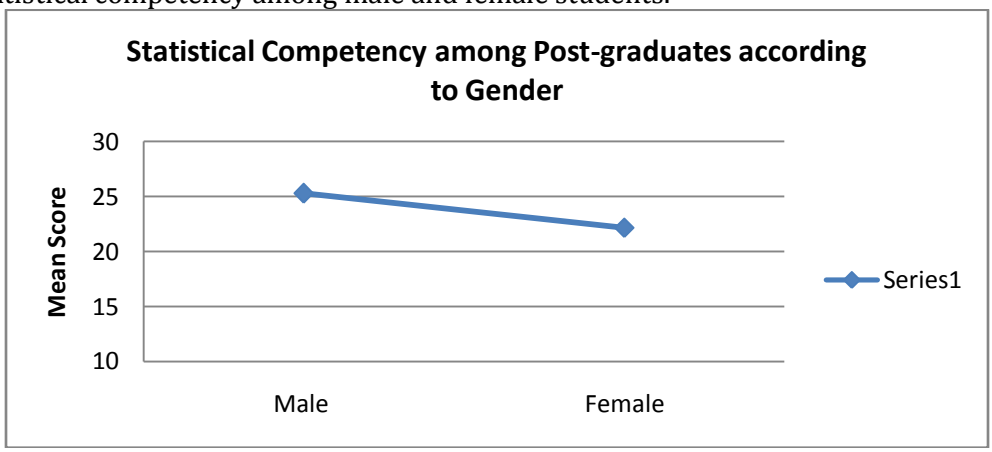


**Figure No.3: Graphical representation of mean difference between male and female post-graduate students in statistical competency**

**OBJECTIVE No. 4**

***To know the difference in the level of statistical competency among post- graduate students according to the place of living***

**Table no. 4: Statistical competency among post-graduate students according to the place of living**

| Living Place | N | Mean | s.d. | df | t | Sig. |
|---|---|---|---|---|---|---|
| Rural | 83 | 25.08 | 9.30 | 183 | 1.64 | 0.23 |
| Urban | 102 | 22.64 | 10.66 | | | |

It is clear from the above given table (No. 4) that the mean score of rural students on statistical competency is 25.08 with s.d. 9.30, similarly the mean scores of urban student is 22.64 with s.d. 10.66. The obtained t-value for the place of living (1.64, P>0.05) is not significant at specified level, which implies that no significant difference exists between rural and urban students in the level statistical competency.

The bar graph also shows the level of statistical competency among post-graduate students according to place of living.

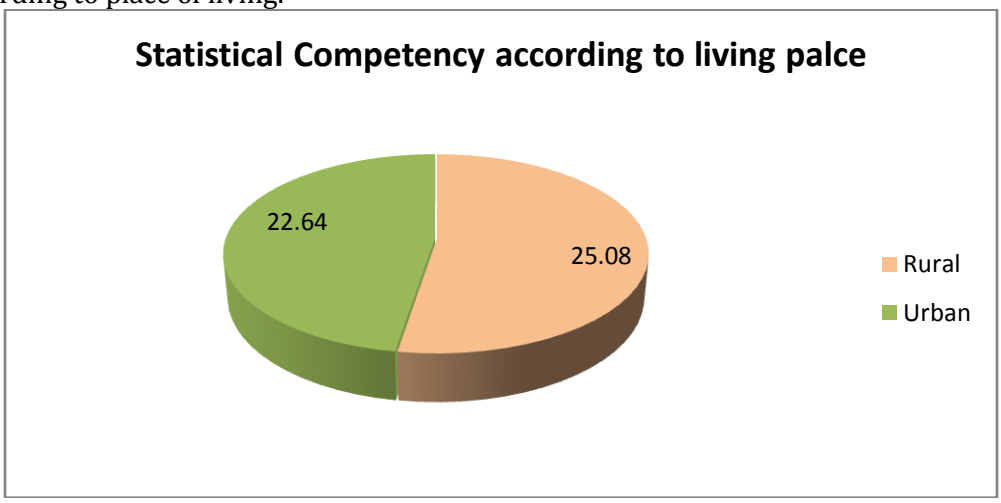


**Figure No.4: Graphical representation of mean difference between rural and urban post-graduate students in statistical competenc**

**OBJECTIVE No. 5**

***To know the weakest aspect of statistical competency among post graduate students***

**Table No. 5: Descriptive statistics related to the weakest aspect of statistical competency among post-graduate students**

| Dimension | N | Mean | s.d. | Percentage of achievement | % of error |
|---|---|---|---|---|---|
| Understanding of basic statistical concepts | 185 | 6.76 | 3.15 | 52% | 48% |
| Interpretation of descriptive statistic | 185 | 5.51 | 2.18 | 50% | 50% |
| Measuring and interpreting the coefficient of correlation | 185 | 3.65 | 2.41 | 36.50% | 63.50% |
| Use of various parametric methods | 185 | 2.23 | 1.44 | 31.85% | 68.15% |
| Use of various non-parametric methods | 185 | 1.09 | 1.19 | 21.80% | 78.20% |
| Explaining the results given by the statistical programs as SPSS etc | 185 | 2.17 | 1.71 | 27.12% | 72.88% |
| Selecting the appropriate statistical method in accordance with the problem | 185 | 2.26 | 1.68 | 37.75% | 62.25% |

The above table (No. 5) reveals the details of achievement according to dimensions. The dimension one 'understanding of basic statistical concepts' includes13 items based on basic knowledge of descriptive and inferential statistics etc. on this dimension, an average student is able to secure 6.76 marks out of 13 with standard deviation 3.152. It means an average student has only 52% understanding of basic statistical concepts while he lacks 48% on the criterion.

