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Students' Course Grades Analysis "Practical Case"

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A R T I C L E I N F O

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A B S T R A C T

To maintain the benefits and improve the course procedure for the next year, this work is devoted to evaluating my course of computer at the faculty of tourism at the Lebanese University during the academic year 2021–2022. Additionally, we want to mention that this method can be used as a model for any similar course evaluation. According to the results, some variables of grades are normally distributed while others are not normally distributed. The final grade average and partial grade average for each student are different from one another. Final grades were statistically equal for both male and female students. The final grade average for this year and last year is the same. There is a correlation between participation and presence grades and the other grades, except the mid-exam grades. Also, the final grades and all other grades, except the mid-exam grades, are correlated. For the following year, we need to make sure that students attend more lectures to raise their grades. Also, to have an impact on final grades, we need to put more effort into mid-exam preparation.

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INTRODUCTION

This work presents the statistical analysis of the grades for the Computer Application course (Semester 4 - Second Year - Hotel Management Section) for the academic year 2021-2022 at the Faculty of Tourism and Hospitality Management - Lebanese University. The six variables that have been taken into account for each student are students' gender, students' presence & participation, students' mid-exam grades, students' final-exam grades, students' partial grades, and students' final grades. Their succinct justifications are as follows:

a) Students' presence & participation grades include counting the student's attendance at lectures and adding marks for the student's involvement as well;
b) Students' mid-exam grades came from a written exam that includes the first part of the course;
c) Students' partial grades are composed of the previous grades (a) and (b), as well as further evaluation;
d) Students' final-exam grades came from a written exam that includes the second part of the course;
e) Students' final grades contain 40% of the partial grades & 60% of the final-exam grades.

The main goal for this work is to continue evaluating the current situation of the Computer Application course by doing the appropriate statistical analysis to describe well and improve the procedure method of the course in the next coming year. The objectives can be summarized as follows: testing the grades' distribution normality of the different variables; determining whether the final grade average for the current year is equal to the prior year; checking to see if each student's final and partial grades are nearly the same; assessing whether the average grade for male and female students is the same; and evaluating the correlation between all grades' components. Additionally, relationships between student attendance or absences and all variables are shown, as in [1]. Based on the above goal and objectives, the following hypotheses have been formulated to be tested if they can be accepted or rejected:

- ✓ H1: Students' grades have a normal distribution (A test of normality will be used).
- ✓ H2: Final grades mean (2022) is statistically the same as the previous year's (2021) final grades mean (One sample t-test will be used).
- ✓ H3: Final grades and partial grades for each student are statistically the same (Paired t-test will be used).
- ✓ H4: Mean of final grades of female students and mean of final grades of male students are statistically the same (Independent sample t-test will be used).
- ✓ H5: The increase in the presence & participation grades yields increasing in the mid-exam grades, final-exam grades, partial grades, and final grades (regression equation will be used).
- ✓ H6: There are correlations between final grades & each of the mid-exam, final-exam, and partial grades (regression equation will be used).

This paper is organized as follows: The related work is discussed in Section 2, the case processing results are summarized in Section 3, the descriptive statistics of all variables are presented in Section 4, the histograms of all variable with the tests for normality are presented in Section 5, the final grades average comparison with the final grades average from the previous year is written in Section 6, the final grades and partial grades comparison with each student is presented in Section 7, the final grades of male and female students are compared in section 8, the impact of attendance and participation on the other grades is discussed in section 9, the relationship between the final grades and each final exam, partial grade, and mid-exam is discussed in section 10, the distribution of the various grades is discussed in section 11, and conclusions are made in section 12.

THEORETICAL REVIEW

There are many works in the literature and the state of the art related to analyzing course grades and course assessment. For example, the relationship between course evaluations and course grades in six allied health programs have been discussed in [2], and stated that the student course evaluations are important tools for course assessment. [3] discusses the prediction of academic performance at undergraduate graduation for course grades or grade point average. [4] presents a Case study of student grade distribution shifts in online engineering fundamental course. [5] shows an analysis of students' grades in mathematics, english, and programming courses. [6] presents an implementation of latest machine learning approaches for students' grade prediction.

The following is a list of my related previous work: [7] presents a comparison of students' grades between the online exam and the written exam done on the university campus for the computer application course; [8] presents an analysis of students' opinions on the online computer course during covid 19 at the Lebanese university's Faculty of tourism; [9] presents a proposed method to be adopted for an online exam without proctored environment during covid 19; [10] presents an analysis of a questionnaire on the opinions of students of an online computer course during the pandemic. The statistical analysis employed in this paper is supported by numerous sources, including [11] [12] [13] [14] [15]. Also, previous works have been used such as the proposed guide for questionnaire analysis part 1 [16] & part 2 [17] and the questionnaire analysis roadmap [18].

METHODOLOGY

The case processing summary is shown in the following table. It contains the included cases, excluded cases, and total cases.

