# Likert Data: What to Use, Parametric or Non-Parametric?

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## Abstract

*The objective of the study was to determine whether the type of statistical tests conducted on Likert scale data affect the conclusions. Pearson, Spearman rho and Kendall tau_b analyses conducted on actual scale data revealed that there was a positive relationship between all the permuted pairs of the variables at the p<.05 level. However the relationship between the variables indicated a weak relationship for all of the tests except for the relationship between the constructs academic self-regulation and learning styles for which the Pearson and Spearman rho lead to the conclusion ofa moderate relationship. The coefficient of determination calculated to ascertain the amount of variability between the permuted pairs of the variables revealed similar variability forall of the variables except for the variables academic self-regulation and learning styles where yet again the conclusions for the Pearson and Spearman rho were similar and that forKendall tau_b different.*

**Keywords:** Likert scale data, Pearson, Spearman, Kendall tau_b, correlation, parametric, non-parametric

## *1. Introduction*

Education practitioners, business organisations, and those new to the field of research, students for example, are often faced with the decision as to what analysis to conduct on the Likert scale data collected from surveys. There is often a level of indecision, especially on the part of those new to research, whether to use parametric or non-parametric tests especially in the light of the discordant views outlined in the literature regarding the use of these analyses for Likert scale data.Vigderhous (1977) opine that the assumptions regarding the measurement level of the data and the corresponding analysis to be used affect the conclusions.

Norman (2010) suggests that Likert data can be analysed using parametric tests without "fear of coming to the wrong conclusion "as contended byJamieson (2004). The question is therefore asked: Do the type of analyses conducted on Likert scale data affect the conclusions drawn from the results? To provide an answer to this question the following hypotheses are posed.

### 1.2 Hypotheses

$H_{o:}$ The type of analyses conducted on Likert scale data does not affect the conclusions drawn from the results.
$H_{a:}$ The type of analyses conducted on Likert scale data affects the conclusions drawn from the results.

### 1.3 Objective

The objective of the study is to determine whether the type of analyses conducted on Likert scale data affect the conclusion drawn from the results obtained.

### 1.4 Associated significance of study

It is hoped that the determination of the effect of conducting parametric or non-parametric tests on Likert scale data will enable researchers, especially those new to the field of research, students for example, to select a particular test with some degree of confidence.

It is also envisioned that the since the study uses actual scale data in the investigation that the findings will provide empirical evidence as to the type of tests to conduct on Likert scale data thus contributing to the body of knowledge existing in the field.

### 1.5 Limitations

The researcher tested the hypotheses posed by the study through conducting Pearson, Spearman and Kendall tau_b Correlation analyses on the summed scores of the Likert scale data which measured specific constructs and not on the individual items which comprised the constructs hence any interpretation on the applicability of using parametric or non-parametric tests on Likert scale data is in relation to correlation analyses conducted on summated scales.

## *2. Literature Review*

Since the development of the Likert scale, named after the inventor, Rensis Likert, many researchers have developed instruments to measure particular attributes or traits of individuals or groups. The instruments usually require respondents to give their level of agreement or disagreement, which can range from 1 to 5, to the statements/questions/items relating to the attribute/trait being measured. Prior to statistically analysing the data, the ratings are sometimes summed to derive an overall score for the attribute/trait measured or used as reported. The controversy begins with the type of analysis to use – parametric or non-parametric?Carifio and Perla, Resolving the 50-year debate around using and misusing Likert scales (2008) believe the issue of whether a parametric test or non-parametric one is suited to the analysis of Likert scale data stems from the views of authors regarding the measurement level of the data itself: ordinal or interval. Gardner and Martin(2007) and Jamieson (2004) contend that Likert data is of an ordinal or rank order nature and hence only non-parametric tests will yield valid results. However, Norman (2010)using real scale data found that parametric tests such as Pearson correlation and regression analysis can be used with Likert data without fear of "coming to the wrong conclusion" as Jamieson (2004) puts it. However, Vigderhous(1977) found that the interchangeable use of parmetric and non parmetric tests on ordinal data results in different conclusions. Creswell(2008)suggeststhat for Likert data to be treated as interval data there is need to develop multiple categories within a scale, establish equality of variance between each value on the scale and normality of the data.

Carifio and Perla(2007) believe that the lack of understanding of the difference between Likert scales and Likert response formats is the root of the confusion. Added to this is the practice of researchers to analyse the responses to Likert scale questions item by item rather than asa collection of items measuring a particular attribute. Carifio and Perla, Resolving the 50-year debate around using and misusing Likert scales (2008)argue that those who hold the "ordinalist" view of Likert scales do not consider the abundance of empirical research that have supported the interval view and opined that it is perfectly all right to use the summed scales to conduct parametric tests. Pell (2005) agrees that parametric tests can be conducted on the summed scores of Likert scale data provided that the assumptions are clearly stated and the data is of the appropriate size and shape.

