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Correlation and Prediction for Preparatory Year Math and Discrete Structure in University of Hail

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Abstract: This paper aim to investigate the correlation between preparatory Mathematics and Discrete Structure course studied in the Faculty of computer sciences after passing Prep-MATH. a linear regression equation was used as a model for early prediction of the performance of the student in Discrete Structure, Prep-MATH was considered as independent variable (predictor), while Discrete MATH was considered as the dependent variable (respondent). This study is carried out on student's results data which consisted of 78 students, finished successfully their studies in Prep-Year on 2012, and enrolled in the Faculty of Computer Sciences. The results, which are verified by using paired t-test and *Pearson* product-moment correlation coefficient, indicated that Prep-Year Math courses and Discrete Structure) are significantly correlated. Prediction of the performance of the students in Discrete Structure was obtained in base of their performance in Prep-Year MATH through linear regression.

Keywords: Correlation, Prediction, Preparatory-Math, Discrete Structure

1. Introduction

Insufficient skills in basic Mathematics cause problems for those majoring in computer sciences l. A lack of deep conceptual understanding of the basic MATH leads to misconceptions in Computer Sciences MATH [17]. Besides possessing basic Math concepts and skills, Computer Sciences students required Problem solving and creative thinking skills, but they have some difficulties in these issues [3, 17].

Discrete Structures: A course in discrete Mathematics should teach students how to work with discrete structures, which are the abstract Mathematical structures used to represent discrete objects and relationships between these objects. These discrete structures include sets, permutations, relations, graphs, trees, and finite-state machines logic and intuition, analysis and construction [1]. According to Fennema and Sherman [6], Mathematics is used and studied in courses other than Mathematics such as computing, chemistry and physics. Mathematical courses are widely used in almost all educational institutions.

In Computer Sciences, Mathematics courses are fundamental for all Computer Sciences courses [11, 22]. Students in University of Hail enrolled first in Preparatory Year taking Basic Math in their program of study (Pre-MATH), before they will enrolled in the Faculty of Computer Sciences. This study is fundamental for enhancing the entries of the Faculty of Computer Sciences through exploring the best preparation in Prep-MATH.

2. Methodology

78 students were successfully completed their studies in the Preparatory Year University of Hail, Hail, Saudi Arabia, in 2012, and enrolled in the faculty of Computer Sciences, Their Average scores in final (PMAT-001, PMAT-002, PMAT-003, PMAT-004) was found and named in this study (Prep-Math), final exam scores in Computer Sciences -MATH courses taken by: (78 students-Discrete Structure), the final exam results for (Prep-MATH) and Computer Sciences MATH scores were used for the data in this study. Final exam results data consist of students' assignment, quizzes, mid-semester

exam. The data was analyzed using Minitab (version 16). Analyses included descriptive statistics. A paired t-test and Pearson product-moment correlation coefficient tests was conducted as in [24] to analyze the results of Prep-Math and Discrete Structure. Linear regression will be used As a prediction model for the performance of the students in Discrete Structure with Prep-MATH as independent variable (predictor).

2.1. Paired T-test

Usually researchers analyze paired data using the paired t-test, which is essentially one-sample Student t-test performed on difference scores [24]. It is the most basic statistical test that measures group differences which is appropriately used when the researcher wishes to determine whether two groups, as defined by the independent variable, differ on the basis of a selected dependent variable [24, 21]. Also stated in [24, 13] that the t-test allows a researcher to compare a categorical independent variable with two groups on the basis of an interval or ratio-scaled dependent variable specifically. The t-test for two dependent groups is used to compare the mean of the two data sets obtained from the same sample. Specifically, we are using a paired t-test to determine whether the mean difference between two groups is statistically significantly different to zero. So will construct the following hypotheses:

H_0: There is no significant differences between Prep-MATH and Discrete Structure final exam results.

H_1: There are significant differences between Prep-MATH and Discrete Structure final exam results

If p-value < $\alpha = 0.05$, H_0 is rejected and shows that there are significant differences between the mean of Prep-MATH and Discrete Structure final exam results.

A paired t-test is used to compare two population means where you have two samples in which observations in one sample can be paired with observations in the other sample. For example:

Before-and-after observations on the same subjects (e.g. students' diagnostic test results before and after a particular module or course).

This approach is Specifically appropriate to this study because the sampling method was simple random sampling, the samples consisted of paired data, and the mean differences were normally distributed and the variables are continuous

So paired t-test is used to calculate differences of group by examining the means of the groups [8, 10, 9]. Using MINITAB (16) we entered the scores of the Exam Scores by pairs (Prep-MATH, Discrete Structure).