Table 1. The Case Processing Summary

	Included Cases		Excluded Cases		Total	
	N	Percent	N	Percent	N	Percent
Full Name	44	100.0%	0	0.0%	44	
Presence & Participation	43	97.7%	1	2.3%	44	100%
Mid-exam	41	93.2%	3	6.8%	44	100%
Final-exam	36	81.8%	8	18.2%	44	100%
Partial Grades	43	97.7%	1	2.3%	44	100%
Final Grades	44	100.0%	0	0.0%	44	100%

We will focus our study on the 36 students (81.8%) who have all types of grades, and we will omit the remaining 8 students (18.2%). The 36 students' grades along with their gender are listed in the following table:

Table 2. The 36 Students' Grades along with Their Gender

Student Number	Gender	Presence & Participation	Mid-exam	Final-exam	Partial Grades	Final Grades
1	M	100	72	94	79	88.00
2	F	72	78	90	77	84.80
3	M	80	90	89	88	88.60
4	F	56	72	86	68	78.80
5	M	88	82	85	84	84.60
6	F	80	80	83	80	81.80
7	M	88	88	82	88	84.40
8	F	56	86	81	79	80.20
9	F	80	84	80	83	81.20
10	F	96	74	80	80	80.00
11	M	72	80	79	78	78.60
12	M	64	84	78	79	78.40
13	F	64	76	77	73	75.40
14	M	88	84	76	85	79.60
15	F	80	76	76	77	76.40
16	F	96	84	75	87	79.80
17	M	72	76	72	75	73.20
18	M	88	82	71	84	76.20
19	F	88	82	69	84	75.00
20	F	80	84	69	83	74.60
21	M	88	80	68	82	73.60
22	F	48	84	68	75	70.80
23	M	40	84	68	73	70.00
24	M	56	82	67	76	70.60
25	F	72	74	66	74	69.20
26	F	40	78	66	69	67.20
27	F	72	84	65	81	71.40
28	M	88	84	62	85	71.20
29	F	72	78	62	77	68.00
30	M	72	86	61	83	69.80
31	M	88	82	57	84	67.80
32	M	48	84	48	75	58.80

33	M	64	72	43	70	53.80
34	M	56	76	40	71	52.40
35	M	32	80	34	68	47.60
36	F	48	84	32	75	49.20

RESULTS

This section contains the descriptive statistics for each variable. Starting with their gender's frequency distributions table as shown in the table below:

Table 3. This Section Contains the Descriptive Statistics for each Variable

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	20	55.6	55.6	55.6
	Female	16	44.4	44.4	100.0
	Total	36	100.0	100.0	

For each of the five numerical questions, the following table displays the central tendency (mean, median, and mode), dispersion (standard deviation, maximum, and minimum), distribution type (skewness and kurtosis), and percentiles (quartiles 1, 2, and 3):

Table 4. The Displays the Central Tendency

Statistics						
		Mid-exam	Presence & Participation	Partial Grades	Final-exam	Final Grades
N	Valid	36	36	36	36	36
	Missing	0	0	0	0	0
Mean		80.72	71.44	78.58	69.42	73.0833
Median		82.00	72.00	79.00	70.00	74.8000
Mode		84	88	75[a]	68	47.60[a]
Std. Deviation		4.639	17.635	5.669	15.163	10.25095
Skewness		.365	.474	.204	.898	.984
Kurtosis		.591	.632	.836	.553	.704
Minimum		72	32	68	32	47.60
Maximum		90	100	88	94	88.60
Percentiles	25	76.50	56.00	75.00	62.75	69.3500
	50	82.00	72.00	79.00	70.00	74.8000
	75	84.00	88.00	83.75	80.00	79.9500
a. Multiple modes exist. The smallest value is shown						

In this section, the histogram of the five numerical questions with the proposed normal distribution curves are presented. The mid-exam grades histogram and its normal curve are shown in the figure below:

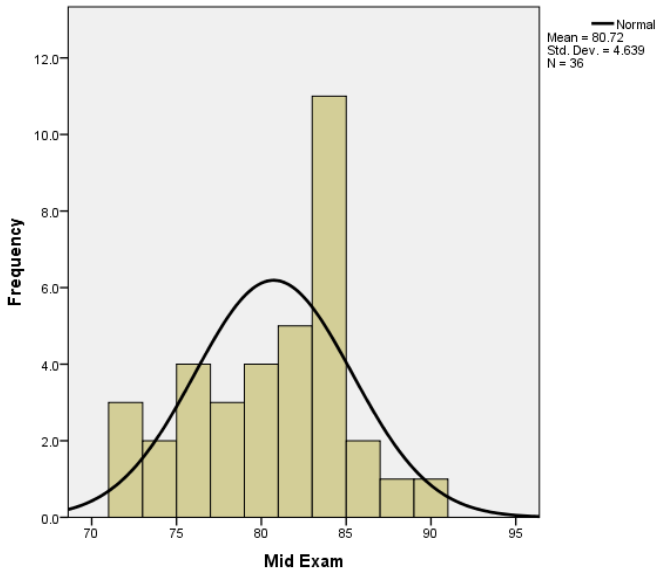

Figure 1. The Mid Exam Grades Histogram and its Normal Curve

The presence and participation grades histogram and its normal curve are shown in the figure below:

