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RESEARCH ARTICLE

EVALUATION OF STATISTICAL METHODS USED IN PH.D. THESES OF SOCIAL SCIENCES IN INDIAN UNIVERSITIES

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ABSTRACT

The study was aimed at finding out the suitability of statistical methods used in the analysis of the data in Ph.D. theses of social science faculty in Indian Universities. It was also the purpose of the study to find out the types of common errors committed by the researchers while using statistical methods to analyze the data in Ph.D. theses. For the purpose, a standardized tool developed by the researchers was used by the investigators to evaluate the statistical methods used in theses of social science faculty. The sample consisted of 20 Ph.D. theses of social science faculty of Indian Universities including 120 statistical methods. In the sample, 10 theses from Department of Education and 10 theses from Psychology Department in faculty of Social Sciences of AMU were randomly selected. The analysis of the study revealed that: (1)79% of the studies have employed appropriate method according to sample size and number of variables and 77% of the theses have employed appropriate method according to research design. However, only 47% of the researchers fulfilled the assumptions of the method used by them. (2) The common errors committed by the researchers while using statistical methods are of serious nature. None of the researchers calculated effect size in his/her thesis. 87% of the evaluated theses did not select the sample in appropriate manner and 36% of the researchers of social sciences used insufficient statistical methods in their theses.

INTRODUCTION

The term 'Research' in general usage refers to a search for knowledge. Hansen (2009) defined it as creative work undertaken on a systematic basis in order to increase the knowledge, including knowledge of man, culture and society and the use of this knowledge to devise new applications. It is also defined as the creation of new knowledge or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings.

Research is not confined to science and technology only. There are vast areas of research in other disciplines such as Humanities, Arts and Social Sciences. Educational research is the systematic application of scientific method for solving the educational problems. It uses both conceptions of social reality and the statistical methods that are considered appropriate for exploring it. The statistical methods are technically very essential in the realm of the research. They help in analyzing the data and to draw out the conclusions more clearly, precisely and more accurately (Rajasekar & *et al*, 2013). Thus statistics is the rule of scientific research and without the rules and procedures for collecting data it would be difficult to draw valid and reliable conclusions. Statistics is the science and practice of developing human knowledge through the use of empirical data expressed in quantitative form. This discipline is based on sound theories and is a branch of applied mathematics. Within statistical theory, randomness and uncertainty are modeled by probability theory. In other words, a researcher can make suitable decisions on research in terms of accepting or rejecting the proposed hypotheses using statistical tools. For that matter, being able to use statistics in research, the required processes and skills for each kind of research is necessary for every researcher so that correct conclusions may be drawn.

Statement of the problem

Briefly, the present study seeks to *"Evaluate Statistical Methods used in Ph.D. Theses of Social Sciences in Indian Universities"* so that quality of the theses carried out in the universities in the area of social sciences may be assessed.

In other words, the present study tries to find out the answer of following questions:

1. What are the statistical methods used generally in the analysis of the data in Ph.D. theses of social sciences in Indian Universities?
2. Do the researchers use the suitable statistical methods in the analysis of the data in Ph.D. theses of social sciences in Indian Universities?

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3. Is there any difference in the quality level of used statistical methods in the analysis of the data in Ph.D. theses according to subject of study (psychology/ education)?
4. What are the types of common errors committed by the researchers while using statistical methods to analyze the data in Ph.D. theses?

Research Objectives

To find out the answers of the above mentioned questions, the researchers framed the following objectives:

1. To find out the appropriateness of statistical methods used in analysis of the data in Ph.D. theses of social sciences in Indian Universities.
2. To find out the difference in the quality level of used statistical methods in analysis of the data in Ph.D. theses according to the subject of study (psychology/ education).
3. To find out the types of common errors committed by the researchers while using statistical methods to analyze the data in Ph.D. theses.

METHODOLOGY OF THE RESEARCH

The following paragraphs describe research methodology of the present study. A number of definitions are there to define statistics. In fact, every author of a book in statistics start with his/her own definition. The most acceptable definition of statistics regards "statistics as a main tool integrated and accompanied in research in the fields of the humanities and other ones in any life matters". (Abu- Hashem, 2004).