Clearly, the divisive views regarding the measurement level of Likert data and the type of statistical analysis to conduct in addition to the practice of researchers to analyse the data item by item or as a summed scale may produce doubt in researchers, particularly those new to the field of research, such as students, as to the appropriate statistical test to conduct hence the thrust of the present study.

## *3. Methodology*

The objective of the study is to determine whether the type of statistical tests conducted on Likert scale data affects the conclusion drawn from the results obtained.

### 3.1 Sample

The data used in the analysis comprised scale data from a prior study for 111 students at a university campus which measured the variables (constructs), mathematics self-efficacy, academic self-regulation, availability of academic resources and learning styles which had required students to select from a range of responses using three different Likert 5 point scales ranging from 5 = strongly agree to 1 = strongly disagree; 5 = every time to 1 = never and 5 = very true of me to 1 = not at all. The summed scores of the responses relating to the individual constructs used in the analyses are displayed in Table 1.

### 1.6 Research design

The researcher made use of Pearson, Spearman and Kendall tau_b correlations to test the hypotheses posed by the study.The Pearson coefficient measures the strength of the linear relationship between two variables, Spearman rho establishes whether two variables are independent (Rumsey, 2009) and Kendall tau_b like Pearson measures the strength of the relationship between two variables (Crichton, 2001). The strength of relationships between two variables range from +1 to -1. The positive sign indicates that increases in one variable leads to increases in the other and a negative sign indicates that as one variable reduces the other increases.

To interpret the strength of the correlation researchers use the rule of thumbs that correlations close to or beyond +0.70 or - 0.70 indicate a strong relationship; correlations closer to +0.5 and -0.5 show a moderate relationship(Rumsey, 2009); and by inference correlations less than +0.5 and -0.5 a weak relationship. However, the statistics derived from these tests do not tell about the amount of variability between two variables only the strength. To ascertain the amount of variability between two variables the coefficient of determination ($r^2$) is computed. The rule of thumb applied here is: where one variable (x) explains a lot of the variability in another variable (y) $r^2$falls between .80 to .90 or = .70; where one variable (x) helps to explain somewhat the variability in (y) $r^2$fallsbetween .30 to .70 and where one variable ( $x$ ) does not help to explain much of the variability in (y)$r^2$falls between 0 to .30(Rumsey, 2009, p. 76).

### 1.7 Procedure

Pearson, Spearman and Kendall tau_b correlations were used to ascertain the relationship among the summed scores for the variables academic resources, mathematics self-efficacy, academic-self-regulation and learning styles. The results were then interpreted to test the hypotheses:

$H_{o:}$ The type of analyses conducted on Likert scale data do not affect the conclusions drawn from the results.

$H_{a:}$ The type of analyses conducted on Likert data affects the conclusions drawn from the results.

Significant path coefficients were set at the .05 level.

The variables derived from the analyses were subsequently squared to derive a value for the coefficient of determination commonly used only with the Pearson correlation. An interpretation was again made to test the hypothesis that the type of analyses conducted on Likert scale data do not affect the conclusions drawn from the results. The Statistical Package for the Social Sciences version 21 aided the analyses.

## 2. Results and Discussion

### Does the type of analysis conducted on Likert scale data affect the conclusions that are made from the results?

The results in Table 2, indicate that in each of the analyses, Pearson, Spearman, Kendal tau_b all of the variables were positively correlated to each other at the $P < .05$ level. The conclusion a researcher would come to, if the aim of their study was to investigate whether a relationship existed between pairs of the variables, is that a positive significant relationship exists between every permuted pair of the variables academic resources, mathematics self-efficacy, academic self-regulation and learning styles.

Hence the null hypothesis is accepted that the type of analyses conducted on Likert scale data do not affect the conclusions drawn from the results. Further, since the correlation coefficients were < .50 the inference is made that a weak relationship exist between each permuted pair of the variables for all the tests conducted except those between the variables academic self–regulation and learning styles which were moderate for the Pearson and Spearman correlation, .604, and .550 respectively. The null hypothesis is yet again accepted that the type of statistical analyses conducted on Likert scale data do not affect the conclusion drawn from the results since the Pearson correlation (parametric statistic) and Spearman (non-parametric statistic) yielded similar interpretations.

The findings are consistent with those of Norman (2010) that parametric tests can be conducted on Likert scale data without coming to the wrong conclusion but inconsistent with the claims of Jamieson (2004) and (Gardner & Martin, 2007).

