Measures of Association for Research in Educational Planning and Administration

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Abstract: This study explained the use of measures of association that could be use for research in educational planning and administration. As a theoretical study, it provides an insight to the particular measure of association that is appropriate to solve a particular research problem. Since every research problem requires a particular measure of association, this study explores the particular technique that would suit the research. In solving a research problem, the study made use of different examples which a researcher could assimilate in order to embark on a particular study. The author also gave the assumptions for using each of the measures of association in educational and scientific research highlighting the advantages and disadvantages of each measure. It was concluded that the use of appropriate measure of association is a fundamental requirement for research in educational planning and administration.

Key words: Administration, association, educational, measures, planning, research

INTRODUCTION

Several Measures of Association could be used for research in Educational Planning. These include Yule’s Q, Phi Coefficient f, Coefficient of Predictability, Lambda l, Gamma g.

Yule’s Q: The Yule’s Q is a nominal level measure of association that could be used to determine the association or relationship between variables (Baddie and Fred, 1995; Kolawole, 2001). Yule originated this measure of association for variables which have two and only two values. It is used with 2 x 2 tables, each variable being expressed as a dichotomy. These dichotomies may be male-female, yes-no, true-false, for-against, agree-disagree, graduate-non-graduate, tall-short, high-low and so on (Adeyemi, 2002).

The Yule’s Q coefficient is a distribution-free statistic. For variables having infinite values, the researcher may want to put these variables into dichotomies. The process involves the construction of dichotomies that would affect the value of the Yule depending on how the original categories were collapsed. Yule’ Q is, therefore, the ratio of the differences between the products of the diagonal cell frequencies and the sum of the products of the diagonal cell frequencies (Campbell, 1999; Oppenhelm, 1992; Adeyemi, 2003). This could be done by using the following formula.

\[ Q = \frac{(ad - bc)}{(ad + bc)} \]

where, a, b, c, d are frequencies found in cells a,b,c, d of a 2 x 2 table.

Example1: Suppose a researcher intends to determine whether or not attending films on campus would affect students’ grade-point averages and involved 200 students in the study. Thirty (30) of the students who had high grade-point average said yes to attending films on campus while the remaining 70 said no. On the other hand, 70 of the students who had low grade-point average said yes to attending films on campus while the remaining 30 said no. Is there is any association between the number of responses given on the grade-point average of students and attending films on campus.

Step 1: Formulate the Null hypothesis and the alternative Hypothesis

Ho: There is no significant association between students’ grade-point average and attending films on campus.

Hi: Students grade-point average is significantly associated with attending films

Step 2: Construct a 2 x 2 table to show the students’ grade point average and their responses to attending films (Table 1).

Step 3: Apply the Yule’s Q formula:

\[ Q = \frac{(30)(30) - (70)(70)}{(30)(30) + (70)(70)} \]
\[ Q = \frac{900 - 4,900}{900 + 4,900} \]
\[ Q = -0.68 \]

Step 4: Interpretation: The level of association between attending films and grade average is -0.68, indicating a moderately high inverse relationship.
This means that students who attend films had low grades. The inverse relationship is indicated by the negative sign (-) and it indicates that as one variable increases, the other decreases.

Thus, since the researcher is interested in predicting grade-point average by examining the effects of the independent variable attending films, then he could confidently conclude that 68% of the error in predicting grade-point average has been reduced.

Assumptions for using Yule’s Q:
- The Yule’s Q coefficient is a distribution-free statistic (Awosami et al., 1999).
- One major assumption of Yule’s Q coefficient is that the data has to be dichotomized.

Advantages of using the Yule’s Q:
- An advantage of Yule’s Q is that no correction needs to be made for it.
- QQ is computed from a 2x2 table without first computing the chi-square test.
- It is best meaningfully applied where data are in dichotomies.
- It has no stringent assumptions for its application.
- It is quickly and easily computed.
- It is a measure of the proportional reduction in error associated with predicting one variable from the other (Baddie and Fred, 1995).

