

CHAPTER III

PRESENTATION and ANALYSIS
of the DATA

III.1 Presentation of the Data

I have taken 100 samples out of the population as the secondary data. The results of the score of courses in natural sciences, mathematics, and English are presented below (Table III.1).

Table III.1 The Scores of Chemistry, Biology, Physics, Mathematics and English

No.	Chemistry	Biology	Physics	Mathematics	English
1.	7	7	7	7	8
2.	4	5	4	5	6
3.	6	7	6	6	7
4.	6	6	6	7	5
5.	7	7	8	7	6
6.	7	7	8	7	7

continued

No.	Chemistry	Biology	Physics	Mathematics	English
7.	6	7	5	5	6
8.	7	7	5	4	7
9.	7	7	7	6	6
10.	5	6	5	7	6
11.	5	6	6	6	5
12.	5	7	6	6	6
13.	7	7	8	7	7
14.	8	7	6	7	7
15.	7	6	6	7	8
16.	7	6	6	6	6
17.	7	6	6	4	8
18.	6	6	6	6	7
19.	8	6	6	4	8
20.	7	6	6	4	7
21.	6	6	6	5	7
22.	6	7	7	7	7
23.	8	6	6	7	8
24.	5	5	5	5	7
25.	8	8	7	8	6
26.	5	6	6	6	6
27.	8	8	6	7	7
28.	6	7	5	5	7
29.	5	6	5	4	7
30.	7	6	6	6	7
31.	8	7	8	5	6
32.	8	7	8	8	6
33.	5	7	6	4	6
34.	6	7	6	7	6
35.	8	7	8	6	8

continued

No.	Chemistry	Physics	Biology	Mathematics	English
36.	6	7	6	5	6
37.	5	6	5	5	7
38.	8	7	6	6	7
39.	6	6	6	6	7
40.	8	8	7	7	7
41.	6	6	5	6	7
42.	8	7	5	7	7
43.	9	7	6	9	8
44.	5	7	6	5	7
45.	9	8	9	7	8
46.	5	6	5	5	7
47.	8	7	9	8	8
48.	8	6	5	6	7
49.	7	7	5	6	7
50.	8	6	8	8	8
51.	9	6	7	6	7
52.	6	7	8	8	8
53.	5	6	7	6	7
54.	5	7	7	6	8
55.	9	8	8	7	7
56.	6	8	7	6	7
57.	4	6	6	5	7
58.	7	8	6	6	7
59.	6	7	6	7	7
60.	6	8	7	8	8
61.	8	7	7	6	7
62.	4	5	5	4	5
63.	7	6	6	6	6
64.	5	6	5	7	6

continued

No.	Chemistry	Physics	Biology	Mathematics	English
65.	6	5	5	4	6
66.	8	7	7	6	8
67.	7	6	6	7	7
68.	6	7	6	6	6
69.	5	6	6	5	6
70.	6	7	6	5	7
71.	7	7	7	4	7
72.	7	5	6	4	7
73.	8	8	7	8	7
74.	6	7	5	6	6
75.	8	7	7	7	6
76.	5	6	5	4	5
77.	8	7	7	7	7
78.	7	7	7	6	6
79.	7	8	7	6	6
80.	8	7	6	6	7
81.	4	4	4	5	6
82.	7	8	8	7	7
83.	6	7	6	4	7
84.	7	7	7	7	6
85.	6	7	7	5	5
86.	7	8	7	8	7
87.	7	8	6	6	9
88.	8	8	9	6	8
89.	5	4	5	5	5
90.	4	4	5	5	4
91.	5	6	5	5	6
92.	5	4	4	5	6
93.	6	7	6	7	7

continued

No.	Chemistry	Physics	Biology	Mathematics	English
94.	7	6	7	6	7
95.	7	8	7	8	7
96.	5	5	5	6	5
97.	4	5	3	5	3
98.	5	5	3	6	3
99.	4	4	4	5	6
100.	7	6	8	6	9

The scores of natural sciences course are obtained from summation of courses such as physics, biology and chemistry as mean values which in the next section will be symbolized as x_1 . While the scores of mathematics and English are the original ones.

