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Correlates of Engineering Diagnostic Test in Mathematics

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ABSTRACT

Correlation coefficient expresses the degree of relationships between variables. The variables used in this study were scores of freshmen students in engineering diagnostic test in mathematics and their final grades in algebra and trigonometry.

I. INTRODUCTION

Algebra and trigonometry are basic mathematics offered in the first semester of freshman year. It was observed that every school year a sizeable number of students failed in algebra and trigonometry. These failures are largely attributed to their weak foundation in these two subjects.

In order to affirm that students' achievement in algebra and trigonometry had direct relationship to their stock knowledge and skills in the fundamentals of high school algebra and trigonometry, this study was conducted. With this in mind, the College of Engineering designed to diagnose the strengths and weaknesses of entering freshmen in the fundamental operations of algebra and trigonometry.

Statement of the Problem

The purpose of the study was to determine the strength of relationships between diagnostic test results and the achievement of freshmen students in algebra and trigonometry.

Specifically, the study endeavored to answer the following queries:

1. Is there a significant relationship between the diagnostic test and achievement of students in college algebra?
2. Is there a significant relationship between the diagnostic test and achievement of students in trigonometry?
3. Is there a significant relationship between the achievement of students in algebra and trigonometry?

In order to ascertain whether or not the relationship between diagnostic test and achievement of students in algebra and trigonometry and relationships between algebra and trigonometry were significant or attributed only to chance, the following hypotheses were advanced:

1. There is no significant relationship between the diagnostic test and achievement of students in algebra.
2. There is no significant relationship between the diagnostic test and achievement of students in trigonometry.
3. There is no significant relationship between the achievements of students in algebra and trigonometry.

Significance of the Study

The study was valuable to both teachers and department chairs of the College of Engineering. The results of the diagnostic test ascertained the preparedness of freshmen students in college algebra and trigonometry. Hence, the results were used as basis for placing students in their proper section, let alone grouping them homogeneously.

From the institutional perspectives, the tests were useful in process of selection and recommendations regarding student placement and remediation (Walsh, 2001). Students who fell short of the cut-off score were given Math Special, a non-credit subject prerequisite to trigonometry.

II. METHODOLOGY

The study used correlational method of research. The study investigated the extent to which variations in one variable correlate with variations in one or more other variables based on correlation coefficient (Aquino, 1992).

Correlation coefficient expressed the degree of linear relationship between two sets of scores obtained from the same persons (Gregory, 2000).

In this study, diagnostic test scores of students were correlated with their final grades in college algebra and trigonometry.

Instrument Used

The diagnostic test was designed ten years ago by a group of mathematics teachers of the College of Engineering. The test items were carefully prepared and reflective of units and topics discussed in high school algebra and trigonometry. Teachers who taught high school algebra and trigonometry validated the instrument.

The instrument was refined by the author-researcher who subjected the individual test item to internal consistency reliability test. In this manner, this method determined whether or not the test items tended to show consistent interrelatedness (Gregory, 2000).

The instrument was designed to assess the specific knowledge and skills in algebra and trigonometry which the students possessed when they entered college. In school year 1995 – 1996 the instrument was first administered to entering freshmen in order to assess the readiness of students in these academic subjects.

The test items included skills in fundamental operations of algebra and trigonometry and comprehension of simple word - problems.

Subjects of the Study

Freshmen engineering students admitted to the College of Engineering during school year 2005–2006 were the subjects of the study.

Forty (40) students were selected by random sampling. Students who have withdrawn algebra and trigonometry or both were excluded from the sampling. Likewise, those who took Math Special and those who left school before the end of the semester were excluded.

Unit of Analysis

Scores of students in diagnostic test were correlated with their final grades in college algebra and trigonometry utilizing the working formula for the coefficient of correlation, r (Ferguson, 1994).

$$r = \frac{N\left(\sum XY\right)-\left(\sum X\right)\left(\sum Y\right)}{\sqrt{\left[N\left(\sum X^2\right)-\left(\sum X\right)^2\right]\left[N\left(\sum Y^2\right)-\left(\sum Y\right)^2\right]}}$$

Correlation analysis is concerned with the relationship in the changes in variables.

Positive correlation relates two variables whose values are both increasing while negative correlation describes a situation where as one variable increases, the other variable decreases (Aiken, 1998).

Coefficient of correlation, r, is the index of relationship between variables (Murphy, 1994). The value ranges from –1.0 to +1.0. The value –1.0 signifies perfect negative correlation while +1.0 indicates perfect positive correlation. The in–between values, except zero, indicate some degree of correlation whether positive or negative. A correlation coefficient of zero (0) indicates no correlation (Downie, 1994).

Testing the Significance of the Coefficient of Correlation, r

After a correlation coefficient was computed, the next question was whether or not the r is signicant. Does r represent a real correlation or is the computed r merely brought about by chance?