Disadvantages of using the Yule’s Q:
- One disadvantage of Q is that it is limited to only 2 x 2 tables.
- When the researcher’s data fit into larger tables, for example, a 2x3, 3x4 or 3x6 table, Yule’s Q cannot be computed unless the data are “collapsed” into a 2x2 table.
- The idea of collapsing data into fewer categories may lead to the loss of vital information. Hence, it is better to avoid collapsing data when using the Yule’s Q (Bandele, 1999).

THE PHI COEFFICIENT, f: The Phi Coefficient f is another nominal measure of association for nominal variables (Kolawole, 2001). It measures the degree of association between two variables that are expressed as a dichotomy. It is expressed by the following formula:

\[ \phi = \frac{(ad - bc)}{\sqrt{(a+b)(c+d)(a+c)(b+d)}} \]

where, a, b, c, and d are the cells of a 2x2 table.

Example 2: Assuming a researcher intends to determine the association between attending films in a College and students’ grade-point average and he took a random sample of 145 students from three departments. Suppose the researcher found that 55 of the students who had high grade point average said yes to attending films on campus while 40 students said no. On the other hand, 20 of the students who had low grade point average said yes to attending films on campus while 30 students said no. Is there any significant association between the students’ grade-point average and attending films on campus at \( \alpha = 0.05 \)?

**Step 1:** Formulate the Null hypothesis and the Alternative Hypothesis

- **Ho:** Students’ grade-point average is not significantly associated with attending films on campus.
- **Hi:** Students grade-point average has a significant association with attending films on campus.

**Step 2:** Draw a 2x2 table showing the data on attending films and students’ grade point average (Table 2).

**Step 3:** Apply the Phi Coefficient f formula:

\[ \phi = \frac{(ad - bc)}{\sqrt{(a+b)(c+d)(a+c)(b+d)}} \]

\[ \phi = \frac{(55)(30) - (40)(20)}{\sqrt{(95)(50)(75)(70)}} \]

\[ \phi = \frac{1650 - 800}{\sqrt{(4750)(5250)}} \]

\[ \phi = 850 \cdot 24.937500 \]

\[ \phi = 0.17 \]

This low Phi value (\( \phi = 0.17 \)) shows that there is a low association between attending films and students’ grade-point averages in the College.

**Step 4:** Significance of Phi: In order to test for the significance of Phi, the chi-square test could be applied using the following formula.

\[ \chi^2 = N\phi^2 \]

Thus, the chi-square would be:

\[ \chi^2 = (145)(0.17)^2 \]

\[ \chi^2 = (145)(0.03) \]

Computed \( \chi^2 = 4.35 \)
Step 5: Determine the degree of freedom (df):

\[
df = (r-1) (c-1)
\]

Since it's a 2 x 2 table:

\[
df = (2-1) (2-1)
\]

\[
df = (1) (1)
\]

\[
df = 1 \text{ while } a = 0.05.
\]

Step 6: Now determine the critical or table Chi Square value:

At \( df = 1 \) and \( a = 0.05 \), the critical chi-square value = 3.841.

\[
\chi^2 = 3.841.
\]

Step 7: Interpretation: Since the observed or computed chi-square value (4.35) is greater than the critical chi-square value (3.841), the researcher has to conclude that there was a significant association between attending films and students’ grade-point average in the College. Thus, the researcher’s computed \( \phi \) of 0.17 was a chance departure from zero association.

Assumptions for Phi:

- One major assumption for using the Phi is that the data must be at the nominal level of measurement.
- Another assumption is that the variables to be examined should be dichotomous (Gay, 1996).

Advantages of Phi:

- One major advantage of the Phi Coefficient is that it has a proportional-reduction in-error interpretation. By squaring Phi, \( \phi^2 = (0.17)^2 \), this would be equal to 0.028. This means that the researcher has accounted for only 2.8% of the error in predicting students’ grade average by using the variable attending films as an independent or predictor variable.
- The Phi coefficient is easy to comprehend and compute (Kinnear and Gray, 1994).

Disadvantages: One disadvantage of Phi Coefficient is that it is limited to 2x2 tables.

Coefficient of predictability, lambda, \( \lambda \): Guttmann’s Coefficient of Predictability Lambda, \( \lambda \), is another nominal level of association and a coefficient of predictability. It is a statistical technique that measures the degree to which one variable can accurately be predicted with a knowledge of the other variable (Moore, 1994). This quality of predictability is one way of looking at the association between variables.

