

Statistical Analysis Of The Scores Of Mathematics Department Students In The General IQ And Emotional Intelligence Test Using One-Way Analysis Of Variance With The Scheffe Test

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Abstract: *In this research, data on general intelligence and emotional intelligence scores were analyzed and the difference between them was studied in terms of their application to students of the Mathematics Department in the four stages in the College of Computer Science and Mathematics at the University of Kufa for the academic year 2023-2024. The statistical method is used to analyze the design of a factorial experiment to study the presence or absence of significant differences between the grades of students in the four stages by classifying the students in the four stages into males and females.*

Keywords: One-way analysis of variance. Completely Randomized Design (CRD). Scheffe Test

1. Introduction

The IQ test is a test used to measure an individual's mental abilities and estimate his level of intelligence. The roots of this test go back to the French scientist Alfred Bennet, who developed the first test to measure intelligence at the beginning of the twentieth century. IQ test questions depend on a set of specific standards and foundations, and data is collected from a large group of people who represent the statistical sample. This data is used as a standard for estimating intelligence, and based on the person's performance in the test, the (IQ) score is calculated, which indicates the extent of his superiority or lag in comparison. In the representative group [1]. Emotional intelligence (EQ) is defined as the ability to possess both the skills of recognizing emotions and expressing them the skills of regulating and managing emotions, and the skills of empathizing with others [2]. Forms for general intelligence (IQ) and emotional intelligence tests were distributed to all students in the four academic levels in the Mathematics Department at the College of Computer Science and Mathematics at the University of Kufa for the first semester, for the academic year 2023-2024. After that, each student's questionnaire was corrected and he was given a score representing his general intelligence quotient (IQ), and also a second score representing his emotional intelligence (EQ), based on the typical answers for both tests. The students' grades were arranged and organized with frequency statistical tables to be analyzed using appropriate statistical methods. Here in this article, a one-way analysis of variance was used to determine whether there are significant differences in the (IQ) of students between the four educational levels, and also to determine the presence or absence of significant differences in the (IQ) of students between the sexes (male and female). If there are significant differences between the intelligence levels of the four educational levels or between males and females, then we resort to the Schiffe test to make comparisons between each two groups separately, to determine and know which of the groups included in the comparison has a greater significant difference than others. We begin by describing the data through graphical forms that show the distribution of students' scores in the general intelligence (IQ) and emotional intelligence (EQ) tests across the four academic levels, as follows:

2. Describing data using graphs

After collecting the student results forms (males and females) in the general intelligence (IQ) and emotional intelligence (EQ) tests, they were arranged and presented with frequency tables and then drawn using the graphical shapes in this section. Figure No. 1 and Figure No. 2 show that the scores of male and female students in the emotional intelligence (EQ) test are almost equal, meaning that there are no clear significant differences between the scores of students in the four academic stages. While Figure No. 3 and Figure No. 4 show the clear significant differences between the students' grades for the four academic stages. The four graphs are shown as follows:



Figure 1. Distribution of male students' scores on the emotional intelligence (EQ) test at the four academic levels

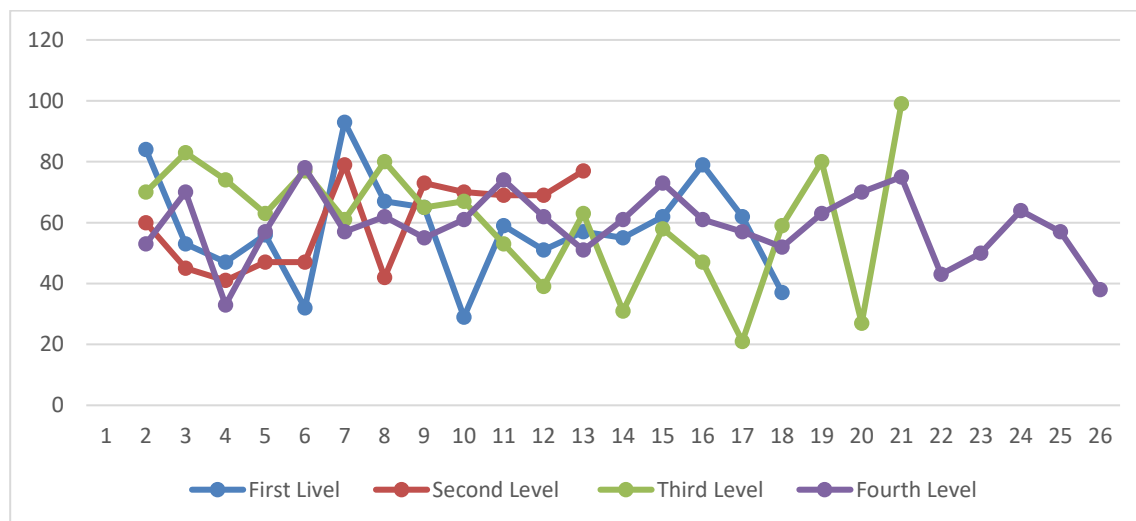


Figure 2. Distribution of female students' scores on the emotional intelligence (EQ) test at the four academic levels