2.2. Pearson Product-Moment Correlation Coefficient

Pearson product-moment correlation coefficient test is used to measure the existence of a linear relationship between two variables. There are three types of linear relationship that may exist between these two variables namely positive linear correlation, negative linear correlation and no correlation. This can be tested by using these two hypotheses:

H_0: There is no linear relationship between Prep-MATH and Discrete Structure

H_1: There is a linear relationship between Prep-MATH and Discrete Structure.

If p-value < $\alpha = 0.05$ (95% level of confidence), then H_0 is rejected and show that there is a significant linear relationship between Prep-MATH and the Discrete Structure. The strength of these variables can be seen by the value of the correlation coefficient. In addition, correlation coefficient for each course is also has been investigated. [8]

2.3. Linear Regression

Regression analysis is a statistical technique for determining the relationship between a single dependent (criterion) variable and one or more independent (predictor) variables. The analysis yields a predicted value for the criterion resulting from a linear combination of the predictors. According to Pedhazur, regression analysis has 2 uses in scientific literature: prediction, including classification, and explanation [4, 5, 6, 22].

3. Results and Discussion

3.1. Paired T-test

Table 1. *Paired Samples t-Test and Pearson product-moment correlation coefficient.*

Difference	Mean Difference	SD Difference	t-test	Sig (p-value)
Discrete Math	-3.56	15.58	-2.02	0.047

Table 1 indicates the results for paired samples t-test and *Pearson* product-moment correlation coefficient of the pair variables Pre-MATH and Discrete Structure. The corresponding two-tailed p-value for the mean difference between Prep –MATH and Discrete Structure is less than the level of significance (α) 0.05. Therefore, we can conclude that there is a significance difference in final exam marks between Prep-MATH and Discrete Structure [13, 15, 17]. We reject the null hypothesis H_0 and accept the alternative hypothesis H_1

Paired T-Test and CI: Discrete Structure; Prep-MATH

Paired T for Discrete Structure - Prep-MATH

	N	Mean	StDev	SE Mean
Discrete Structure	78	70.26	15.18	1.72
Prep-MATH	78	73.81	9.69	1.10
Difference	78	-3.56	15.58	1.76

95% CI for mean difference: (-7.07; -0.04)