Lambda symmetrical: The term ‘symmetrical’ indicates an index of association or mutual predictability between two variables (Kolawole, 2001). As such, the formula used to compute Lambda Symmetrical \( \lambda \) is as follows:

\[
\lambda = \frac{[\sum f_i + \sum f_c - (F_i + F_c)]}{[2N - (F_i + F_c)]}
\]

where,

- \( f_i \) = largest frequency occurring in a row
- \( f_c \) = largest frequency occurring in a column
- \( F_i \) = largest marginal frequency occurring among the rows
- \( F_c \) = largest marginal frequency occurring among the columns
- \( N \) = Number of observations

Example 3: Assuming a researcher wished to examine 200 students, 75 of whom were truants and 125 of whom were not truants in a to determine the association between truancy and students’ motivation to read. The 200 students were categorized in two ways. In the first instance, they were categorized as to whether or not they are truants. They were also categorized as to whether or not they had a high motivation to read. Suppose the researcher found that 20 of those with high motivation to read were truants while 85 were non-truants; and that 55 of those with low motivation to read were truants while 40 were non-truants. Using the Lambda symmetrical formula, determine whether there is any association between truancy and students’ motivation to read at \( a = 0.05 \)?

Step 1: Formulate the null hypothesis and the alternative Hypothesis:

- \( Ho \): There is no significant association between truancy and students’ motivation to read
- \( Hi \): Truancy and students’ motivation to read are significantly associated

Step 2: Draw a 2x2 table showing the data collected (Table 3):

<table>
<thead>
<tr>
<th>Motivation to read</th>
<th>Truants</th>
<th>Non-truants</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Motivation</td>
<td>20</td>
<td>85</td>
<td>105</td>
</tr>
<tr>
<td>Low Motivation</td>
<td>55</td>
<td>40</td>
<td>95</td>
</tr>
<tr>
<td>Total</td>
<td>75</td>
<td>125</td>
<td>200</td>
</tr>
</tbody>
</table>

Step 3: Apply the Lambda Symmetrical formula:
Thus, \( \gamma = \frac{[(85 + 55) + (85 + 55) - (95 + 125)]}{[2(200) - (95 + 125)]} \)
\( = \frac{[(140) + (140) - (220)]}{[400 - (220)]} \)
\( = \frac{(280 - 220)}{180} = \frac{60}{180} = 0.33 \)

- **Step 4: Interpretation:** With a \( \gamma = 0.33 \), the researcher can conclude that there is a low association between truancy and motivation to learn among the students.

**Lambda asymmetrical:** The term ‘asymmetrical’ refers to a situation whereby different values of \( \gamma \) are examined on the basis of how the researcher views the variables involved (SPSS, 1990). Thus, Lambda Asymmetrical is represented by the following formula:

\[
\gamma = \frac{[\sum f_i - F_d]/[N - F_d]}{}
\]

where,
- \( f_i \) = largest frequency occurring within each subclass of the independent variable
- \( F_d \) = largest frequency found within the dependent totals of the independent variable
- \( N \) = Total number of observations.

**Example 4:** Suppose a researcher wished to determine to what extent he could predict student’s motivation to read by investigating whether or not some students were truants? He might also wish to determine the extent to which he could predict truancy by investigating students’ motivation to read? In the first instance, truancy could be treated as the independent variable. In the second instance, motivation to read could be treated as the independent variable. Suppose that the researcher found that out of the 75 students who were involved in truancy, 20 had high motivation to read while 55 had a low motivation to read. Likewise, out of the 125 students who were involved in truancy in the second group, 85 of them had high motivation to read while 40 of them had a low motivation to read. Using the Lambda Asymmetrical formula, is there any association between truancy and students’ motivation to read at a = 0.05?

- **Step 1:** Formulate the null hypothesis and the alternative hypothesis:
  - Ho: There is no significant association between truancy and students’ motivation to read.
  - Hi: Truancy and students’ motivation to read are significantly associated.