The statistic .403 for Kendall tau b revealed that a weak but significant relationship exist between academic resources and learning styles. The finding differs from that of the Pearson and Spearman's tests as discussed above and one may argue that in this instance that the null hypothesis should be rejected in favour of the alternate hypothesis that the type of analyses conducted on Likert scale data affect the conclusion drawn from the result.

On the face of it this conclusion may be accurate and appears consistent with the claims of Jamieson's (2004) and others that when parametric tests are conducted on Likert scale data researchers run the risk of coming to the wrong conclusion. However, when interpreting the results one need to consider that Kendall tau_b takes considers ties in its calculations and hence this may have accounted for the dissimilarity of the findings from that of the Pearson and Spearman tests. Notwithstanding this both the Pearson (parametric) and Spearman (non-parametric) tests enabled similar conclusions to be drawn from the results.

**Table 2: Comparative analysis, Pearson Correlation, Spearman rho, Kendall tau_b correlation**

| Correlations | | | | | |
|---|---|---|---|---|---|
| **Constructs** | **Statistical Tests** | **Academic Resources** | **Mathematics Self-Efficacy** | **Academic Self-Regulation** | **Learning Styles** |
| **Academic Resources** | Pearson Correlation | **1** | | | |
| | Spearman | **1** | | | |
| | Kendall tau_b | **1** | | | |
| **Mathematics Self-Efficacy** | Pearson Correlation | **.277**** | **1** | | |
| | Spearman | **.266**** | **1** | | |
| | Kendall tau_b correlation | **.181**** | **1** | | |
| **Academic Self-Regulation** | Pearson Correlation | **.264**** | **.284**** | **1** | |
| | Spearman | **.292**** | **.265**** | **1** | |
| | Kendall tau_b correlation | **.212**** | **.182**** | **1** | |
| **Learning Styles** | Pearson Correlation | **.360**** | **.389**** | **.604**** | **1** |
| | Spearman | **.372**** | **.404**** | **.550**** | **1** |
| | Kendall tau_b correlation | **.270**** | **.298**** | **.403**** | **1** |
| **. Correlation is significant at the 0.01 level (2-tailed). | | | | | |

Further examination of the coefficients of determination in Table 3 calculated on the correlations coefficients in Table 2 reveal that in all of the cases the variables do not help much in explaining the amount of variability when paired with each other $r^2$<.30 except for the relationship between the variables academic-self regulation and learning styles where the Pearson and Spearman coefficients of determination were > .30 indicating that the variables aided somewhat in explaining the variability between themselves.

The null hypothesis is yet again accepted that the type of analyses conducted on Likert scale data do not affect the conclusions drawn from the results. However, a difference was observed for Kendall tau_b where the coefficient of determination calculated on the correlation coefficient between the variables academic self-regulation and learning styles, indicate that very little of variation between the variables could be ascribed to each other.Clearly researchers and statisticians would be quick to point out that the coefficient of determination is only calculated on the Pearson statistics and as such should not be conducted for Spearman nor Kendall tau b since these analyses are for ordinal or rank order data. However, the treatment is purely an academic exercise to ascertain whether the conclusions drawn from the results of the statistical tests would differ.

**Table 3: Comparative Analysis, Coefficient of Determination Pearson, Spearman, Kendall tau_b**

| Coefficient of Determination | | | | | |
|---|---|---|---|---|---|
| **Constructs** | **Statistical Tests** | **Academic Resources** | **Mathematics Self-Efficacy** | **Academic Self-Regulation** | **Learning Styles** |
| **Academic Resources** | Pearson | **1** | | | |
| | Spearman | **1** | | | |
| | Kendall tau_b | **1** | | | |
| **Mathematics Self-Efficacy** | Pearson | **0.077** | **1** | | |
| | Spearman | **0.071** | **1** | | |
| | Kendall tau_b | **0.033** | **1** | | |
| **Academic Self-Regulation** | Pearson | **0.070** | **0.081** | **1** | |
| | Spearman | **0.085** | **0.070** | **1** | |
| | Kendall tau_b | **0.045** | **0.033** | **1** | |
| **Learning Styles** | Pearson | **0.130** | **0.151** | **0.365** | **1** |
| | Spearman | **0.140** | **0.163** | **0.303** | **1** |
| | Kendall tau_b | **0.073** | **0.089** | **0.162** | **1** |

## *5. Conclusion*

The objective of the study was to determine whether the type of analyses conducted on Likert scale data affect the conclusion drawn from the results obtained. It is concluded that parametric and non- parametric tests such as Pearson and Spearman rho conducted on Likert scale data do not affect the conclusions drawn from the results. However, the jury is still out on Kendall tau_b whose conclusion differed, regarding the strength of the correlation and degree of variability, from that of Pearson and Spearman for the variables academic self-regulation and learning styles.