T-Test of mean difference = 0 (vs not = 0): T-Value = -2.02 P-Value = 0.047

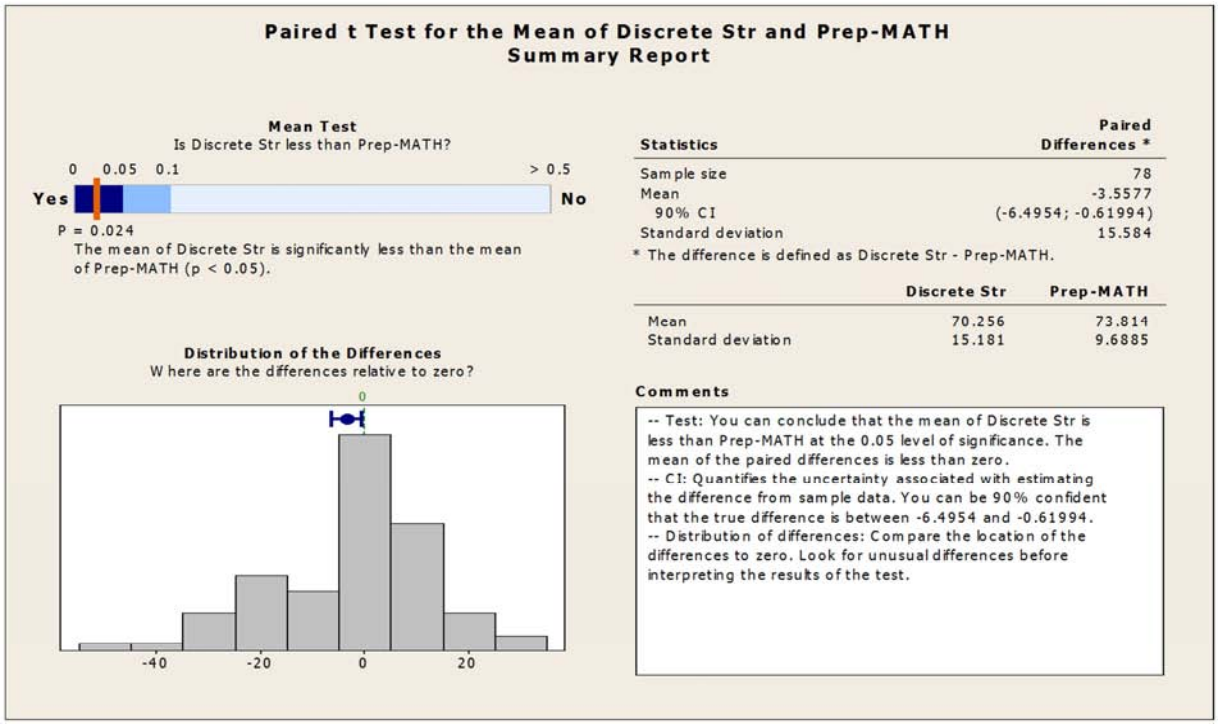

Figure 1. *Paired t Test for the Mean Of Methods of Applied MATH and Prep-MATH.*

3.2. Pearson Correlation

Correlations: Prep-MATH; Discrete Structure

Pearson correlation of Prep-MATH and Discrete Structure = 0.277

P-Value = 0.014

Table 2. *Pearson product-moment Table 2. correlation coefficient for each Computer Sciences Math course.*

Prep-Math			
Computer Sciences Math Courses	N	Person Correlation	P-Value
Discrete Structure	78	0.277	0.014

Pearson product-moment correlation coefficient of the paired variables Prep-MATH and Discrete Structure course shown in Table 2. Generally, the *Pearson* correlation is positive and p-value is 0.014 less than 0.05 so we reject the null hypothesis H_0 and accept the alternative hypothesis H_1, i.e. The t Prep-MATH and Discrete Structure have significant correlation.

Therefore, we can conclude that there is a significance difference in final exam marks between the mean of Prep-MATH and the mean of Discrete Structure. The value of mean difference with the negative values suggested that mean marks for Prep-MATH course is greater than the mean of Discrete Structure. The significant Differences concluded from the t-paired test is a strong indication that any positive development in the performance of the students in Prep-MATH will make a positive change in the performance of the students in Discrete Structure course.

3.3. Linear Regression

Regression Analysis: Discrete Structure versus Prep-MATH

The regression equation is

Discrete Structure = 38.2 + 0.434 Prep-MATH

Predictor	Coef	SE Coef	T	P
Constant	38.23	12.86	2.97	0.004
Prep-MATH	0.4339	0.1727	2.51	0.014

S = 14.6826 R-Sq = 7.7% R-Sq (adj) = 6.5%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	1360.8	1360.8	6.31	0.014
Residual Error	76	16384.0	215.6		
Total	77	17744.9			

Unusual Observations

Obs	Prep-MATH	Discrete Structure	Fit	SE Fit	Residual	St Resid
4	81.3	40.00 73.48	2.10	-33.48	-2.30R	
73	93.8	40.00 78.91	3.82	-38.91	-2.74R	

R denotes an observation with a large standardized residual.

Table 3. *Regression for Discrete Structure Vs Prep-MATH*

Computer Sciences MATH Course	P-Value	Linear Regression Equation	Score in Prep-Math When Score In Discrete Structure = 60
Discrete Structure	0.007 < 0.05	Discrete Structure = 38.2 + 0.434 Prep-MATH	50.2

In table 3 the fitted equations that are describe the linear model that describe the relation between Prep-MATH and Discrete Structure is given by Minitab (16), this relations is statistically significant but can't imply that Prep-MATH causes Discrete MATH. Using these equations for predicting the required score for passing Computer Sciences MATH with (60 Marks) showed all students who pass Prep-MATH with (60 Marks) can Pass Discrete Structure. The relatively weak positive correlation may prompt us to deeply analyse the contents of Discrete Structure and Prep-MATH giving more concentration for discovering to some extent creative thinking, problem solving were integrated with the curriculum of the two courses.