III.2 Analysis of the Data

To be able to apply the multi-linear correlation, I have to find out the x_1 , x_2 and y . Here, in this research, I label the scores of natural sciences course as x_1 , the scores of mathematics as x_2 , and the scores of English as y . The symbol x_1^2 means that the value of x_1 is squared, and so does x_2^2 . The value of x_1y is a

multiplication value of x_1 and y , the value x_2y is that of x_2 and y , whereas the value of x_1x_2 is that of x_1 and x_2 . Those x_1^2 , x_2^2 , x_1y , x_2y , and x_1x_2 are used for the need of statistical computation.

Table III.2 The Values of Components of Multi-linear Correlation Test

No.	x_1	x_1^2	x_2	x_2^2	y	y^2	x_1y	x_2y	x_1x_2
1.	7	49	7	49	8	64	56	56	49
2.	4,3	18,49	5	25	6	36	25,8	30	21,5
3.	6,3	39,69	6	36	7	49	44,1	42	37,8
4.	6	36	7	49	5	25	30	35	42
5.	7,3	53,29	7	49	6	36	43,8	42	51,1
6.	7,3	53,29	7	49	7	49	51,1	49	51,1
7.	6	36	5	25	6	36	36	30	30
8.	6,3	39,69	4	16	7	49	44,1	28	25,2
9.	7	49	6	36	6	36	42	36	42
10.	5,3	28,09	7	49	6	36	31,8	42	37,1
11.	6	36	6	36	5	25	30	30	36
12.	6	36	6	36	6	36	36	36	36
13.	6,7	44,89	7	49	7	49	46,9	49	46,9
14.	7,7	59,29	7	49	7	49	53,9	49	53,9
15.	6,3	39,69	7	49	8	64	50,4	56	44,1
16.	6,3	39,69	7	49	6	36	37,8	42	44,1
17.	6,3	39,69	4	16	8	64	50,4	32	25,2
18.	6	36	6	36	7	49	42	42	36
19.	6,7	44,89	4	16	8	64	53,6	32	26,8
20.	6,3	39,69	4	16	7	49	44,1	28	25,2
21.	6	36	5	25	7	49	42	35	30
22.	6,7	44,89	7	49	7	49	46,9	49	46,9

continued

No.	x_1	x_1^2	x_2	x_2^2	y	y^2	x_1y	x_2y	x_1x_2
23.	6,7	44,89	7	49	8	64	53,6	56	46,9
24.	5	25	5	25	7	49	35	35	25
25.	7,7	59,29	8	64	6	36	46,2	48	61,6
26.	5,7	32,49	6	36	6	36	34,2	36	34,2
27.	7,3	53,29	7	49	7	49	51,1	49	51,1
28.	6	36	5	25	7	49	42	35	30
29.	5,3	28,09	4	16	7	49	37,1	28	21,2
30.	6,3	39,69	6	36	7	49	44,1	42	37,8
31.	7,7	59,29	5	25	6	36	46,2	30	38,5
32.	7,7	59,29	8	64	6	36	46,2	48	61,6
33.	6	36	4	16	6	36	36	24	24
34.	6,7	44,89	7	49	6	36	40,2	42	46,9
35.	7,7	59,29	6	36	8	64	61,6	48	46,2
36.	6,3	39,69	5	25	6	36	37,8	30	31,5
37.	5,3	28,09	5	25	7	49	37,1	35	26,5
38.	7	49	6	36	7	49	49	42	42
39.	6	36	6	36	7	49	42	42	36
40.	7,3	53,29	7	49	7	49	51,1	49	51,1
41.	5,7	32,49	6	36	7	49	39,9	42	34,2
42.	6,7	44,89	7	49	7	49	46,9	49	46,9
43.	7,3	53,29	9	81	8	64	58,4	72	65,7
44.	6	36	5	25	7	49	42	35	30
45.	8,7	75,69	7	49	8	64	69,6	56	60,9
46.	5,3	28,09	5	25	7	49	37,1	35	26,5
47.	8	64	8	64	8	64	64	64	64
48.	6,3	39,69	6	36	7	49	44,1	42	37,8
49.	6	36	6	36	7	49	42	42	36
50.	7	49	8	64	8	64	56	64	56
51.	7,3	53,29	6	36	7	49	51,1	42	43,8