- **Step 2:** If Truancy is the independent variable, the data would be as a Table 4:

<table>
<thead>
<tr>
<th>Truancy</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Yes</td>
<td>20</td>
</tr>
<tr>
<td>No</td>
<td>85</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
</tr>
</tbody>
</table>

- **Step 3:** Apply the Lambda Asymmetrical formula 1:

\[
\gamma = \frac{[\sum f_i - F_d]/[N - F_d]}{}
\]

where,
- \( f_i \) = largest frequency occurring within each subclass of the independent variable
- \( F_d \) = largest frequency found within the dependent totals of the independent variable
- \( N \) = Total number of observations

\( \gamma = \frac{(55 + 85) - 95}{200 - 95} \)
\( = \frac{140 - 95}{105} \)
\( = \frac{45}{105} \)
\( = 0.428 \)

- **Step 4:** If motivation is the independent variable, compute the data as in Table 5:

<table>
<thead>
<tr>
<th>Motivation to Read</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Yes</td>
<td>20</td>
</tr>
<tr>
<td>No</td>
<td>85</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
</tr>
</tbody>
</table>

- **Step 5:** Apply the Lambda Asymmetrical formula 1:

\[
\gamma = \frac{[\sum f_i - F_d]/[N - F_d]}{}
\]

where,
- \( f_i \) = largest frequency occurring within each subclass of the independent variable
- \( F_d \) = largest frequency found within the dependent totals of the independent variable
- \( N \) = Total number of observations

\( \gamma = \frac{(85 + 55) - 125}{200 - 125} \)
\( = \frac{140 - 125}{75} \)
\( = \frac{15}{75} \)
\( = 0.2 \)

- **Step 6:** Interpretation: By using truancy as the independent variable, the researcher had been able to reduce the error of predicting the motivation to read by 43%. On the other hand, by using motivation to ready as the independent variable, the researcher had been able to reduce the error of predicting truancy by 20%. It appears that truancy is a better predictor of motivation to read than motivation to read in predicting truancy.

**Assumptions for lambda \( \gamma \):**
- Lambda assumes that data must be at the nominal-level measure of association.
Table 6: Job satisfaction and workers’ performance level

<table>
<thead>
<tr>
<th>Companies</th>
<th>Job satisfaction Rank 1</th>
<th>Level of performance Rank 2</th>
<th>Frequency of Agreements Fa</th>
<th>Frequency of Inversions fi</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>4</td>
<td>5</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>( \sum \text{fa} = 8 )</td>
<td>( \sum \text{fi} = 2 )</td>
</tr>
</tbody>
</table>

- It makes no assumption concerning the distribution of variables.
- It does make any assumption about the distribution of variables.
- It could be computed whenever data are categorized (SPSS, 1993).

Advantages of lambda 1:
- Lambda is not restricted to 2x2 tables. It could be computed for tables of any number of rows and columns.
- It is also a direct proportional - reduction in error interpretation.
- It can be interpreted directly without being modified by any correction factor.
- It is relatively easy to compute an disbecoming a popular nominal measure of association (Oppenheim, 1992).

Gamma \( \gamma \): The Goodman’s and Kruskal’s Gamma is an ordinal measure of association between two variables (Adeyemi, 1998). It measures the degree of agreement or association between two ordinal-level data. Gamma can be analyzed in two ways. The first is when no ties occur in the rankings while the second way is when there are ties in the rankings (Aghenta, 2000).

When there are no ties in the rankings:
Example 5: Assuming a researcher is interested in examining the association between two variables namely job satisfaction of workers in some companies and their level of performance. Job satisfaction is determined by the total count of the responses of the workers to ten Likert-type questions. Suppose the researcher found five companies where the levels of job satisfaction were to a varying degree. Assuming the researcher ranks these companies in order of the level of job satisfaction from greatest (1) to least (5). All the workers were given the performance questionnaire to complete. After this, the researcher determined a performance score for each company as follows:

Job satisfaction: 1 2 3 4 5
Level of Performance: 1 3 2 5 4

Is there is any significant association between job satisfaction and the level of performance of workers in the companies at \( \alpha = 0.05 \)?

- Step 1: Formulate the null hypothesis and the alternative hypothesis:
  - \( H_0 \): There is no significant association between job satisfaction of workers and level of performance at work.
  - \( H_1 \): Job satisfaction of workers is significantly association with the level of performance at work (Table 6).