To test the significance of r at 1% level of significance, the Z–test was used because the sample size was greater than 30. The working formula used is

$Z = \frac{r}{Sr_0}$, where Sr_0 is the standard error when the population R is zero and equal to $Sr_0 = \frac{1}{\sqrt{N-1}}$ (Downie, 1994).

III. PRESENTATION AND ANALYSIS OF DATA

Table 1 reveals the diagnostic test scores of students and their final grades in Algebra (Math 1E) and Trigonometry (Math 2E). From this table, it can be deduced that students who score low in the diagnostic test also score low in Math 1E and Math 2E.

Table 2 shows the correlation between the diagnostic test and the final grades of students in Math 1E. It can be noted that the coefficient of correlation between the diagnostic test and final grades in Math 1E is 0.90, a value interpreted as the existence of a strong positive relationship between the two variables. For detailed computation of the correlation coefficient, see Appendix A.

Table 3 reflects the relationship between the diagnostic test and the final grades of students in Math 2E. The table also reveals that the coefficient of correlation between the diagnostic test and final grades of students in trigonometry is 0.84, interpreted as a strong positive relationship. The detailed computation for the coefficient of correlation between diagnostic test and trigonometry is in Appendix B.

Table1. Diagnostic Test Scores, Final Grades of Students in Trigonometry and Algebra

Student	Diag. Test	Trigonometry	Algebra
1.	51	87	91
2.	48	82	87
3.	43	84	87
4.	25	70	70
5.	32	76	75
6.	51	85	76
7.	27	75	76
8.	41	82	83
9.	17	70	70
10.	44	80	85
11.	30	78	76
12	22	70	70
13.	26	75	77
14.	45	80	81
15.	50	91	94
16.	23	70	76
17.	46	91	91
18.	35	78	83
19.	43	83	90
20.	23	70	73
21.	46	79	83
22.	34	75	78
23.	52	98	98
24.	50	93	93
25.	42	82	86
26.	42	76	86
27.	52	86	97
28	21	75	77
29.	43	85	89
30.	29	76	81
31.	42	82	82
32.	43	83	86
33.	43	82	92
34.	35	75	77
35.	34	75	76
36.	35	81	82
37.	47	90	93
38.	25	76	78
39.	38	75	86
40.	34	82	84
Total	**1,509**	**3,203**	**3,335**

Table2. Correlation Between Diagnostic Test and Algebra

Stu	**Diag. (1)**	**Alg (2)**	**(1) (2)**	**$(1)^2$**	**$(2)^2$**
1.	51	91	4641	2601	8281
2.	48	87	4176	2304	7569
3.	43	87	3741	1849	7569
4.	25	70	1750	625	4900
5.	32	75	2400	1024	5625
6.	51	96	4896	2601	9216
7.	27	76	2052	729	5776
8.	41	83	3403	1681	6889
9.	17	70	1190	289	4900
10.	44	85	3740	1936	7225
11.	30	76	2280	900	5776
12	22	70	1540	484	4900
13.	26	77	2002	676	5929
14.	45	81	3645	2025	6561
15.	50	94	4700	2500	8836
16.	23	76	1748	529	5776
17.	46	91	4186	2116	8281
18.	35	83	2905	1235	6889
19.	43	90	3870	1849	8100
20.	23	73	1679	529	5329
21.	46	83	3818	2116	6889
22.	34	78	2652	1156	6084
23.	52	98	5096	2704	9604
24.	50	93	4650	2500	8649
25.	42	86	3612	1764	7396
26.	42	86	3612	1764	7396
27.	52	97	5044	2704	9409
28	21	77	1617	441	5929
29.	43	89	3827	1849	7921
30.	29	81	2349	841	6561
31.	42	82	3444	1764	6724
32.	43	86	3698	1849	7396
33.	43	92	3956	1849	8464
34.	35	77	2695	1225	5929
35.	34	76	2584	1156	5776
36.	35	82	2870	1225	6724

37.	47	93	4371	2209	8649
38.	25	78	1950	625	6084
39.	38	86	3268	1444	7396
40.	34	84	2856	1156	7056
Tot	**1,509**	**3,335**	**128,513**	**60,813**	**280,363**