However, in the present study, the term 'statistical methods' refers to the methods used by researchers to analyze the data in Ph.D. theses in social science faculty in Indian Universities, including both parametric and non parametric statistics.

The research sample consisted of 20 Ph.D. theses of social sciences in Indian Universities, 10 theses from Department of Education and 10 theses from Psychology, Department in Faculty of Social Sciences of AMU. All the 20 theses used 120 statistical methods. The theses have been submitted between 2000 and 2014. The sample has been selected according to simple random sampling procedure from the available theses in Maulana Azad library at AMU.

To achieve the objective of the research i.e. the evaluation of statistical methods of social sciences in Indian Universities, the researchers used standardized tool prepared by Qasem (2015). The tool consists of information schedule and 13 standards to evaluate the statistical methods. The validity coefficient of the tool was .613. The tool was reliable according to Kappa coefficient and Kooper coefficient. The value of Kappa coefficient was .85 at level of significance (0.01) and value of Kooper coefficient was 0.68 at the level of significance (0.01).
The present research is confined only to 20 theses submitted in the Department of Education and Psychology. The study has taken into consideration only quantitative measures and no heed has been paid to qualitative parameters of the studies.

Analysis and Interpretation

The following paragraphs present the analysis of the data and subsequent interpretation according to the objectives. Since the data is on ordinal scale, only frequency and percentage have been calculated. The table (1) given below presents the distribution of the studies on the basis of the size of sample. The descriptive statistics (frequencies and percentages) were used to know the statistical methods used in the analysis of the data in Ph.D. theses of social sciences in Indian Universities.

Table 1 The descriptive statistics for Ph.D. theses according to sample size

	Sample size		
Size of sample	Frequency	Percent	Cumulative Percent
200 to 500	15	75.0	75.0
more than 500	5	25.0	100.0
Total	20	100.0	

The above given table (1) shows that out of the total studies evaluated in the present investigation, 75% studies have collected data on the sample between 200-300 and only 25% of the studies have calculated data on the sample more than 500.
Since there is no prescribed rule for the sample size of the study, generally researchers use convenient sample ranging from 200 to 300. However, the studies based on large sample data (more than 500) may be considered as having 'appropriate sample size'. There is an urgent need of prescribing sample limit for the award of degree at doctoral level. However, consideration may be given to the type of the population. But in any case, there should be minimum prescribed limit as there are the cases, where researchers have submitted theses on the sample below 250. The table (2) given below classifies the studies on the basis of research design used in the studies.

Table 2 The descriptive statistics for Ph.D. theses according to research method

	Research method		
	Frequency	Percent	Cumulative Percent
Quasi experimental	2	10.0	10.0
Descriptive	18	90.0	100.0
Total	20	100.0	

The above given table (2) reveals that only 10% of the theses have employed quasi-experimental design and 90% studies have employed descriptive method. The reason is very obvious; it is easy to employ descriptive method in comparison to quasi-experimental and other methods and it is also easy to calculate descriptive statistical measures through computer. This also indicates that the researchers enrolled in Ph.D. courses of social sciences prefer descriptive method more than quasi-experimental method because descriptive method is Comparatively easier and doesn't require more time and specifications.

The table (3) given below presents the details of the statistical techniques used in the studies.

Table 3 Descriptive statistics for Ph.D. theses according to the type of statistical method

	Type of statistics		
	Frequency	Percent	Cumulative Percent
Parametric	18	90.0	90.0
Non-parametric	2	10.0	100.0
Total	20	100.0	

It is evident from the above given table (3) that in only 10% of the theses, non-parametric measures have been used and 90% of the theses have employed parametric statistics. It is comparatively easy to handle large data through parametric statistics and draw inferences for the population. The figure (1) given below clearly depicts the picture of type of statistics used in the studies by the researchers.