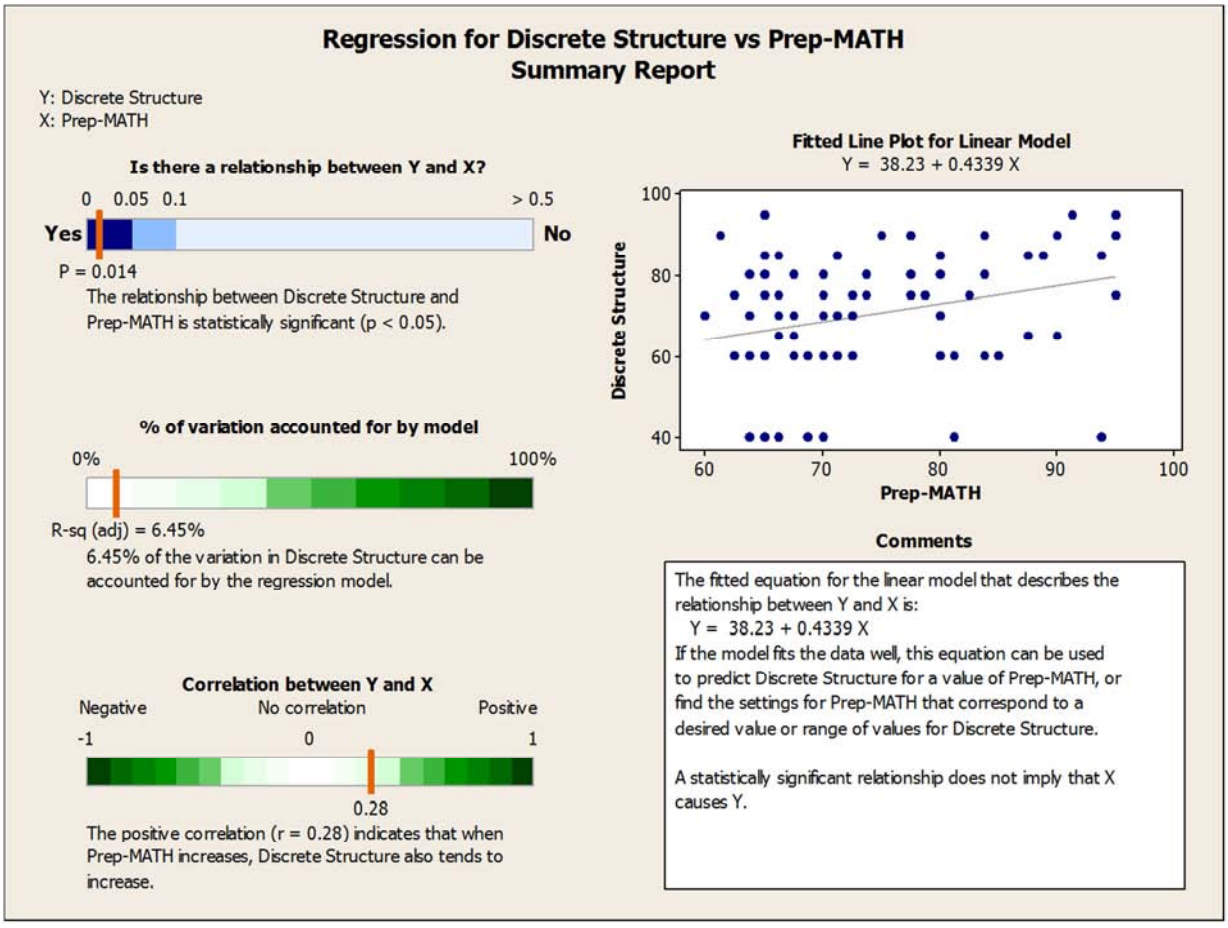

Figure 2. *Regression for Discrete Structure Vs Prep-Math.*

Figure 2 is an output result of line regression run with Minitab (16), a summary was given in Table 3.

4. Conclusion

An analysis on students' performance based on their final exam results in Prep-Math and four Discrete Structure: is conducted. Based on analysis and results, the t-test and Pearson correlation shows that Discrete Structure and Pre-Math courses are significantly related and have positive linear relationship. The main reason behind this correlation is that students in Prep-Math was equipped with the basics on topics covered with, Discrete Math such as System of Linear Equations, System of non-linear equations, Set Theory,

Integers Division and Functions, are the basic knowledge students have to know in order to learn Computer Sciences Math courses. This shows that students have to give more concentration on these topics before they proceed to the Computer Sciences Mathematics courses. As conclusion, Prep-Math achievement is important and very effective in Computer Sciences Math courses. The correlation is not strong because discrete Math contains topics that need beside Mathematical concepts, creative thinking and problem solving techniques like, Coloring sparse hyper graphs [16], expansion of graphs [2], problems for hyper graphs [17]. The regression equation concluded from the regression analysis is:

Discrete Math score = 38.23 + 0.4339 (PrepYear Math), from this equation if we can predict that for the student to pass discrete Math course with (60 points) he must obtain minimum (50.173 points) in Prep-Year Math.

A deep content analysis is necessary to integrate thinking skills problem solving skills within Prep-MATH curriculum.

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