- Step 2: Draw a table showing the ranking and scoring of data:

- Step 3: Rank the companies according to the degree of job satisfaction of the workers in column labeled Rank 1. In the next column labeled Rank 2, rank the respective workers’ performance in each company. Assuming that a perfect positive association existed between the two variables, the performance rankings would be identical to the job satisfaction rankings. Likewise, a perfect negative or inverse relationship would occur if one set of ranks were exactly opposite to the other. Since there is neither a perfect positive nor a perfect negative association between the variables, job satisfaction and workers’ performance, the degree of association can be determined by using the following Gamma formula:

\[
\gamma = \frac{\sum \text{fa} - \sum \text{fi}}{\sum \text{fa} + \sum \text{fi}}
\]

where,
\( \gamma \) = Gamma
\( \text{fa} \) = Frequency of agreements
\( \text{fi} \) = Frequency of inversions

- Step 4: After ranking the first variable that is, the degree of job satisfaction in a perfect order, the rankings of the other variable, workers’ level of performance are juxtaposed according the score for each company. It should be noted that the performance scores are not in the same order as the job satisfaction scores.

- Step 5: Computation of the frequency of agreements \( S_{fa} \):
  In determining the frequency of agreements, \( S_{fa} \), attention is given to the column of ranks which is not in perfect order. Hence, the researcher would examine the ranking of the level of performance column in Table 6.
Step 5.1: Starting from the first rank in level of performance column, determine how many ranks above the first rank i.e. 1 that are smaller than 1. Since there is no rank above 1 that is smaller than 1, the researcher has to enter a zero (0) in the Agreements (fa) column.

Step 5.2: The next rank in the level of performance column is 3 and it was observed that there is only one rank above 3 that is smaller than 3. Therefore, the researcher has to enter 1 in the Agreements column.

Step 5.3: The next rank is 2 in the level of performance column, and it was noticed that there is only 1 rank above 2 that is smaller than 2. Therefore, the researcher has to enter another 1 in the Agreements column.

Step 5.4: The next rank is 5. It was observed that there are three ranks above this 5 that are smaller than 5, that is 3, 2 and 1. Therefore, the researcher has to enter 3 in the Agreements column.

Step 5.5: The last rank is 4 in the level of performance column; and it was noticed that there are 3 ranks above this 4 that are smaller than 4. Therefore isenteredinthe Inversions column.

Step 5.6: The final rank in the level of performance column is 4; and it has only 1 rank above it which are larger than 4. Therefore isenteredinthe Inversions column.

Step 6: Computation of the frequency of inversions Sfi: In order to determine the frequency of inversions, Sfi, attention would now also be paid to the column in Table 6 that is not perfect order. Hence, the researcher would examine the ranking of the column on performance ranks to determine how many larger ranks occur above a specified score.

Step 6.1: Starting from the first rank, 1 in the level of performance column, it was discovered that there was no rank above 1 that is larger than 1. Hence, the researcher has to enter zero in a column labeled inversions (fi).

Step 6.2: The next rank is 3; and it has no larger ranks above it. As such, the researcher has to enter another zero in the inversions column.

Step 6.3: The next rank is 2. It has only one rank above it that is larger than 2, that is 3. Thus, 1 is entered in the Inversions column.

Step 6.4: The next rank is 5; and it has no rank above it that is larger than 5. As such, zero is entered in the Inversions column.

Step 6.5: The final rank in the level of performance column is 4; and it has only 1 rank above it which are larger than 4. Therefore isenteredinthe Inversions column.

Step 6.6: Sum up the number of inversions in the inversions column to give the Sfi in Table 6. Thus:

\[
Sfi = \sum_{i=1}^{4} f_i = 0 + 0 + 1 + 0 + 1 = 2
\]

Step 7: Computation of Sfa and Sfi: After the computation of both the Sfa and Sfi, it would be observed that the total number of agreements in Table 6 is 8 while the total number of inversions is 2. The researcher would then need to apply the Gamma g formula and substitute the values for symbols in formula thus:

\[
\gamma = \frac{Sfa - Sfi}{Sfa + Sfi} = \frac{8 - 2}{8 + 2} = 0.60
\]

Step 8: Interpretation: The findings, \( \gamma = 0.60 \) shows that there is a low level association between the two sets of ranks. Only 60% of the error was reduced in the mutual predictability of job satisfaction and level of performance.