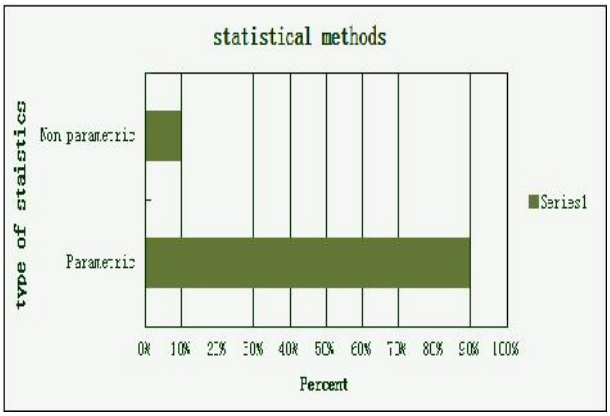

Figure No.1 Types of statistical methods used in Studies

The table (4) given below presents the frequencies of the different statistical measures used in the theses.

Table 4 Descriptive statistics for Ph.D. theses according to statistical measures used in the theses

Statistical methods			
	Frequency	Percent	Cumulative Percent
t test for one sample	1	0.8	0.8
Two independent samples t test	52	43.3	44.2
Two dependent samples t test	2	1.7	45.8
ANOVA	11	9.2	55.0
ANCOVA	3	2.5	57.5
Regression	21	17.5	75.0
Kolomogorov- Smirnov	2	1.7	76.7
Mann- Whitney	3	2.5	79.2
Pearson coefficient	25	20.8	100.0
Total	120	100.0	

The above table (4) shows that certain measures like‘t’ test for one sample, ‘t’ test for dependent samples, ANOVA, Mann-Whitney and Kolomogorov-Smirnov tests have rarely been used by the researchers. Most of the researchers have employed‘t’ test for independent samples. Even coefficient of correlation has also been used reasonably by the researchers.

The following paragraphs present the analysis of the data in accordance with the objectives formulated earlier.

Objective No. 1: To find out the appropriateness of statistical methods used in analysis of the data in Ph.D. theses of social sciences in Indian Universities. The inferential statistics t-test for one-sample, (sample mean and assumed mean) and descriptive statistics (frequencies and percentages) have been used to know to what extent the researchers used the suitable statistical methods in analysis of the data in Ph.D. theses of social sciences in Indian Universities.

Here, assumed mean = degree of middle response score × total number of items (2×12=24).

The above given table (5) reveals that the statistical measures used in the studies are appropriate i.e. the measures have been employed according to the nature of the data.

The t-value (3.49) is significant at 0.01 level, which confirms that statistical methods were used in an appropriate manner by the researchers in Ph.D. theses of Social Sciences in Indian Universities.

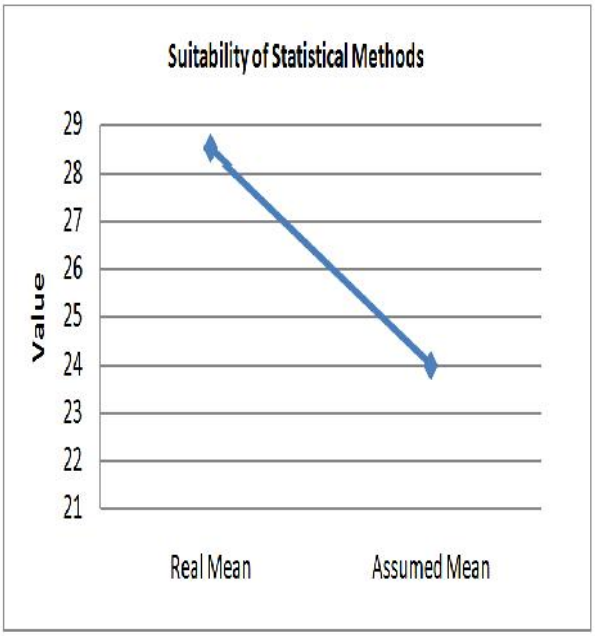

Figure 2 Mean Scores of Used suitable Statistical Methods in Ph.D. Theses of Social Sciences

Table No. 6 Descriptive statistics for Ph.D. theses according to various parameters of statistics

N	Standards	The proportion of suitable using
1	The method is appropriate for the sample size.	79%
2	The method is appropriate for the number of variables	79%
3	The method is appropriate for research design.	77%
4	The method is appropriate for the level of scale used for measurement.	78%
5	The method is appropriate for the objectives.	77%
6	The method is appropriate for the type of tool of research.	76%
7	The researcher presents the results in appropriate style.	46%
8	The tool of research was valid.	62%
9	The tool of research was reliable.	63%
10	The method is sufficient.	64%
11	The researcher calculated an effect size.	0%
12	The researcher fulfilled the assumptions of the method that was used by him.	47%
13	The researcher selected the sample in suitable style.	13%