The second dimension 'interpretation of descriptive statistics' includes 11 items related to the calculation and interpretation of descriptive statistical methods i.e. mean, median, mode, quartile deviation standard deviation etc. An average student is able to secure 5.51 marks out of 11 with s.d. 2.182. It implies that an average student possesses only 50% knowledge about interpretation of descriptive statistics while there is 50% chance to fall in error on the criterion.

The third dimension 'understanding of coefficient of correlation' includes 10 items, which are related to the knowledge of selecting appropriate correlation method according to the problems etc. An average student is able to secure 3.65 marks out of 10 with s.d. 2.41. It indicates only 36.50% awareness about selecting appropriate correlation methods is available in an average post-graduate student while there are 48% chances of committing error on the criterion.

The fourth dimension 'various parametric measures' includes 7 items related to the basic understanding of parametric statistics and their uses etc. An average student is able to secure 2.23 marks out of 7 with s.d. 1.44. It means an average learner has only 31.85% understanding of parametric statistical concepts while there are 68.15% chances to fall in error on the criterion.

The next 'fifth' dimension 'use of various non-parametric measures' includes 5 items to check the knowledge about the use of non-parametric statistics i.e. Chi-square Mann- Whitney, Wilcoxon etc. An average student is able to secure 1.09 marks out of 5 with s.d. 1.19. It depicts that an average student has only 21.80% acquaintance with non-parametric concepts while he has 78.20% ignorance about these methods or concepts.

The 'sixth' dimension includes 8 items related with the ability to explain results by the statistical programs as SPSS etc. An average student is able to secure 2.17 marks out of 8 with s.d. 1.71, which implies that 27.12% an average post-graduate student is able to explain the results obtained through SPSS etc., while 72.88% he is unable to explain the results.

The seventh dimension 'selecting the appropriate statistical method in accordance with the problem' includes 6 items. An average student is able to secure 2.28 marks out of 6 with s.d. 1.68. It means only 37.75% understanding of selecting the appropriate statistical method is possessed by an average post-graduate student and on remaining 62.25% he is ignorant.

On the basis of above description, it can be concluded that 'use of various non-parametric methods' is the weakest aspect among all the aspects of statistical competency. Post-graduate students have poor understanding about the uses of non-parametric methods and often they commit mistakes regarding their appropriate use.

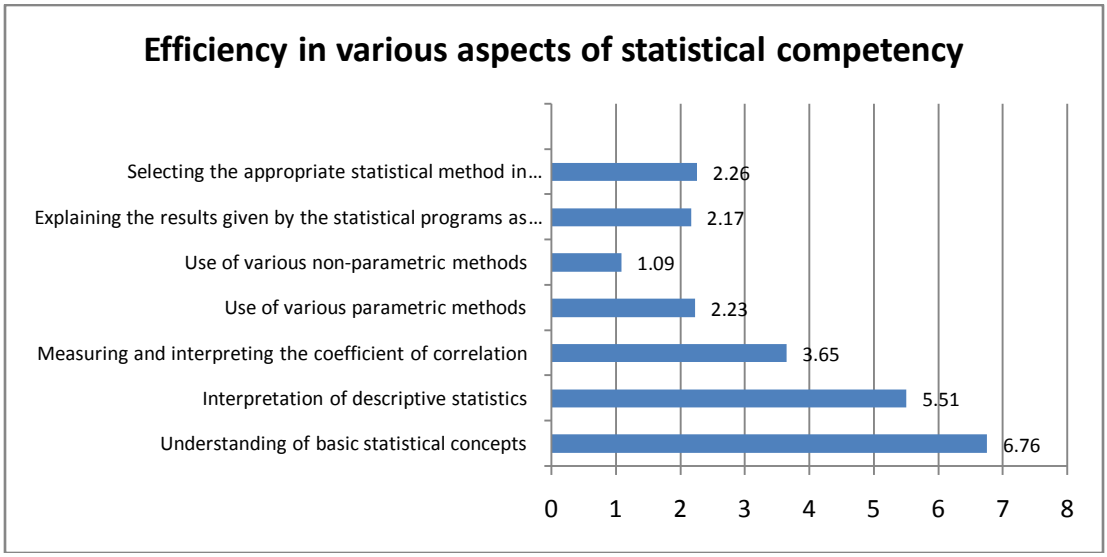


**Figure 5: Graphical presentation of the weakest aspect of statistical competency among post-graduate students**

## Conclusion

Briefly, the study leads to certain conclusions, which are as following:

1. The level of statistical competency among post graduate students has been found below average.
2. The students of science faculty have performed better than the students of social science faculty.
3. There is no significant difference in the level of statistical competency of male and female post-graduate students.
4. There is no significant difference in the level of statistical competency of post-graduate students living at urban and rural areas.
5. The post-graduate students have basic knowledge of statistical concepts but are very weak in 'using of non-parametric statistics'.

## Discussion

The importance of statistics in the social science research is increasing day by day. The understanding of various statistical methods, skill to use them appropriately, ability to explain and interpret the statistical tables and graphs, and to draw out the inferences is considered the important skill in statistics. The use of statistics has a unique role to play in the modern scientific researches, which ended with certain conclusions about the phenomenon or problem (Qasem, 2015; Gupta, et al., 2015). Therefore, to achieve efficiency in statistical methods is very necessary in behavioural sciences and more specifically in Education and Psychology. The present study reveals that the level of post-graduate students in statistical competency is below than average and the students are very weak in using non-parametric statistics. Thus, the present study points out that strict step should be taken to improve the educational level of students. Workshops and seminars should be organized in the faculties for students and faculty members also. The prescribed syllabus should be revised and upgraded to develop the knowledge and expertise in the use of statistical methods.

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