When there are ties in the rankings: When ties occur in either variable, the same formula is still employed, but a different method of arriving at Sfa and Sfi is applied.

Example 6: Suppose a researcher had the scores of respondents in respect of two variables, social status and achievement urge for 50 sampled students as follows:

<table>
<thead>
<tr>
<th>Social Status</th>
<th>High: 4312</th>
<th>Moderately high: 3543</th>
<th>Moderately low: 2356</th>
<th>Low: 2124</th>
</tr>
</thead>
<tbody>
<tr>
<td>Achievement urge</td>
<td>High: 4322</td>
<td>Moderately high: 3531</td>
<td>Moderately low: 1452</td>
<td>Low: 2364</td>
</tr>
</tbody>
</table>

Determine whether any significant association exists between the social status of parents and the achievement urge of their children at school?

Step 1: Formulate the null hypothesis and the alternative hypothesis:

**Ho:** There is no significant association between the social status of parents and the achievement urge of their children.

**Hi:** The social status of parents is significantly associated with the achievement urge of their children at school.

Step 2: Group the scores on social status and achievement urge into four categories as in Table 7:
Table 7: Achievement urge and social status scores

<table>
<thead>
<tr>
<th>Achievement urge scores</th>
<th>High</th>
<th>Moderately high</th>
<th>Moderately low</th>
<th>Low</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Moderately high</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Moderately low</td>
<td>1</td>
<td>4</td>
<td>5</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Low</td>
<td>2</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Total</td>
<td>10</td>
<td>15</td>
<td>16</td>
<td>9</td>
<td>50</td>
</tr>
</tbody>
</table>

- **Step 3:** Identify the ties in the pattern of scoring:
  Thus, in Table 7, it could be observed for example, that 4 students were tied at high achievement urge and high social status of parents.

- **Step 4:** Computation of Sfa: In order to compute Sfa, the researcher must take each score in Table 7 beginning with 4 at the upper left-hand corner, and multiply it by the sum of all scores below it and to the right of it. The scores below and to the right of 4 are 5, 3, 1, 4, 5, 2, 3, 6, 4. The analysis is as follows:
  - **Step 4.1:**
    \[(4)(5+3+1+4+5+2+3+6+4) = (4)(33)\]
    \[fa = 132\]
  - **Step 4.2:**
    \[(3)(3+1+5+2+6+4) = (3)(21)\]
    \[fa = 63\]
  - **Step 4.3:**
    \[(2)(1+2+4) = (2)(7)\]
    \[fa = 14\]
  - **Step 4.4:**
    \[(2)(0) = 0\] (As there are no scores below and to the right of 2)
    \[fa = 0\]
  - **Step 4.5:**
    \[(3)(4+5+2+3+6+4) = (3)(24)\]
    \[fa = 72\]
  - **Step 4.6:**
    \[(5)(5+2+6+4) = (5)(17)\]
    \[fa = 85\]
  - **Step 4.7:**
    \[(3)(2+4) = (3)(6)\]
    \[fa = 18\]
  - **Step 4.8:**
    \[(1)(0) = 0\] (As there are no scores below and to the right of 1)
    \[fa = 0\]
  - **Step 4.9:**
    \[(1)(3+6+4) = (1)(13)\]
    \[fa = 13\]
  - **Step 4.10:**
    \[(4)(6+4) = (4)(10)\]
    \[fa = 40\]
  - **Step 4.11:**
    \[(5)(4)\]
    \[fa = 20\]
  - **Step 4.12:**
    \[(2)(0) = 0\] (As there are no scores below and to the right of 2)
    \[fa = 0\]

All scores on the lowest row, such as 2, 3, 6 and 4 have no other scores below them and to their right. Hence, do not border about them.