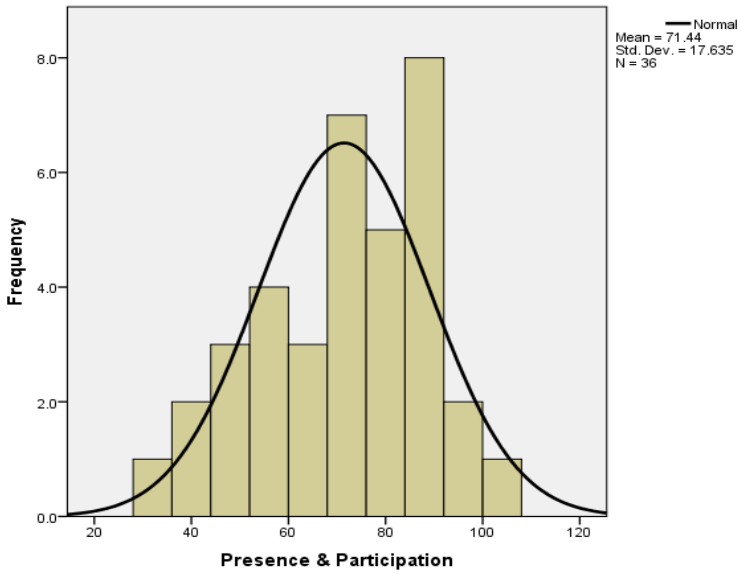

Figure 2. The Presence and Participation Grades Histogram and its Normal Curve

The partial grades histogram and its normal curve are shown in the figure below:

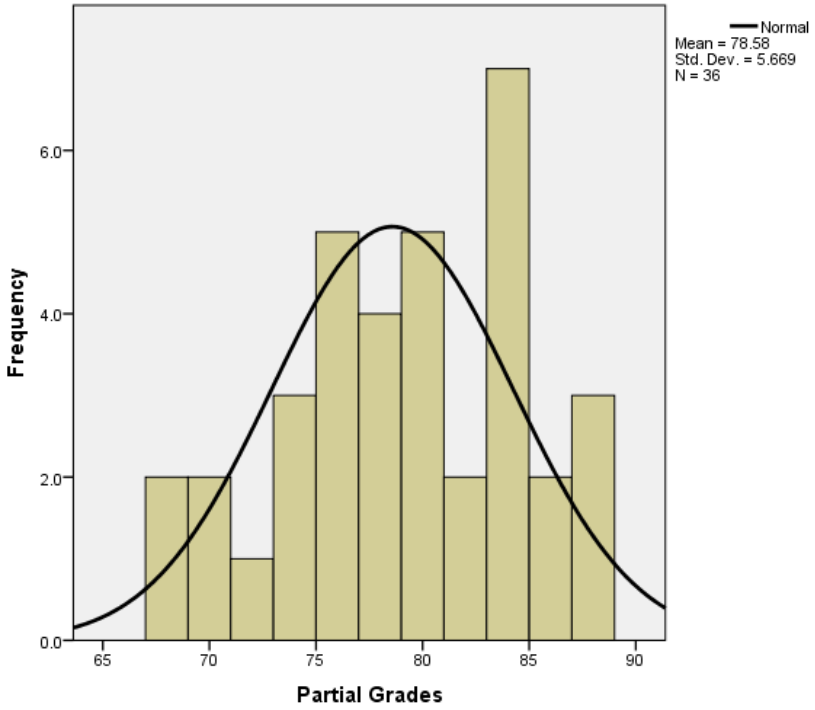

Figure 3. The Partial Grades Histogram and its Normal Curve

The final-exam grades histogram and its normal curve are shown in the figure below:

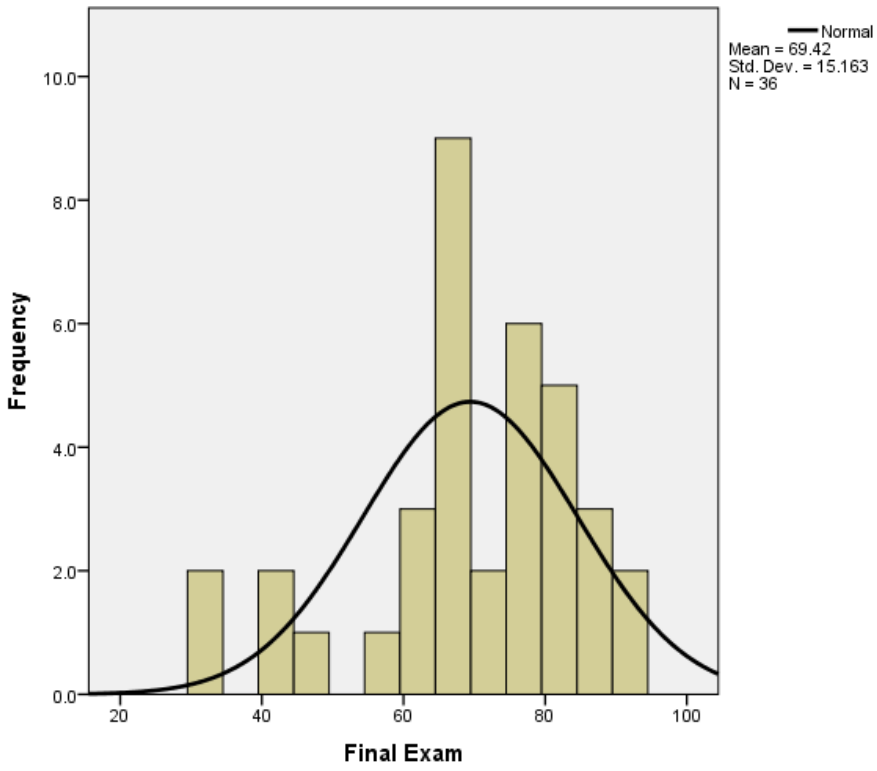

Figure 4. The Final Exam Grades Histogram and its Normal Curve

The final grades histogram and its normal curve are shown in the figure below:

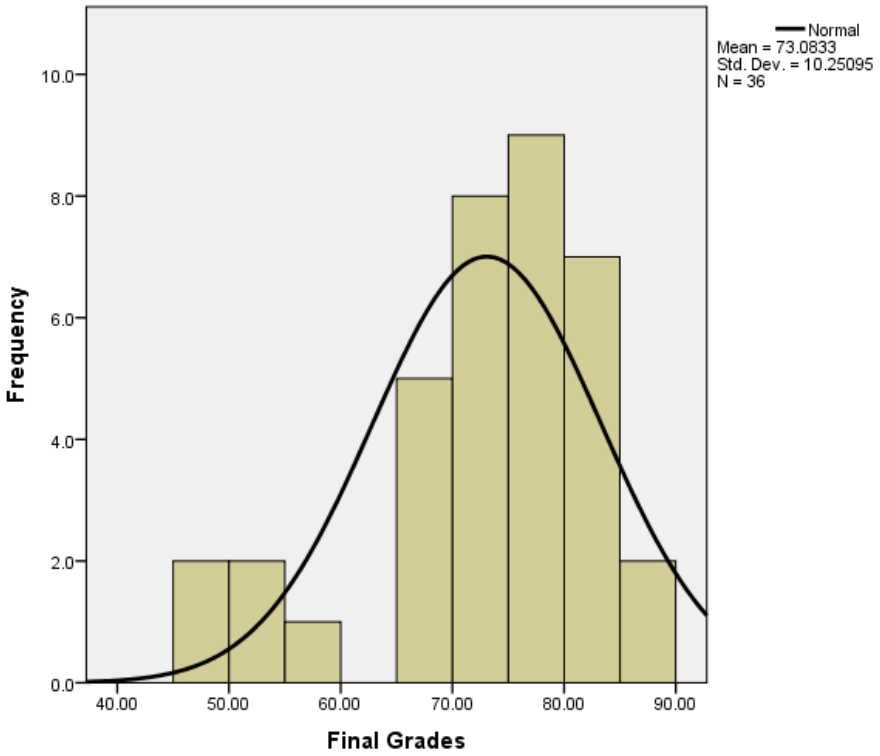

Figure 5. The Final Grades Histogram and its Normal Curve

The following table displays the tests of normality:

Table 5. The Displays the Tests of Normality

Tests of Normality						
	Kolmogorov: Smirno[va]			Shapiro: Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mid-exam	.177	36	.006	.936	36	.039
Presence & Participation	.151	36	.036	.946	36	.076
Partial Grades	.115	36	.200*	.964	36	.284
Final-exam	.135	36	.093	.930	36	.025
Final Grades	.144	36	.057	.914	36	.008

From the above table, H1 is accepted for both presence & participation grades (p-value=7.6%) and partial Grades (p-value=28.4%), then we conclude that they are normally distributed since their p-value is > 5%. While H1 is rejected for mid-exam grades, final-exam grades, and final grades, then we conclude that they are not normally distributed (p-value is < 5%). Since the number of students is 36, which is greater than 30, then the central limit theorem [19] can be taken into account for inferencing the mean grades even if there is no normal distribution.

The previous year's mean grade was 37.7/50 or 75.4/100 (presented in [3]). Now, is there a significant difference between this year's mean and the previous one? By using the one-sample t-test, we get that there is no significant difference, since the p-value=18.4% which is greater than 5%. Then we conclude

that H2 is accepted (The final grades mean is statistically equal to the previous year's final grades).

Is there a significant difference between each student's partial grade and final grade? A paired t-test will be used. The results are shown in the following tables. It shows us that they are different and not the same since the p-value equals 0 which is less than 5%. Then H3 is rejected (There is a significant difference between final grade and partial grade for each student). Is there a significant difference between the mean grades of female students and male students? An Independent sample t-test will be used. The results are shown in the following tables. It shows that there are no significant differences since the p-value equals 54.4% > 5%. Then H4 is accepted (The mean grades of male and female students do not significantly differ from one another).