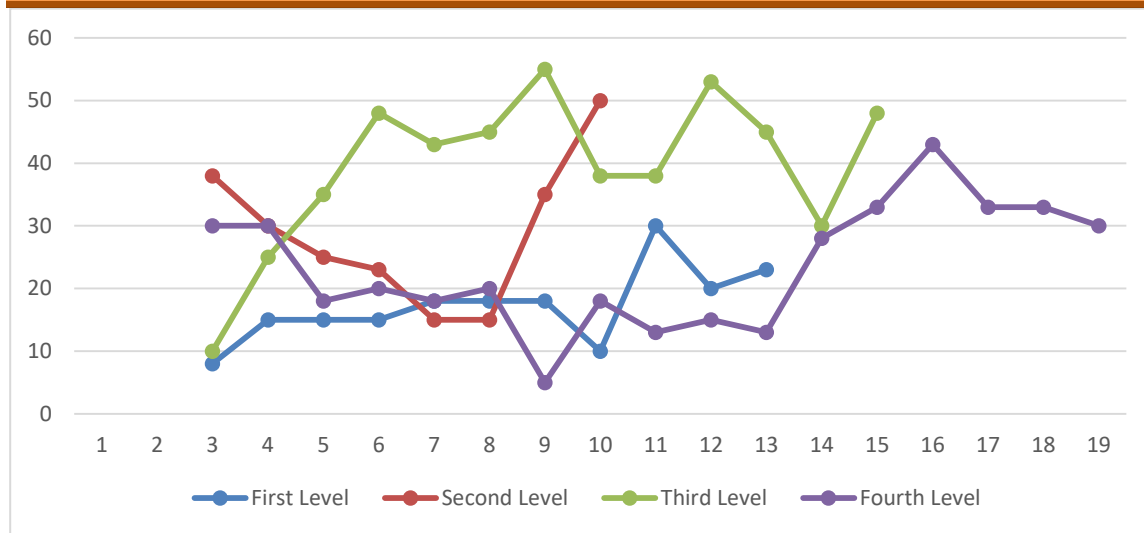


Figure 3. Distribution of male students' scores in the general intelligence (IQ) test across the four academic levels

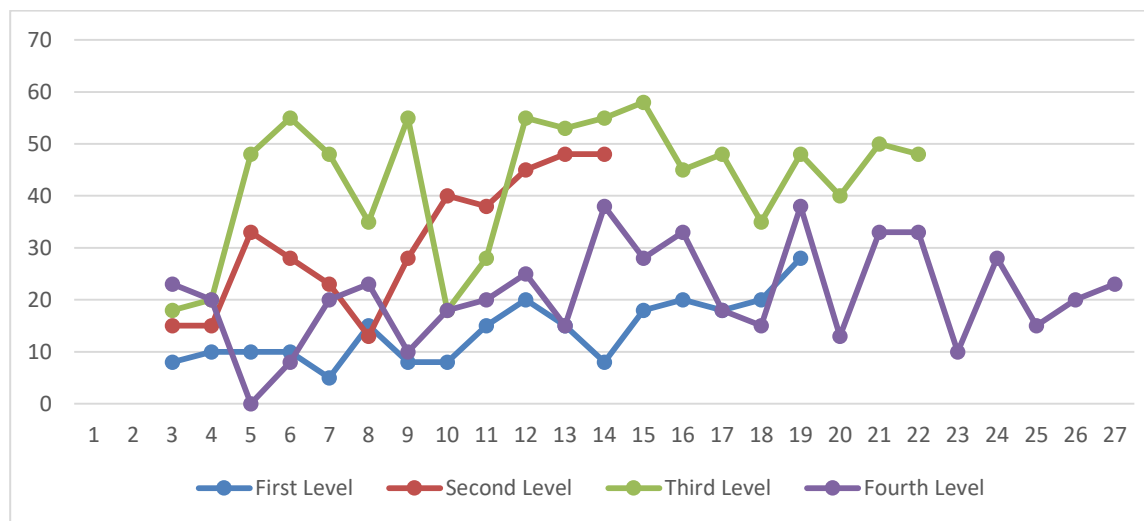


Figure 4. Distribution of female students' scores in the general intelligence (IQ) test across the four academic levels

3. One-way analysis of variance

The final data was arranged in two tables, the first showing the distribution of students' scores on the emotional intelligence test for the four academic levels, classified according to gender (males and females). The data was analyzed using a one-way analysis of variance, to determine the presence or absence of significant differences between the grades of female students in the four academic stages or not, through the F value calculated in the analysis of variance table. The same analysis was performed on the grades of male students. The results are shown in the following steps:

Table 1. Mathematics Department students' scores on the emotional intelligence (EQ) test, distributed according to student gender (male, female) for the first semester of the 2023-2024 academic year.