continued

No.	x_1	x_1^2	x_2	x_2^2	y	y^2	x_1y	x_2y	x_1x_2
52.	7	49	8	64	8	64	56	64	56
53.	6	36	6	36	7	49	42	42	36
54.	6,3	39,69	6	36	8	64	50,4	48	37,8
55.	8,3	68,89	7	49	7	49	58,1	49	58,1
56.	7	49	6	36	7	49	49	42	42
57.	5	25	5	25	7	49	35	35	25
58.	7	49	6	36	7	49	49	35	42
59.	6,3	39,69	7	49	7	49	44,1	49	44,1
60.	7	49	8	64	8	64	56	64	56
61.	7,3	53,29	6	36	7	49	51,1	42	43,8
62.	4,7	22,09	4	16	5	25	23,5	20	18,8
63.	6,3	39,69	6	36	6	36	37,8	36	37,8
64.	5,3	28,09	7	49	6	36	31,8	42	37,1
65.	5,3	28,09	4	16	6	36	31,8	24	21,2
66.	7,3	53,29	6	36	8	64	58,4	48	43,8
67.	6,3	39,69	7	49	7	49	44,1	49	44,1
68.	6,3	39,69	6	36	6	36	37,8	36	37,8
69.	5,7	32,49	5	25	6	36	34,2	30	28,5
70.	6,3	39,69	5	25	6	36	37,8	30	31,5
71.	7	49	4	16	7	49	49	28	28
72.	6	36	4	16	7	49	42	28	24
73.	7,7	59,29	8	64	7	49	53,9	56	61,6
74.	6	36	6	36	6	36	36	36	36
75.	7,3	53,29	7	49	6	36	43,8	42	51,1
76.	5,3	28,09	4	16	5	25	26,5	20	21,2
77.	7,3	53,29	7	49	7	49	51,1	49	51,1
78.	7	49	6	36	6	36	42	36	42
79.	7,3	53,29	6	36	6	36	43,8	36	43,8
80.	7	49	6	36	7	49	49	42	42

continued

No.	x_1	x_1^2	x^2	x_2^2	y	y^2	x_1y	x_2y	x_1x_2
81.	4	16	5	25	6	36	24	30	20
82.	7,7	59,29	7	49	7	49	53,9	49	53,9
83.	6,3	39,69	4	16	7	49	44,1	28	25,2
84.	7	49	7	49	6	36	42	42	49
85.	6,7	44,89	5	25	5	25	33,5	25	33,5
86.	7,3	53,29	8	64	7	49	51,1	56	58,4
87.	7	49	6	36	9	81	63	54	42
88.	8,3	68,89	6	36	8	64	66,4	48	49,8
89.	4,7	22,09	5	25	5	25	23,5	25	23,5
90.	4,3	18,49	5	25	4	16	17,2	20	21,5
91.	5,3	28,09	5	25	6	36	31,8	30	26,5
92.	4,3	18,49	5	25	6	36	25,8	30	21,5
93.	6,3	39,69	7	49	7	49	44,1	49	44,1
94.	6,7	44,89	6	36	7	49	46,9	42	40,2
95.	7,3	53,29	8	64	7	49	51,1	56	58,4
96.	5	25	6	36	5	25	25	30	30
97.	4	16	5	25	3	9	12	15	20
98.	4,3	18,49	6	36	3	9	12,9	18	25,8
99.	4	16	5	25	6	36	24	30	20
100.	7	49	6	36	9	81	63	54	42
Total	637,9	4172,45	601	3751	665	4531	4300,6	4021	3899,3

In order to be sure, then, I make a hypothesis test as in the following procedures:

1. H_0 : The coefficient of correlation of x_1 , x_2 , and y is equal to null.

$$R^2 = 0$$

H_1 : The coefficient of correlation of x_1 , x_2 , and y is not equal to null.

$$R^2 \neq 0$$

2. The confidence level (α) which is chosen is 5%.

3. Criteria:

a. H_0 is accepted if $-Z_{(\alpha/2)} \leq Z \leq Z_{(\alpha/2)}$.

b. H_0 is rejected if $Z < -Z_{(\alpha/2)}$ or $Z > Z_{(\alpha/2)}$.