Table 5 Result of t-test for one sample

Using of statistics	N	Real Mean	Test Value (assumed mean)	s.d.	df	t	Level of Sig.
	120	28.53	24	7.95	119	3.49	0.001

To know the proportion of suitable use of statistics in the theses, the percentage was used. The results have been given in the above given table;

The table (6) given above presents the analysis of studies on a variety of parameters. The table reveals that only 79% of the studies have employed appropriate method according to the sample size. In the same way 79% of the studies have used appropriate statistical measures according to the numbers of variables. 77% of the theses have employed appropriate method according to the research design. However, 78% of the studies have employed appropriate statistical measures in accordance with the level of scale used in the study.

77% of the studies have employed suitable method according to the requirement of the tool. Very surprising results have been revealed by 7th parameter i.e. presentation of the results in appropriate style. Only 46% of the researchers have presented and interpreted the results in an appropriate manner.

The table also reveals that only 62% studies have used valid tools and 63% have used reliable tools. Only 64% of the theses have used measures, which are appropriate according to the nature of data. Only 47% of the researchers have tried to fulfil the underlying assumptions of methods. Only 13% of the researchers selected the sample in the appropriate manner. The present researchers could not find even a single thesis, which has calculated effect size.

Objective No 2: To find out the difference in the quality level of used statistical methods in analysis of the data in Ph.D. theses according to the subject of study (psychology/education).

The inferential statistics t-test for two independent samples was used to know the difference in the quality level of used statistical methods in analysis of the data in Ph.D. theses according to the subject of study (psychology/education).

The table no. 7 reveals that the t-value (3.99) is significant at (0.01) level, which confirms that there is significant difference in the quality level of used statistical methods in the analysis of the data in Ph.D. theses according to the subject of study (psychology/ education). The results reveal that the theses in education department fulfill more qualitative parameters than the theses in Psychology Department. The figure (3) given above clearly depicts the picture of mean scores of used suitable statistical methods in education and psychology department.

Objective No. 3: To find out the types of common errors committed by the researchers while using statistical methods to analysis the data in Ph.D. theses.

The following table describes the proportion of most common errors committed by the researchers in hierarchical manner.

Table 8 Types of common errors committed by the researchers

N	Standards	The proportion of the error
1	The method is appropriate for the sample size.	21%
2	The method is appropriate for the number of variables	21%
3	The method is appropriate for research design.	23%
4	The method is appropriate for the level of scale used for measurement.	22%
5	The method is appropriate for the objectives.	23%
6	The method is appropriate for type of tool of research.	24%
7	The researcher presents the results in appropriate style.	54%
8	The tool of research was valid.	38%
9	The tool of research was reliable.	37%
10	The method is sufficient.	36%
11	The researcher calculated an effect size.	100%
12	The researcher fulfilled the assumptions of the method that was used by him.	53%
13	The researcher selected the sample in suitable style.	87%

Table 7 Result of t-test for two independent samples

	Group	N (Used Statistical Methods)	Mean	s.d.	df	t	Level of Sig.
Using of statistics	Education	60	31.27	6.43	118	3.99	0.001
	Psychology	60	25.8	8.43			

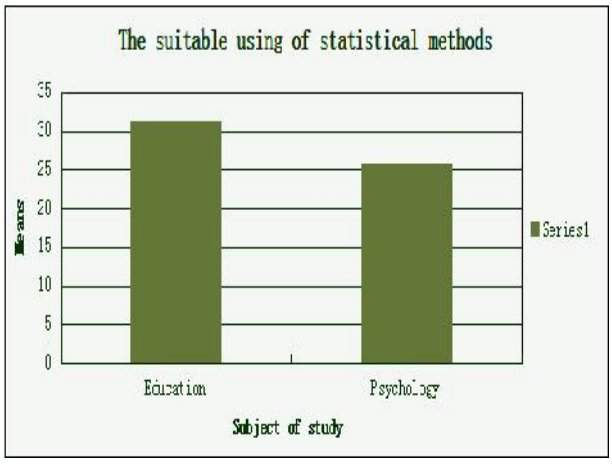

Figure No. 3 Mean Scores of Used Suitable Statistical Methods in Education and Psychology Department