DISCUSSION

In this section, we try to test that the increase in the presence & participation grades yields increasing in the mid-exam grades, final-exam grades, partial grades, and final grades (this is the H5 hypothesis). As shown in the next table of correlations, H5 is accepted for final-exam grades, partial grades, and final grades; and H5 is rejected for mid-exam grades:

Table 6. The Increase in the Presence & Participation Grades Yields Increasing in the Mid Exam Grades

Correlations					
		Mid-exam	Partial Grades	Final-exam	Final Grades
Presence & Participation	Pearson Correlation	0.005	.786**	.520**	.636**
	Sig. (2:tailed)	0.977	0	0.012	0
	N	36	36	36	36
**. Correlation is significant at the 0.01 level (2:tailed).					
*. Correlation is significant at the 0.05 level (2:tailed).					

- ✓ There is a negligible correlation (correlation = .005 nearly is 0 & p-value = 97.7%>5%) between mid-exam grades and presence & participation (H5 for mid-exam is rejected). Then there is no need for proposing a regression equation.
- ✓ There is a strong correlation (correlation = .636 > 0.6 & p-value = 0%<5%) between presence & participation and final grades (H5 for final grades is accepted). Then the following regression equation can be proposed, which shows a positive slope:

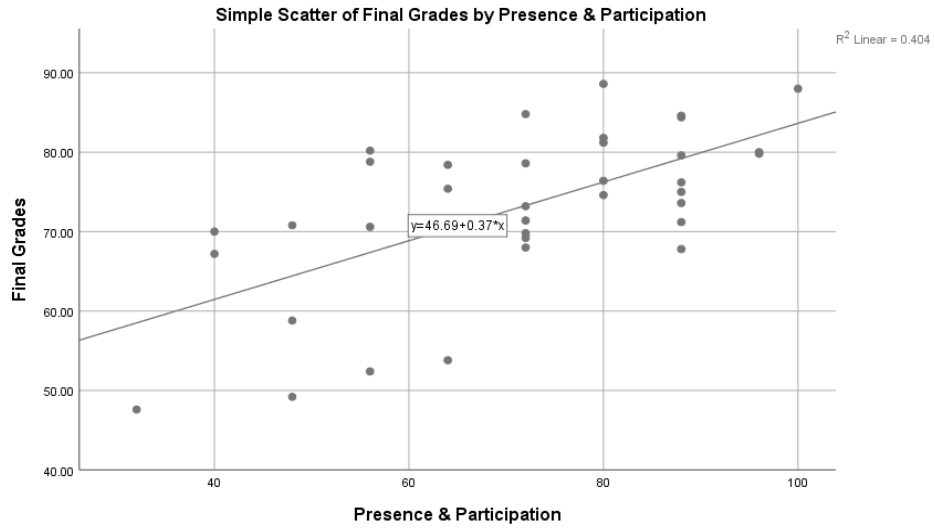

Figure 6. Simple Scatter of Final Grades by Presence & Participation

✓ There is a relatively strong correlation (correlation = .520 & p-value = 1.2%<5%) between final-exam grades and presence & participation. (H5 for final-exam grades is accepted). Then the following regression equation can be proposed, which shows a positive slope:

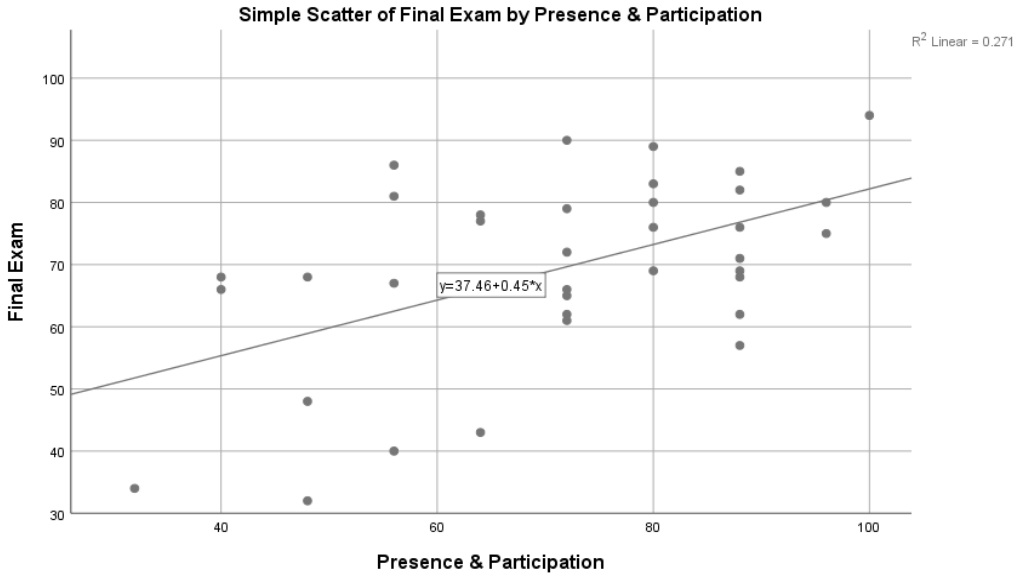

Figure 7. Simple Scatter of Final Grades by Presence & Participation

✓ There is a strong correlation (correlation = .786 & p-value = 0%<5%) between partial grades and presence & participation (H5 for partial grades is accepted). Then the following regression equation can be proposed, which shows a positive slope:

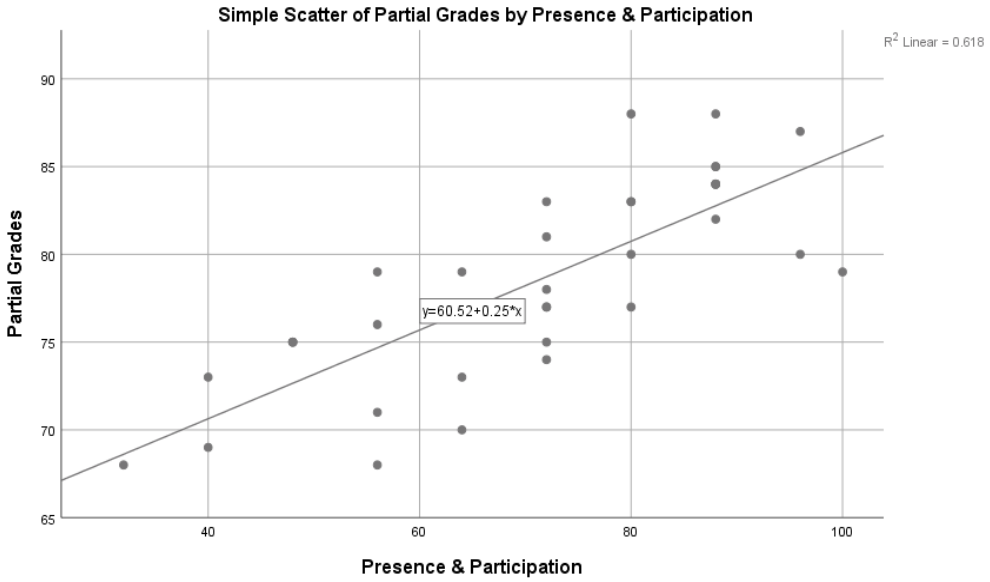

Figure 8. Simple Scatter of Final Grades by Presence & Participation

In this section, we try to test the H6 hypothesis, which states that there are correlations between final grades and each of mid-exam, final-exam, and partial grades. As shown in the next table of correlations, H6 is accepted for final-exam grades and partial grades; and H6 is rejected for mid-exam grades:

Table 7. The Table of Correlations, H6 is Accepted for Final Exam Grades and Partial Grades; and H6 is Rejected for Mid Exam Grades

Correlations				
		Mid-exam	Partial Grades	Final-exam
Final Grades	Pearson Correlation	0.144	.591**	.980**
	Sig. (2:tailed)	0.402	0	0
	N	36	36	36
**. Correlation is significant at the 0.01 level (2:tailed).				
*. Correlation is significant at the 0.05 level (2:tailed).				

- ✓ There is a very strong correlation (correlation = 0.980 > 0.8 & p-value = 0%<5%) between final-exam and final grades. In this relation, H6 for the final-exam is accepted. Then the following regression equation can be proposed, which shows a positive slope:

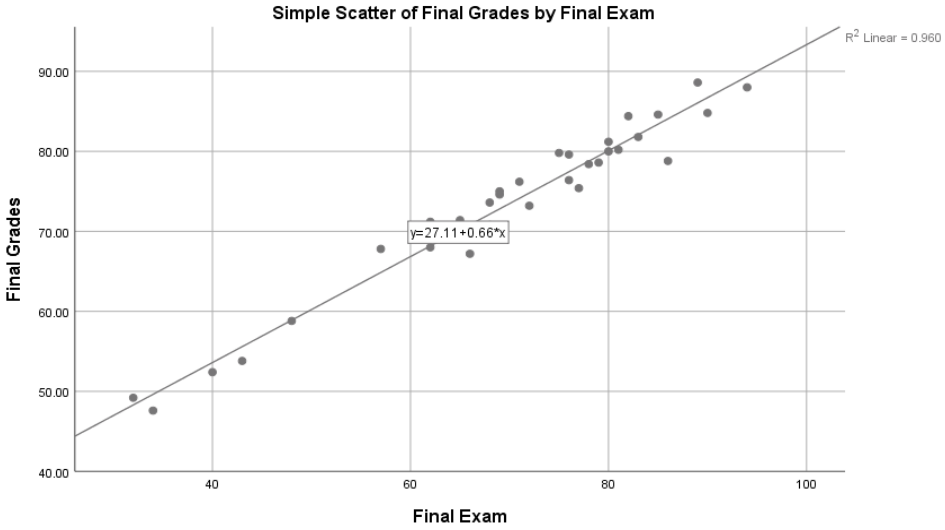

Figure 9. Simple Scatter of Final Grades by Presence & Participation

✓ There is a relatively strong correlation (correlation = .591 > 0.4 & p-value = 0%<5%) between partial grades and final grades. In this relation, H6 for partial grades is accepted. Then the following regression equation can be proposed, which shows a positive slope:

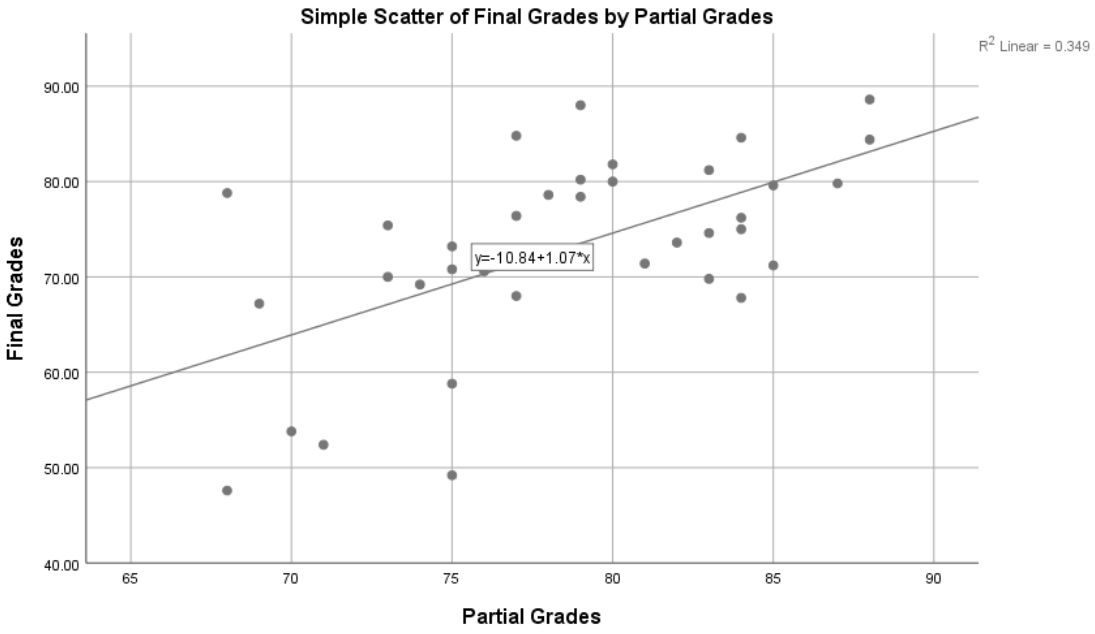

Figure 10. Simple Scatter of Final Grades by Presence & Participation

✓ There is a weak correlation (correlation = .144 < 0.2 & p-value = 40.2%>5%) between mid-exam grades and final grades. In this relation, H5 for mid-exam grades is rejected. Then there is no need for a regression equation.

Also, we get that there is a negligible correlation between mid-exam grades and final-exam grades (correlation = .008 nearly is 0); there is a strong correlation (correlation = .620 nearly is 0) between mid-exam grades and partial

grades; there is a relatively strong correlation (correlation = .416 nearly is 0) between final-exam grades and partial grades.

Since the test of normality of the variables in section 4 is accepted only for two variables "presence & participation grades and partial grades", then we can say that the distributions of the different grades are statistically different. If the test of normality was accepted for all variables, then we can say that the distributions of the different grades are statistically the same (normal distribution); and in this case, the ANOVA test can be used to test if they have statistically the same average or no.

In our case, and because the distributions of the different grades are statistically different, we can use the Friedman test [20] to demonstrate the same result obtained in section 4 (This will confirm also the H1 result) and to know more about the differences between every two variables. As it is well known that the Friedman test is the non-parametric alternative to the one-way ANOVA with repeated measures and it is used to test for differences between groups when the dependent variable being measured is ordinal or not normal distribution continuous data.

The figure below (done by SPSS) shows us that "the distributions of the different grades are the same" is rejected. Consequently, the different grades do not have statistically the same distributions. The figure below (done by SPSS) shows us the distribution and mean rank value of each variable. The test statistic is 29.092 and the p-value is 0%< 5% (It confirms the rejection of the null hypothesis).