Educational Level Y_i	First Level Y_1		Second Level Y_2		Third Level Y_3		Fourth Level Y_4	
	Male G_1	Female G_1	Male G_2	Female G_2	Male G_3	Female G_3	Male G_4	Female G_4
n_i	66	84	81	60	65	70	51	53

n_2	53	53	35	45	53	83	58	70
n_3	63	47	71	41	65	74	63	33
n_4	66	56	62	47	59	63	63	57
n_5	69	32	71	47	75	77	3	78
n_6	49	93	47	79	60	61	73	57
n_7	42	67	83	42	73	80	85	62
n_8	51	65	57	73	49	65	47	55
n_9	65	29	-	70	62	67	42	61
n_{10}	61	59	-	69	55	53	63	74
n_{11}	53	51	-	69	79	39	64	62
n_{12}	-	57	-	77	63	63	69	51
n_{13}	-	55	-	-	70	31	54	61
n_{14}	-	62	-	-	-	58	51	73
n_{15}	-	79	-	-	-	47	79	61
n_{16}	-	62	-	-	-	21	73	57
n_{17}	-	37	-	-	-	59	55	52
n_{18}	-	-	-	-	-	80	-	63
n_{19}	-	-	-	-	-	27	-	70
n_{20}	-	-	-	-	-	99	-	75
n_{21}	-	-	-	-	-	-	-	43
n_{22}	-	-	-	-	-	-	-	50
n_{23}	-	-	-	-	-	-	-	64
n_{24}	-	-	-	-	-	-	-	57
n_{25}	-	-	-	-	-	-	-	38

The data in the table above is analyzed twice. The first analysis shows a one-way analysis of variance for females only to determine whether there is a significant difference between females in the four educational levels with regard to emotional intelligence (EQ) or not. The same applies to analyzing data on male grades only. The beginning will be by following the following steps to find a variance analysis table for the intelligence scores of female students only, as follows:

Write the statistical hypothesis as follows:

$$H_0 = \mu_1 = \mu_2 = \mu_3 = \mu_4$$

H_A : At least one of the means is different from the other means

Then start calculating the values of the correction factor, the sum of squares of the parameters, the sum of the squares of the total sum, and the sum of the squares of the error. Finally, create a variance analysis table to find out the calculated F values and compare them with the tabulated F value.

$$CF = \frac{y_{..}^2}{\sum ri} = 261740.5541, \quad SSt = \frac{\sum Y_i^2}{ri} - CF = 75.3745734, \quad SST = \sum Y_{ij}^2 - CF = 17690.44595, \quad SSe = SST - SSt = 17615.07137.$$

Table 2. Analysis of variance table for female students' scores on the emotional intelligence (EQ) test

S.O.V	df	S.S	M.S	F _{cal.}	F _{tab.}
Treat.	3	75.3745734	25.1248578	0.0998	2.76
Experimental Error	70	17615.07137	251.6438768		

Total	73	17690.44595	
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Since the calculated F value is less than its tabulated value, we conclude that there are no significant differences in the scores of female students on the emotional intelligence test for the four academic stages. The same steps above are applied for the purpose of obtaining an analysis of variance table for male students' scores on the emotional intelligence test

Write the hypotheses to be tested:

$$H_0 = \mu_1 = \mu_2 = \mu_3 = \mu_4$$

H_A : At least one of the means is different from the other means

The, calculate the Correction Factor, such that: $CF = \frac{Y_{..}^2}{\sum r_i} = 179533.8$, Treatment sum of square $SSt = \frac{\sum Y_i^2}{r_i} - CF = 341.4422$, Total sum of square $SST = \sum Y_{ij}^2 - CF = 9348.204$, Error sum of square $SSe = SST - SSt = 9006.762$.

Table 3. Analysis of variance table for male students' scores in the emotional intelligence (EQ) test

S.O.V	df	S.S	M.S	F _{cal.}	F _{tab.}
Treat.	3	341.4422	113.8141	0.568643	2.84
Experimental Error	45	9006.762	200.1503		
Total	48	9348.204			

We note from the table above that the calculated F value is less than its tabulated value. Therefore, we conclude that there are no significant differences between the scores of male students in the emotional intelligence test for the four academic stages.

Table 4. Mathematics Department students' scores on the general intelligence (IQ) test distributed according to the student's gender (male, female) for the first semester of the 2023-2024 academic year.