Coeff of Correlation, r = 0.90

Table3. Correlation Between Diagnostic Test and Trigonometry

Student	**Diag. Test (1)**	**Trigo (2)**	**(1) (3)**	**$(1)^2$**	**$(3)^2$**
1.	51	87	4437	2601	7569
2.	48	82	3936	2304	6724
3.	43	84	3612	1849	7056
4.	25	70	1750	625	4900
5.	32	76	2432	1024	5776
6.	51	85	4335	2601	7225
7.	27	75	2025	729	5625
8.	41	82	3362	1681	6724
9.	17	70	1190	289	4900
10.	44	80	3520	1936	6400
11.	30	78	2340	900	6084
12	22	70	1540	484	4900
13.	26	75	1950	676	5625
14.	45	80	3600	2025	6400
15.	50	91	4550	2500	8281
16.	23	70	1610	529	4900
17.	46	91	4186	2116	8281
18.	35	78	2730	1235	6084
19.	43	83	3569	1849	6889
20.	23	70	1610	529	4900
21.	46	79	3634	2116	6241
22.	34	75	2550	1156	5625
23.	52	98	5096	2704	9604
24.	50	93	4650	2500	8649
25.	42	82	3444	1764	6724
26.	42	76	3192	1764	5776
27.	52	86	4472	2704	7396
28	21	75	1575	441	5625
29.	43	85	3655	1849	7225
30.	29	76	2204	841	5776
31.	42	82	3444	1764	6724
32.	43	83	3569	1849	6889
33.	43	43	3526	1849	6724
34.	35	35	2625	1225	5625
35.	34	34	2550	1156	5625
36.	35	35	2835	1225	6561
37.	47	47	4230	2209	8100
38.	25	25	1900	625	5776
39.	38	38	2850	1444	5625
40.	34	34	2788	1156	6724
Tot	**1509**	**3203**	**123073**	**60813**	**258297**

Coeff of Correlation, r = 0.84

It can be gleaned from Table 4 that the relationship between the grades of students in trigonometry and algebra is 0.88 which is interpreted as strong positive relationship. The detailed computation for the coefficient of correlation is found in Appendix C.

Testing the significance of the relationship between diagnostic test and algebra, between diagnostic test and trigonometry, and between algebra and trigonometry, the working equation $Z = \frac{r}{Sr_0}$ is utilized and yields the following results:

1. Testing the significance of r between the diagnostic test and algebra,

$$S\,r_0 = \frac{1}{\sqrt{40-1}} = 0.16$$

$$Z = \frac{0.90}{0.16} = 5.625, \text{ significant at 1\% level}$$

Hypothesis no. 1 is rejected: It states that there is no significant relationship between the diagnostic test and algebra.

2. Testing the significance of r between the diagnostic test and trigonometry.

$$S\,r_0 = \frac{1}{\sqrt{40-1}} = 0.16$$

$$Z = \frac{0.84}{0.16} = 5.25, \text{ significant at 1\% level}$$

Hypothesis no. 2 is rejected. It states that there is no significant relationship between the diagnostic test and trigonometry.

Table 4. Correlation Between Trigonometry and Algebra

Stu	**Trigo (1)**	**Alg (2)**	**(1) (2)**	**$(1)^2$**	**$(2)^2$**
1.	87	91	7917	7569	8281
2.	82	87	7134	6724	7569

3.	84	87	7308	7056	7569
4.	70	70	4900	4900	4900
5.	76	75	5700	5776	5625
6.	85	96	8160	7225	9216
7.	75	76	5700	5625	5776
8.	82	83	6806	6724	6889
9.	70	70	4900	4900	4900
10.	80	85	6800	6400	7225
11.	78	76	5928	6084	5776
12	70	70	4900	4900	4900
13.	75	77	5775	5625	5929
14.	80	81	6480	6400	6561
15.	91	94	8554	8281	8836
16.	70	76	5320	4900	5776
17.	91	91	8281	8281	8281
18.	78	83	6474	6084	6889
19.	83	90	7470	6889	8100
20.	70	73	5110	4900	5329
21.	79	83	6557	6241	6889
22.	75	78	5850	5625	6084
23.	98	98	9604	9604	9604
24.	93	93	8649	8649	8649
25.	82	86	7052	6724	7396
26.	76	86	6536	5776	7396
27.	86	97	8342	7396	9409
28	75	77	5775	5625	5929
29.	85	89	7565	7225	7921
30.	76	81	6156	5776	6561
31.	82	82	6724	6724	6724
32.	83	86	7138	6889	7396
33.	43	92	7544	6724	8464
34.	35	77	5775	5625	5929
35.	34	76	5700	5625	5776
36.	35	82	6642	6561	6724
37.	47	93	8370	8100	8649
38.	25	78	5928	5776	6084
39.	38	86	6450	5625	7396
40.	34	84	6888	6724	7056
Tot	**3,203**	**3,335**	**268,862**	**258,297**	**280,363**

Coeff of Correlation, r = 0.88

3. Testing the significance of r between algebra and trigonometry.

$$S r_0 = \frac{1}{\sqrt{40-1}} = 0.16$$

$$Z = \frac{0.88}{0.16} = 5.50, \text{ significant at 1\% level}$$

Hypothesis no. 3 is rejected. It states that there is no significant relationship between algebra and trigonometry.

IV. FINDINGS OF THE STUDY

The study disclosed that students who have solid foundation in high school algebra and trigonometry were better prepared for college algebra and trigonometry.