From the Table III.2, x_1 refers to natural sciences, x_2 refers to mathematics, and y refers to English. And it can be obtained the total number as follows:

Σx_1	=	637,9
Σx_2	=	601
Σy	=	665
Σx_1^2	=	4172,45
Σx_2^2	=	3751
Σy^2	=	4531
$\Sigma (x_1y)$	=	4300,6

$$\Sigma (x_2y) = 4021$$

$$\Sigma (x_1x_2) = 3899,3$$

Before to be able to find the value of R^2 , it is necessary to find out the b_0 , b_1 , and b_2 as the variables of line equation of multi-linear correlation. The formula of the equation is:

$$y_i = b_0 + b_1 \cdot x_{1,i} + b_2 \cdot x_{2,i}$$

in which :

y_i = the value of y to i

$x_{1,i}$ = the value of x_1 to i

$x_{2,i}$ = the value of x_2 to i

Those variables can be known through the following equations.

$$n \cdot b_0 + \Sigma x_1 \cdot b_1 + \Sigma x_2 \cdot b_2 = \Sigma y \dots\dots\dots (1)$$

$$100 \cdot b_0 + 637,9 \cdot b_1 + 601 \cdot b_2 = 665$$

$$x_1 \cdot b_0 + x_1^2 \cdot b_1 + \Sigma (x_1x_2) \cdot b_2 = \Sigma (x_1y) \dots\dots\dots (2)$$

$$637,9 \cdot b_0 + 4172,45 \cdot b_1 + 3899,3 \cdot b_2 = 4300,6$$

$$x_2 \cdot b_0 + \Sigma (x_1x_2) \cdot b_1 + x_2^2 \cdot b_2 = \Sigma (x_2y) \dots\dots\dots (3)$$

$$601 \cdot b_0 + 3899,3 \cdot b_1 + 3752 \cdot b_2 = 4021$$

By using an elimination method, the values of b_0 , b_1 and b_2 can be figured out as follow:

equations (1) and (2)

$$\begin{array}{r}
 100.b_0 + 637,9.b_1 + 601.b_2 = 665 \quad \left| \begin{array}{l} \times 637,9 \\ \times 100 \end{array} \right| \\
 \hline
 637,9.b_0 + 4172,45.b_1 + 3899,3.b_2 = 4300,6 \\
 \hline
 063790.b_0 + 406916,41.b_1 + 383377,9.b_2 = 424203,5 \\
 63790.b_0 + 417245.b_1 + 389930.b_2 = 430060 \quad - \\
 \hline
 -10328,59.b_1 - 6552,1.b_2 = -5856,5 \\
 10328,59.b_1 + 6552,1.b_2 = 5856,5 \quad \dots\dots(4)
 \end{array}$$

equations (1) and (3)

$$\begin{array}{r}
 100.b_0 + 637,9.b_1 + 601.b_2 = 665 \quad \left| \begin{array}{l} \times 601 \\ \times 100 \end{array} \right| \\
 \hline
 601.b_0 + 3899.3.b_1 + 3751.b_2 = 4021 \\
 \hline
 60100.b_0 + 383377,9.b_1 + 361201.b_2 = 399665 \\
 60100.b_0 + 389930.b_1 + 375100.b_2 = 402100 \quad - \\
 \hline
 -6552,1.b_1 - 13899.b_2 = -2435 \\
 6552,1.b_1 + 13899.b_2 = 2435 \dots\dots\dots(5)
 \end{array}$$

equations (4) and (5)

$$\begin{array}{r}
 10328,59.b_1 + 6552,1.b_2 = 6455 \quad \left| \begin{array}{l} \times 13899 \\ \times 7093 \end{array} \right| \\
 6552,1.b_1 + 13899.b_2 = 2435 \\
 \hline
 143557072,4.b_1 + 98585607.b_2 = 89718045 \\
 42930014,41.b_1 + 98585607.b_2 = 15954363,5 \quad \underline{\quad} \\
 \hline
 100627058.b_1 = 65445130 \\
 b_1 = 0,65
 \end{array}$$