Educational Level Y_i	First Level Y_1		Second Level Y_2		Third Level Y_3		Fourth Level Y_4	
	Male G_1	Female G_1	Male G_2	Female G_2	Male G_3	Female G_3	Male G_4	Female G_4
n_i								
n_1	8	8	38	15	10	18	30	23
n_2	15	10	30	15	25	20	30	20
n_3	15	10	25	33	35	48	18	0
n_4	15	10	23	28	48	55	20	8
n_5	18	5	15	23	43	48	18	20
n_6	18	15	15	13	45	35	20	23
n_7	18	8	35	28	55	55	5	10
n_8	10	8	50	40	38	18	18	18
n_9	30	15	-	38	38	28	13	20
n_{10}	20	20	-	45	53	55	15	25
n_{11}	23	15	-	48	45	53	13	15
n_{12}	-	8	-	48	30	55	28	38
n_{13}	-	18	-	-	48	58	33	28
n_{14}	-	20	-	-	-	45	43	33
n_{15}	-	18	-	-	-	48	33	18
n_{16}	-	20	-	-	-	35	33	15
n_{17}	-	28	-	-	-	48	30	38
n_{18}	-	-	-	-	-	40	-	13
n_{19}	-	-	-	-	-	50	-	33

n_{20}	-	-	-	-	-	48	-	33
n_{21}	-	-	-	-	-	-	-	10
n_{22}	-	-	-	-	-	-	-	28
n_{23}	-	-	-	-	-	-	-	15
n_{24}	-	-	-	-	-	-	-	20
n_{25}	-	-	-	-	-	-	-	23

By following the same steps and applying the same equations above, the students' scores (males and females) in the general intelligence (IQ) test are analyzed. The analysis of variance tables for both males and females are shown as follows:

Table 5. Table of variance analysis of female students' scores on the general intelligence (IQ) test.

S.O.V	df	S.S	M.S	F _{cal.}	F _{tab.}
Treat.	3	9129.7151	3043.2384	27.397974	2.76
Experimental Error	70	7775.2714	111.07531		
Total	73	16904.986			

The table above shows that the calculated F value is greater than its tabulated value. Therefore, we find that there is a clear significant difference between the scores of female students in the general intelligence test in the four academic levels.

Table 6. Table of variance analysis of male students' scores on the general intelligence (IQ) test.

S.O.V.	df	S.S	M.S	F _{cal.}	F _{tab.}
Treat.	3	3290.008	1096.669	10.40149	2.84
Experimental Error	45	4744.523	105.4338		
Total	48	8034.531			

When comparing the scores of male students in the general intelligence test (IQ), we found that there is a significant difference between the scores of students in the four educational levels, noting the calculated F value, which indicates that it is greater than its tabulated value. Therefore, we conclude that there is a significant difference between the scores.

4. Scheffe Test

The use of the Scheffe test comes after we obtained significant differences in the analysis of variance table, where we found that there are clear significant differences between the scores of students (males, females) in the general intelligence test among students in the four stages. Accordingly, the Scheffe test was used to find out which of these four educational levels recorded the highest (IQ) scores among its students, whether male or female. As follows:

Table 7. The general conclusion of the Scheffe test for differences between the grades of male students

Treatment	F _{Scheffe}	F _{Critical}	Conclusion
Y ₁ vs. Y ₂	5.913371712	8.52	not Significant
Y ₁ vs. Y ₃	27.82356875	8.52	Significant
Y ₁ vs. Y ₄	2.479659529	8.52	not Significant
Y ₂ vs. Y ₃	5.264316261	8.52	not Significant
Y ₂ vs. Y ₄	1.4743815	8.52	not Significant
Y ₃ vs. Y ₄	17.735298	8.52	Significant

The table above shows that there is a significant difference between the values of students' scores on the general intelligence test in the first and third academic stages, as well as the fourth and third grades. Therefore, it can be said that the third academic stage recorded a significant difference from the rest of the educational stages in the general intelligence level of its male students.

Table 8. The general conclusion of the Scheffe test for differences between the grades of female students

Treatment	F_{Scheffe}	F_{Critical}	Conclusion
Y_1 vs. Y_2	18.919904	8.28	Significant
Y_1 vs. Y_3	70.141045	8.28	Significant
T_1 vs. Y_4	4.7195785	8.28	not Significant
Y_2 vs. Y_3	9.4549219	8.28	Significant
Y_2 vs. T_4	7.4267252	8.28	not Significant
Y_3 vs. Y_4	48.064129	8.28	Significant

We notice a significant difference in the general intelligence percentage of female students for the four academic stages, specifically between female students in the first and second stages, first and third, second and third, and third and fourth. Therefore, it can be concluded that there is a significant difference in IQ among female students in the third stage compared to the rest of the four educational stages.

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