The study revealed the following findings:

1. The coefficient of correlation, r between the diagnostic test and algebra was 0.90 which signified strong relationship.
2. The coefficient of correlation, r between the diagnostic test and trigonometry was 0.84, signifying strong relationship, and
3. The correlation coefficient, r between algebra and trigonometry was 0.88 which signified strong relationship.

Furthermore, the study revealed that the relationship between the diagnostic test and algebra, is significant at 1% level; between the diagnostic test and trigonometry, significant at 1% level; and between algebra and trigonometry, also significant at 1% level.

The computed correlation coefficient represented a real correlation and not merely brought by chance.

The inadequacy of some students in algebra and trigonometry could be traced back to their school of origin. There are schools which integrate algebra and trigonometry in their curriculum, and giving the least priority to trigonometry, however.

V. RECOMMENDATIONS

In light of the findings of the study, it is recommended that diagnostic test be utilized in identifying students who will take special course in mathematics which can strengthen their basic skills and knowledge in algebra and/or trigonometry. Moreover, the results of the diagnostic test can be used as basis of classifying students into homogeneous class sections.

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Appendix A
Correlation Between Diagnostic Test and Achievement in Algebra

$$r = \frac{N\sum XY - \left(\sum X\right)\left(\sum Y\right)}{\sqrt{\left[N\left(\sum X^2\right) - \left(\sum X\right)^2\right]\left[N\left(\sum Y^2\right) - \left(\sum Y\right)^2\right]}}$$

N = 40

$\sum XY = 128,513$

$\sum X = 1509$

$\sum Y = 3335$

$\sum X^2 = 60,813$

$\sum Y^2 = 280,363$

$$r = \frac{40(128,513) - (1509)(3335)}{\sqrt{\left[40(60813) - (1509)^2\right]\left[40(280,363) - (3335)^2\right]}}$$

$$r = \frac{5,140,520 - 5,032,515}{\sqrt{(2,432,520 - 2,277,081)(11,214,520 - 11,122,225)}}$$

$$r = \frac{108,005}{119,775.801} = 0.90$$

Appendix B
Correlation Between Diagnostic Test and Achievement in Trigonometry

$$r = \frac{N\sum XY - \left(\sum X\right)\left(\sum Y\right)}{\sqrt{\left[N\left(\sum X^2\right) - \left(\sum X\right)2\right]\left[N\left(\sum Y^2\right) - \left(\sum Y\right)^2\right]}}$$

N = 40

$\sum XY = 123,073$

$\sum X = 1509$

$\sum Y = 3203$

$\sum X^2 = 60813$

$\sum Y^2 = 258,297$

$$r = \frac{40(123073) - (1509)(3203)}{\sqrt{\left[40(60813) - (1509)^2\right]\left[40(258,297) - (3203)^2\right]}}$$

$$r = \frac{4,922,920 - 4,833,327}{\sqrt{\left(2,432,520 - 2,277,081\right)\left(10,331,880 - 10,259,209\right)}}$$

$$r = \frac{89,593}{106,282.207} = 0.84$$

Appendix C
Correlation Between Algebra and Trigonometry

$$r = \frac{N\sum XY - \left(\sum X\right)\left(\sum Y\right)}{\sqrt{\left[N\left(\sum X^2\right) - \left(\sum X\right)^2\right]\left[N\left(\sum Y^2\right) - \left(\sum Y\right)^2\right]}}$$

N = 40

$\sum XY = 268,862$

$\sum X = 3203$

$$\sum Y = 3335$$
$$\sum X^2 = 258{,}297$$
$$\sum Y^2 = 280{,}363$$

$$r = \frac{40(268{,}862) - (3203)(3335)}{\sqrt{\left[40(258{,}297) - (3203)^2\right]\left[40(280{,}363) - (3335)^2\right]}}$$

$$r = \frac{10{,}754{,}480 - 10{,}682{,}005}{\sqrt{[10{,}331{,}880 - 10{,}259{,}209][11{,}214{,}520 - 11{,}122{,}225]}}$$

$$r = \frac{72{,}475}{\sqrt{(72{,}671)(92{,}295)}} = \frac{72{,}475}{81{,}897.31} = 0.88$$

AUTHOR'S BIOGRAPHY

Florita C. Napallatan was Associate Dean of the College of Engineering of the University of St. La Salle in Bacolod City from 1990 to 1993. She was the dean of the said college from 1993 to 2008. She was also chairperson of the Academic Personnel Board of the University College unit from 1997 to 2007, former president of the Council of Engineering and Architectural Schools of Western Visayas, member of Board of Directors of the Association of Colleges and Universities of Negros Occidental from 2004 to 2008 and PATE Director for the Visayas from 2006 to 2008. She was a member of the CHED Regional Quality Assessment Team.