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**Table 1: Summed Likert Scale Data Set Used in Analyses**

| Student ID | | Academic Resources | Mathematics Self-Efficacy | Academic Self-Regulation | Learning Styles |
|---|---|---|---|---|---|
| Student Unique Identification Number | 1 | **34.00** | **58.00** | **45.00** | **31.00** |
| | 10 | **31.00** | **58.00** | **49.00** | **26.00** |
| | 101 | **34.00** | **49.00** | **50.00** | **30.00** |
| | 103 | **34.00** | **49.00** | **43.00** | **21.00** |
| | 105 | **18.00** | **31.00** | **41.80** | **21.00** |
| | 109 | **35.00** | **38.00** | **37.00** | **22.00** |
| | 110 | **26.00** | **62.00** | **26.00** | **21.00** |
| | 113 | **28.00** | **67.00** | **35.00** | **23.00** |
| | 114 | **34.00** | **35.00** | **32.00** | **21.00** |
| | 115 | **33.00** | **54.00** | **36.00** | **27.00** |
| | 117 | **22.00** | **53.00** | **44.00** | **26.00** |
| | 122 | **33.00** | **56.00** | **43.00** | **23.00** |
| | 123 | **19.00** | **48.00** | **36.00** | **15.00** |
| | 125 | **29.00** | **41.00** | **32.00** | **20.00** |
| | 127 | **28.00** | **38.57** | **35.20** | **14.00** |
| | 13 | **32.00** | **35.00** | **37.00** | **25.00** |
| | 130 | **31.00** | **62.00** | **41.00** | **23.00** |
| | 133 | **45.00** | **51.00** | **50.00** | **35.00** |
| | 134 | **28.00** | **67.00** | **41.00** | **27.00** |
| | 139 | **28.00** | **58.00** | **50.00** | **27.00** |
| | 141 | **21.00** | **51.00** | **43.00** | **24.00** |
| | 144 | **36.00** | **73.00** | **40.00** | **34.00** |
| | 145 | **23.00** | **46.00** | **42.00** | **27.00** |
| | 148 | **28.00** | **55.00** | **48.00** | **28.00** |
| | 150 | **29.00** | **43.00** | **31.00** | **22.00** |
| | 151 | **21.00** | **40.00** | **39.00** | **24.00** |
| | 154 | **23.00** | **45.00** | **42.00** | **26.00** |
| | 157 | **26.00** | **57.00** | **46.00** | **27.00** |
| | 158 | **26.00** | **63.00** | **41.80** | **29.00** |
| | 159 | **22.00** | **38.00** | **36.00** | **17.00** |
| | 16 | **32.00** | **49.00** | **54.00** | **26.00** |
| | 162 | **16.00** | **54.00** | **52.00** | **31.00** |
| | 163 | **28.00** | **40.00** | **46.00** | **22.00** |
| | 164 | **21.38** | **46.00** | **47.00** | **27.00** |
| | 165 | **35.00** | **58.00** | **43.00** | **26.00** |
| | 167 | **16.00** | **43.00** | **33.00** | **20.00** |
| | 168 | **43.00** | **67.00** | **47.00** | **31.00** |
| | 169 | **22.00** | **52.00** | **41.00** | **28.00** |
| | 17 | **40.00** | **62.00** | **41.00** | **32.00** |
| | 171 | **18.00** | **36.00** | **35.00** | **15.00** |
| | 172 | **36.00** | **54.00** | **44.00** | **28.00** |
| | 173 | **32.00** | **42.00** | **42.00** | **35.00** |
| | 175 | **34.00** | **34.00** | **37.00** | **22.00** |
| | 176 | **20.00** | **45.00** | **33.00** | **22.17** |
| | 177 | **43.00** | **67.00** | **51.00** | **33.00** |
| | 178 | **24.00** | **63.00** | **47.00** | **30.00** |
| | 180 | **22.00** | **56.00** | **42.00** | **22.00** |
| | 181 | **33.00** | **41.00** | **36.00** | **18.00** |
| | 182 | **30.00** | **62.00** | **39.00** | **24.00** |
| | 184 | **33.00** | **53.00** | **45.00** | **27.00** |
| | 185 | **34.00** | **56.00** | **48.00** | **30.00** |
| | 187 | **28.00** | **56.00** | **41.00** | **26.00** |
| | 189 | **30.00** | **63.00** | **38.00** | **29.00** |
| | 19 | **29.00** | **62.00** | **36.00** | **21.00** |