- **Step 4.13:** Now add up the total Sfa to derive the \(\Sigma fa\): \[\Sigma fa = 132 + 63 + 14 + 0 + 72 + 85 + 18 + 0 + 13 + 40 + 20 + 0 = 457\]
  \[\Sigma fa = 457\]

- **Step 5:** Computation of Sfi: In computing Sfi, the process is reversed. The researcher has to begin at the upper right-hand corner of Table 7, that is, from 2 and multiply each score systematically by the sum of all scores below it and to the left of it. Thus,
  - **Step 5.1:**
    \[(2)(3+5+3+1+4+5+2+3+6) = (2)(32)\]
    \[fi = 64\]
  - **Step 5.2:**
    \[(2)(3+5+1+4+2+3) = (2)(18)\]
    \[fi = 36\]
  - **Step 5.3:**
    \[(3)(3+1+2) = (3)(6)\]
    \[fi = 18\]
  - **Step 5.4:**
    \[(4)(0)\] (As there are no scores below and to the left of 4).
    \[fi = 0\]
  - **Step 5.5:**
    \[(1)(1+4+5+2+3+6) = (1)(21)\]
    \[fi = 21\]
**Step 5.6:**
\[(3)(1+4+2+3) = (3)(10)\]
\(f_i = 30\)

**Step 5.7:**
\[(5)(1+2) = (5)(3)\]
\(f_i = 15\)

**Step 5.8:**
\[(3)(0)\] (As there are no scores below and to the left of 3).
\(f_i = 0\)

**Step 5.9:**
\[(2)(2+3+6) = (2)(11)\]
\(f_i = 22\)

**Step 5.10:**
\[(5)(2+3) = (5)(5)\]
\(f_i = 25\)

**Step 5.11:**
\[(4)(2)\]
\(f_i = 8\)

**Step 5.12:**
\[(1)(0)\] (As there are no scores below and to the left of 1).
\(f_i = 0\)

All scores on the lowest row, that is, 2, 3, 6 and 4 have no other scores below them and to their left. Hence, do not border about them.

**Step 5.13:**
Now add up the total \(f_i\) to derive the \(Sf_i\):
\[\gamma \sum f_i = 64 +36 +18 + 0 + 21+ 30+15+ 0 +22+25+ 8+0 = 239\]
\[\gamma \sum f_i = 239\]

**Step 6:** After computing the \(Sf_a\) and \(Sf_i\), apply the gamma \(g\) formula:
\[\gamma = \Sigma f_a - \Sigma f_i\]
\[\Sigma f_a + \Sigma f_i\]

where,
\(f_a\) = frequency of agreements
\(f_i\) = frequency of inversions
\(\Sigma\) = Summation

\[\gamma = 457 - 239 / 457 + 239\]
\[\gamma = 218 / 696\]
\[\gamma = 0.31\]

**Step 7: Interpretation:** The Gamma \(g = 0.31\) indicates that there was a moderately low association between the social status of parents and achievement urge of children at school. This shows that the error in the mutual predictability of achievement urge and the social status of parents has been reduced by 31 percent. Thus, there was 31% agreement or association between the two variables. However, if the \(\Sigma f_i\) is found to be greater than \(\Sigma f_a\), an inverse association would be found between the variables and this would be indicated by a minus sign (-).

**Assumption for gamma \(g\):** In order to effectively use Gamma \(g\), the researcher must assume that the variables being examined are at least in the ordinal level of measurement (Anderson, 1998).

**Advantages of gamma \(g\):**
- Gamma \(g\) can fit tables of any size, making it to be a useful statistic
- No correction is necessary for ties except for changes on how \(Sf_a\) and \(Sf_i\) are computed
- The computation of Gamma \(g\) for both tied and untied sets of ranks is simple and well suited for data at the ordinal level
- When compared to other measures of association, Gamma \(g\) is flexible
- It readily shows both positive and negative associations between variables and is easily interpretable (Beehr, 1996)

**CONCLUSION**

In view of the foregoing, it was concluded that Measures of Association are critical requirements for research into problems dealing with relationships or association. This is evident in the sense that the solving of a particular research problem in scientific and behavioural studies is a function of the required Measure of Association. Hence, researchers would find this study as a pointer to how they could effectively utilize Measures of Association to solve research problems in Educational Planning and Administration.

**REFERENCES**