In equation (4), the value of b_2 can be obtained by substituting the value of b_1 into it.

$$\begin{aligned}
 10328,59.b_1 + 6552,1.b_2 &= 5856,5 \\
 10328,59.(0,65) + 6552,1.b_2 &= 5856,5 \\
 6713,58 + 6552,1.b_2 &= 5856,5 \\
 6552,1.b_2 &= 5856,5 - 6713,58 \\
 &= -857,08 \\
 b_2 &= -0,13
 \end{aligned}$$

With equation (1), the value of b_0 can be obtained by using substitutions of the value of b_1 and b_2 into it.

$$\begin{aligned}
 100.b_0 + 637,9.b + 601.b_2 &= 665 \\
 100.b_0 + 637,9 (0,65) + 601.(-0,13) &= 665 \\
 100.b_0 + 414,64 + (-78,13) &= 665 \\
 100.b_0 + 336,51 &= 665 \\
 100.b_0 &= 665 - 336,51 \\
 100.b_0 &= 328,49 \\
 b_0 &= 3,2849 \\
 b_0 &\approx 3,29
 \end{aligned}$$

Thus, the variables of line equation of multi-linear correlation which are stated as b_0 , b_1 and b_2 are:

$ \begin{aligned} b_0 &= 3,29 \\ b_1 &= 0,65 \\ b_2 &= -0,13 \end{aligned} $
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After finding out the value of those three variables, the coefficient of correlation is obtained by using the following formula:

$$R^2 = 1 - \frac{SSE}{SS}$$

In which SSE is the sum of squares for error and SS is the sum of squares.

The SSE itself can be found out by using the following formula:

$$\begin{aligned} SSE &= \Sigma y^2 - \Sigma y \cdot b_0 - \Sigma(x_1 \cdot x_2) \cdot b_1 - \Sigma(x_2 \cdot y) \cdot b_2 \\ &= 4531 - (665 \times 3,29) - (3899,3 \times 0,65) - \{4021 \times (-0,13)\} \\ &= 4531 - 2187,85 - 2795,39 + 522,73 \\ &= 4543,9 - 4983,24 \\ &= 70,49 \end{aligned}$$

And the SS value is found out by using the following computation.

$$\begin{aligned} SS &= \Sigma y^2 - \frac{(\Sigma y)^2}{n} \\ &= 4531 - \frac{665^2}{100} \\ &= 4531 - 4422,25 \\ &= 108,75 \end{aligned}$$

After acquiring the value of SSE and SS, the coefficient correlation of the scores of mathematics, natural sciences and English can be figured out by using computation below.

$$\begin{aligned}
 R^2 &= 1 - \frac{SSE}{SS} \\
 &= 1 - \frac{70,49}{108,75} \\
 &= 1 - 0,65 \\
 R^2 &= 0,35
 \end{aligned}$$

This statistical test uses normal distribution with the following formula:

$$Z = \frac{\sqrt{(n-3)}}{2} \ln \left\{ \frac{(1+R^2)(1-f_0)}{(1-R^2)(1+f_0)} \right\}$$

In which n = the sample size

R^2 = the correlation coefficient

f_0 = the value of null coefficient of
correlation

Thus, the value of normal distribution test is shown in the following:

$$\begin{aligned}
 Z &= \frac{\sqrt{(100-3)}}{2} \ln \left\{ \frac{(1+0,35)(1-0)}{(1-0,35)(1+0)} \right\} \\
 &= \frac{\sqrt{97}}{2} \ln \left\{ \frac{1,35}{0,8} \right\} \\
 &= \frac{9,85}{2} \ln 2,08 \\
 &= 4,93 \times 0,73 \\
 \mathbf{Z} &= \mathbf{3,61}
 \end{aligned}$$

This research uses 95% as the confidence level, so it means that the value of α is 5% ($\alpha = 100\% - 95\%$). Since this is a two-tailed statistical test, then the value of $Z_{(\alpha/2)}$ for $\alpha = 5\%$ is 1,96 (using normal distribution table or Z table). The diagram of the results is shown on Figure III.1.