The present investigators could not find even a single thesis consisting of effect size value. It seems that researchers are not aware with the advanced statistical methods. Out of the total evaluated theses, 87% theses didn't select sample in appropriate manner. It seems that researchers are very fond of using the term 'random sampling'. However, only a few of them actually followed the procedure, which they mentioned. Many researchers did not follow any rigorous method, rather collected the data from the conveniently available population. This aspect of researches has been found severely weak.

54% of evaluated theses did not present the results in appropriate manner. In this category, the researchers committed mistakes like not presenting the data on normal probability curve, histogram, pie diagram or other graphical manner. Here, mistakes have been found like not mentioning specific level of significance, degree of freedom etc. Only a few presented graphical representation of regression line.

The analysis of the above table reveals that 53% of researchers did not fulfill the assumptions of using various statistical methods and none of the researchers satisfied the assumption of normality and homogeneity of the data.

The analysis pointed out that out of the total evaluated theses, 38% of the theses did not employ valid tool of measurement. Even 37% studies did not employ the tools with established reliability measures. The present investigators found that some of the tools used by researchers were of very low standard, prepared long ago and also in very crude manner, consisting of frequent spelling mistakes and grammatical errors.

The present investigation also revealed that 36% of total evaluated theses did not employ sufficient statistical measures i.e. the researchers had left the analysis in half cooked manner, e.g. none of the researchers applied further statistical measures after getting significant 'F' value.

During the analysis, the present investigators found very surprising mistakes. 24% of the theses had not employed the appropriate tool according to the requirement of the variable, i.e. the tool employed was meant for something else and the researcher employed it to measure something else.

The investigators found that 23% of the theses did not formulate the objectives in appropriate manner. In some cases the language of the objectives was ambiguous, while in other cases objectives were insufficient.

The analysis revealed that 23% of the evaluated theses did not choose the appropriate statistical measure to suit the research design. Similarly 22% of the theses did not use the appropriate measure according to the level of scale.

However, 21% of the theses were found to have errors like employing inappropriate method according to sample size and numbers of variables.

CONCLUSION

Briefly, the present investigation leads to the following conclusions:

1. There are 90% of Ph.D. theses of social sciences in which, parametric statistics are used and in 10% theses non parametric statistics are used. The independent samples 't' test and Pearson correlation coefficient are mostly used in Ph.D. theses of social sciences.
2. There is difference in the quality level of used statistical methods in analysis of the data in Ph.D. theses according to the subject of study (psychology / education) and the theses in education department are better in quality than the theses of Psychology department.
3. The common errors committed by the researchers while using statistical methods to analyze the data in Ph.D. theses are:

(i) there is no researcher in Ph.D. of social sciences who has calculated effect size in his/her thesis. (ii) In 87% of evaluated theses of social science the researchers didn't select the sample in an appropriate style. (iii) 53% of researchers in Ph.D. didn't fulfill the assumptions of the method that was used by them. (iv) 54% researchers of social sciences didn't present the results in an appropriate style and (v) 36% researchers used insufficient statistical methods in their theses.

DISCUSSION

Overall the mistakes found in the evaluated theses are of serious nature, which can't be overlooked in any case. Production of such type of theses brings down the standards of quality. This small scale evaluation of the theses has proved the fact that why our universities are not ranked in top 200 universities of the world. If this is the condition of research of a central university, one can assume the status of state universities. In central universities, stern steps are taken to select the students through written and oral entrance procedure. Research activity is a full time course and the government provides stipend to research scholars to carry out the research work in the most ethical and justifiable manner.

The present analysis reveals a serious and pathetic situation of the status of research in the country. Attempts need be taken to improve the quality of researches in every possible manner. UGC has already shown concern towards the issue. RUSA has already come into existence. Since researches in the area of education and psychology have an additional responsibility of improving the teaching-learning process and improving the society, therefore, the responsibility of researchers working in social science area is all the more.

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