| | | | | | |
|---|---|---|---|---|---|
| | 191 | **30.00** | **35.00** | **39.00** | **23.00** |
| | 192 | **29.00** | **42.00** | **46.00** | **23.00** |
| | 2 | **31.00** | **38.00** | **47.00** | **26.00** |
| | 20 | **31.00** | **57.00** | **37.00** | **27.00** |
| | 24 | **42.00** | **74.00** | **49.00** | **35.00** |
| | 25 | **39.00** | **72.00** | **48.00** | **32.00** |
| | 27 | **43.00** | **68.00** | **48.00** | **34.00** |
| | 29 | **33.00** | **59.00** | **44.00** | **29.00** |
| | 30 | **25.00** | **55.00** | **34.00** | **28.00** |
| | 31 | **36.00** | **22.00** | **45.00** | **33.00** |
| | 32 | **40.00** | **74.00** | **46.00** | **35.00** |
| | 33 | **36.00** | **33.00** | **36.00** | **22.00** |
| | 34 | **28.00** | **40.71** | **40.00** | **24.00** |
| | 35 | **35.00** | **57.00** | **38.00** | **26.00** |
| | 36 | **29.00** | **40.38** | **37.40** | **28.00** |
| | 37 | **30.00** | **41.00** | **42.00** | **24.00** |
| | 38 | **26.00** | **60.00** | **38.00** | **28.00** |
| | 39 | **45.00** | **70.00** | **51.00** | **34.00** |
| | 4 | **40.00** | **70.00** | **40.70** | **29.00** |
| | 40 | **28.00** | **35.36** | **41.00** | **24.00** |
| | 41 | **41.00** | **59.00** | **46.00** | **14.00** |
| | 42 | **25.00** | **45.00** | **44.00** | **18.00** |
| | 43 | **35.00** | **58.00** | **34.00** | **28.00** |
| | 44 | **28.00** | **44.00** | **44.00** | **32.00** |
| | 46 | **36.00** | **58.00** | **39.00** | **27.00** |
| | 47 | **33.00** | **34.29** | **11.00** | **7.00** |
| | 48 | **35.00** | **75.00** | **38.50** | **25.00** |
| | 49 | **35.00** | **58.00** | **48.00** | **27.00** |
| | 5 | **30.00** | **62.00** | **43.00** | **32.00** |
| | 52 | **29.25** | **43.93** | **44.00** | **27.00** |
| | 53 | **38.00** | **51.00** | **48.00** | **21.00** |
| | 54 | **35.00** | **59.00** | **37.00** | **17.50** |
| | 55 | **31.00** | **43.00** | **33.00** | **20.00** |
| | 57 | **27.00** | **52.00** | **43.00** | **20.00** |
| | 58 | **16.00** | **69.00** | **36.00** | **25.00** |
| | 59 | **37.00** | **45.00** | **44.00** | **32.00** |
| | 60 | **38.00** | **55.00** | **45.00** | **31.00** |
| | 61 | **32.00** | **50.00** | **42.00** | **27.00** |
| | 62 | **34.00** | **40.00** | **43.00** | **28.00** |
| | 63 | **33.00** | **56.00** | **39.00** | **29.00** |
| | 67 | **27.00** | **57.00** | **37.00** | **26.00** |
| | 71 | **26.00** | **45.00** | **39.00** | **28.00** |
| | 72 | **30.00** | **46.00** | **32.00** | **27.00** |
| | 74 | **37.00** | **75.00** | **49.00** | **35.00** |
| | 75 | **40.00** | **62.00** | **48.00** | **26.00** |
| | 77 | **29.00** | **49.00** | **32.00** | **7.00** |
| | 8 | **33.00** | **53.00** | **41.00** | **22.00** |
| | 80 | **35.00** | **71.00** | **36.00** | **25.00** |
| | 81 | **37.00** | **36.00** | **43.00** | **33.00** |
| | 83 | **37.00** | **60.00** | **47.00** | **29.00** |
| | 84 | **31.00** | **69.00** | **32.00** | **16.00** |
| | 86 | **32.00** | **46.00** | **37.00** | **28.00** |
| | 88 | **40.00** | **57.00** | **46.00** | **31.00** |
| | 90 | **27.00** | **64.00** | **36.00** | **28.00** |
| | 91 | **34.00** | **39.00** | **34.00** | **28.00** |
| | 93 | **36.00** | **21.00** | **34.00** | **19.00** |
| | 95 | **25.00** | **56.00** | **48.00** | **32.00** |

Limited to first 111 cases.