Since the Z value resides at the right side of points of the normal distribution, thus H_0 is rejected or H_1 is automatically accepted. This means that there is a linear relationship among x_1 , x_2 and y .

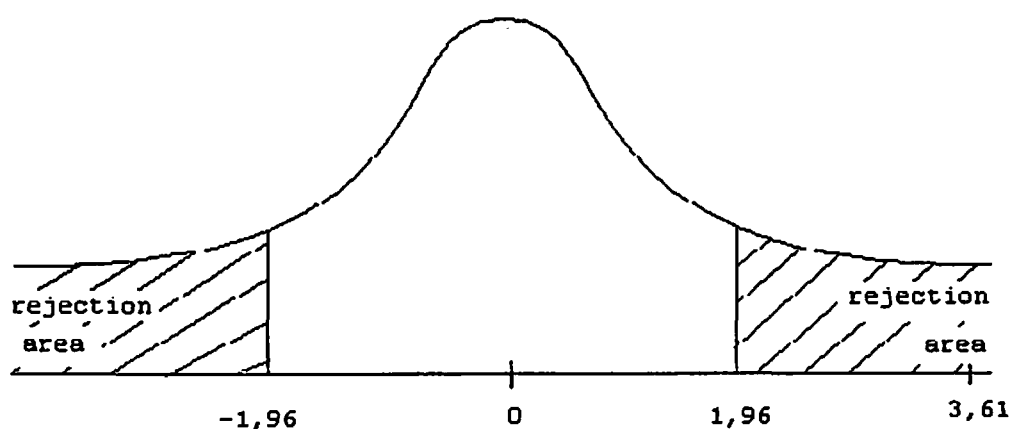


Figure III.1 Two-tailed diagram of normal distribution

III.3 The Interpretation of the Result

According to the previous description, it is found out that there are two evidences that support the result of statistical test. The first is the value of R^2 that is equal to 0,35, and the second is the Z value where resides at the right of thse normal distribution test or at the rejection area (see Figure III.1).

As the $R^2 = 0,35$, the value of correlation coefficient is considered positive. It means that there is a correlation among analytical reasoning, arithmetical, and language; in this case among the scores of natural sciences, mathematics, with English. Thus, the achievements of the scores of courses in natural sciences and mathematics are followed proportionally by the increase English scores.

However, the R^2 signifies that its value is small. It is said to be weak correlation which means the correlation is low. In other words, the abilities of analytic reasoning and arithmetical are not followed extensively by the ability of language.

The Z value resides at the right side of normal distribution test or in the rejection area. This proves that the null hypothesis is rejected and, automatically, the alternative hypothesis is accepted. Although the h_0 is rejected, it means there is an associative relationship among analytic reasoning and arithmetical to that of language.

The students' abilities of the three courses are almost the same, it indicates that the abilities of

language, analytic reasoning, and arithmetic are almost the same. A student may have a good mark in natural sciences, and then, he or she may get a good mark in English as well.

In accordance with lateralization of human brain, these three abilities are controlled by the same cerebral hemisphere, which is the left one. Thus, a student who has good achievement of analytic reasoning or arithmetic may also have good achievement of language.

There may be some external factors that affect the result of this study. These are students' interest, teaching method, family support, teachers personality, duration of learning those courses, students' motivation and perhaps more. Those factors can affect the students' language ability, especially in English course. For example, if a student is not interested in English, but in mathematics, certainly he will not get a good mark as well as his mathematics score. Or, if one student is interested in English only, then, he will not get a good score of other subjects.

However, this study may contribute that the value of correlation signifies an associative or linear

relationship among analytic reasoning and arithmetical to language where these abilities reside at the same cerebral hemisphere. In other words, the abilities which are controlled by the same hemisphere are propotionally the same.

CHAPTER IV

CONCLUSION