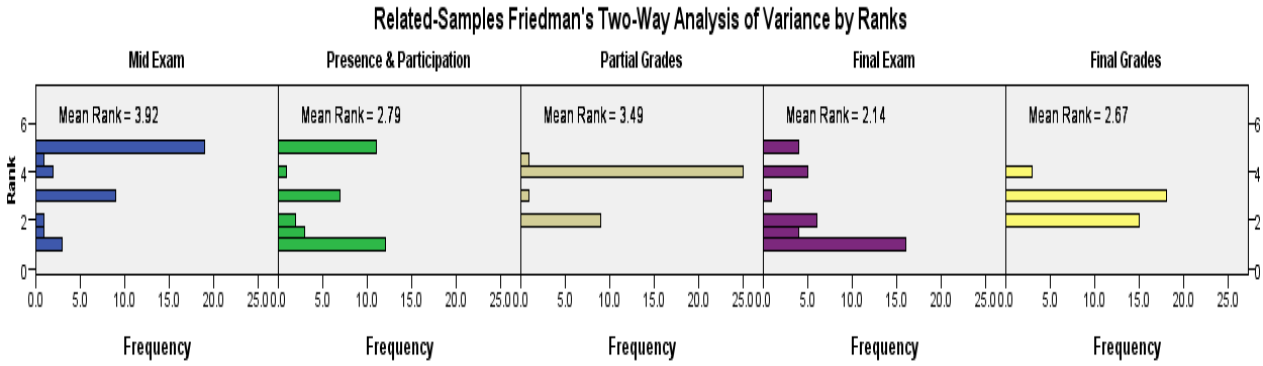

Figure 11. Related Samples Friedman's Two Way Analysis of Variance by Ranks

The figure below shows the variations between each pair of variables. If the p-value is greater than 5%, then any two variables have the same statistical distribution and mean rank. The distributions are statistically different elsewhere if the p-value is less than 5% (Yellow color). According to the above figure, the mid-exam grades and partial grades have near values (3.92 and 3.49 respectively), and the other grades' mean ranks also appear to have near values (2.79, 2.14, and 2.67). These mean rank values are depicted in the figure below. Where a variable from the first group of mean rank is paired with a variable from

the second group, we have a different distribution; otherwise, we have a similar distribution.

Each node shows the sample average rank.

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj.Sig.
Final Exam-Final Grades	-.528	.373	-1.416	.157	1.000
Final Exam-Presence & Participation	.653	.373	1.752	.080	.798
Final Exam-Partial Grades	1.347	.373	3.615	.000	.003
Final Exam-Mid Exam	1.778	.373	4.770	.000	.000
Final Grades-Presence & Participation	.125	.373	.335	.737	1.000
Final Grades-Partial Grades	.819	.373	2.199	.028	.279
Final Grades-Mid Exam	1.250	.373	3.354	.001	.008
Presence & Participation-Partial Grades	-.694	.373	-1.863	.062	.624
Presence & Participation-Mid Exam	1.125	.373	3.019	.003	.025
Partial Grades-Mid Exam	.431	.373	1.155	.248	1.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.
Significance values have been adjusted by the Bonferroni correction for multiple tests.

Figure 12. These Mean Rank Values are Depicted

CONCLUSIONS AND RECOMMENDATIONS

The results of the seven hypotheses are summarized as shown in the table below:

- ✓ H1 is accepted for both presence & participation grades and partial grades (they are normally distributed, and it is rejected for mid-exam grades, final-exam grades, and final grades (they are not normally distributed). This result means that the five variables do have not the same distribution.
- ✓ H2 is accepted. It means that the final grades mean is statistically equal to the previous year's final grades.
- ✓ H3 is rejected. It means that the final grades and partial grades for each student are statistically different.
- ✓ H4 is accepted. It means that the mean of final grades of female students and male students are statistically the same.
- ✓ H5 is accepted between presence & participation and each of final grades (with a strong correlation 0.636 > 0.6), final-exam grades (with a relatively strong correlation 0.520 > 0.4) and partial grades (with a strong correlation 0.786 > 0.6); and it is rejected with the mid-exam (negligible correlation .005 nearly is 0). In a conclusion, the students' grades are directly impacted by their presence and participation, except for the mid- exam.

- ✓ H6 is accepted between final grades and each of final-exam (with a very strong correlation 0.980 > 0.8) and partial grades (with a relatively strong correlation 0.591 > 0.4); and it is rejected with mid-exam grades (with weak correlation 0.144 < 0.2). In a conclusion, as we said in H5, we have to make more attention to the mid-exam preparation in the next year.

From the overall results, we conclude that not all types of grades are normally distributed, and as a result, the five variables do not have the same distribution. Each student's final grade average and partial grade average differ from one another. Both male and female students received final grades that were statistically the same. The final grade average for this year and last year is statistical the same. Except for the mid-exam grades, there is a correlation between participation and presence and the other grades. Also, the final grades and all other grades, except the mid-exam grades, are correlated. To maintain the benefits and enhance the course procedure for the following year, we must build on the obtained results. Especially by requiring students more attendance at lectures to improve grades, and to work more on the mid-exam.

FURTHER STUDY

Since the test of normality of the variables in section 4 is accepted only for two variables "presence & participation grades and partial grades", then we can say that the distributions of the different grades are statistically different. If the test of normality was accepted for all variables, then we can say that the distributions of the different grades are statistically the same (normal distribution); and in this case, the ANOVA test can be used to test if they have statistically the same average or no.

In our case, and because the distributions of the different grades are statistically different, we can use the Friedman test [20] to demonstrate the same result obtained in section 4 (This will confirm also the H1 result) and to know more about the differences between every two variables. As it is well known that the Friedman test is the non-parametric alternative to the one-way ANOVA with repeated measures and it is used to test for differences between groups when the dependent variable being measured is ordinal or not normal distribution continuous data.

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