ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

CORRELATION AND PREDICTION FOR PREPARATORY YEAR MATH AND ENGINEERING MATH IN UNIVERSITY OF HAIL

Azhari Ahmad*, Sofian Obiedat
* Department of MATH , Preparatory Year ,University of Hail , Hail , Saudi Arabi

DOI: 10.5281/zenodo.253971

ABSTRACT

Students' performance can be evaluated through final exam results consist of students' assignment, quizzes, mid-semester exam. In engineering and computer sciences , mathematics is one of the important subject students should dominated in many courses. However, students should have deep understanding of some important topics covered in Prep-Year such as, real numbers , equations , inequalities, matrices, functions , before they taken the Engineering , Computer Sciences (MATH) courses. This article attempts to explore students' performance in MATH in the Faculty of Engineering and its correlation with Prep-Year mathematics . A study is carried out on student's results data which consisted of 216 students , finish successfully their studies in Prep-Year on 2012 , some of them enrolled in the Faculty of Engineering and others in the Faculty of Computer Sciences , taking different MATH courses . The results, which are verified by using paired t-test and Pearson product-moment correlation coefficient, indicated that Prep-Year Math courses and early MATH Courses in Engineering and Computer Sciences (MATH-101) are significantly strongly correlated , for the later Engineering MATH courses we verified a significant positive linear relationship. Prediction of the performance of the students in Engineering MATH courses can be obtained in base of their performance in Prep-Year MATH through linear regression.

KEYWORDS: Digital CORRELATION , PREPARATORY -MATH, ENGINEERING MATH.

INTRODUCTION

Insufficient skills in basic mathematics cause problems for those majoring in engineering at university level. A lack in deep conceptual understanding of the basic MATH leads to misconceptions in Engineering MATH [16] . Besides possessing basic math concepts and skills , engineering students required Problem solving and creative thinking skills, but they have some difficulties in these issues [2,17].

Mathematics is a tool and language for studying and solving engineering problems , through its thermos , relations 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 Engineering, Mathematics courses are fundamental for all engineering courses [10, 19]. 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 Engineering and Computer Sciences Colleges . This study is fundamental for our project about the best practices in teaching and learning Prep-MATH, our aim is to enhance the academics incomes of the faculty of engineering. The purposes of this paper are to investigate the nature of the correlation between students' performance in Math courses taken after Prep-Year and Prep-MATH. On the light of this study Content analysis for Engineering MATH courses and Prep-MATH will be necessary as one of the main guides to develop Prep-MATH curriculum.

METHODOLOGY

216 students were successfully completed their studies in the Preparatory Year University of Hail , Hail ,Saudi Arabia, in 2012 , and enrolled in the faculty of Engineering , 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 Engineering-MATH courses taken by : (78 students-Discrete Mathematics),(30 students– Method of Applied Mathematics),

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

(55 students-Numerical Methods) ,(216 students –Calculus :MATH101), the final exam results for (Prep-MATH) and Engineering 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 [21] to analyze the results of Prep-Math and MATH courses results after Prep-Year. Linear regression will be used As a prediction model for the performance of the students in Engineering courses with Prep-MATH as independent variable (predictor).

.

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 [21]. 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 [21, 18]. Also stated in [21 ,12] 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 are no significant differences between Prep-MATH and Numerical and Statistical Methods final exam results.

H_1 : There are significant differences between Prep-MATH and Numerical and Statistical Methods final exam results

---

H_0 : There are no significant differences between Prep-MATH and Numerical Methods final exam results.

H_1 : There are significant differences between Prep-MATH and Numerical Methods final exam results

---

H_0 : There are no significant differences between Prep-MATH and l Methods of Applied MATH final exam results.

H_1 : There are significant differences between Prep-MATH and Methods of Applied MATH final exam results

---

H_0 : There are no significant differences between Prep-MATH and MATH-101 final exam results.

H_1 : There are significant differences between Prep-MATH and MATH-101 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 Engineering MATH courses 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 going to be used to calculate differences of group by examining the means of the groups [7,8,9]. Using MINITAB (16) we entered the scores of the Exam Scores by pairs (Prep-MATH , Numerical and Statistical Methods) , (Prep-MATH , Numerical Methods) , (Prep-MATH, Numerical Methods), (Prep-MATH, MATH101) .

***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

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

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 MATH-101

H_1 : There is a linear relationship between Prep-MATH and MATH-101

H_0 : There is no linear relationship between Prep-MATH and Numerical and Statistical Methods final exam results.

H_1 : There is linear relationship between Prep-MATH and Numerical and Statistical Methods final exam results

---

H_0 : There is no linear relationship between Prep-MATH and Numerical Methods final exam results.

H_1 : There is linear relationship between Prep-MATH and Numerical Methods final exam results

---

H_0 : There is no linear relationship between Prep-MATH and l Methods of Applied MATH final exam results.

H_1 : There is linear relationship between Prep-MATH and Methods of Applied MATH final exam results

---

H_0 : There is no linear relationship between Prep-MATH and Discrete MATH final exam results.

H_1 : There is linear relationship between Prep-MATH and Discrete MATH final exam results.

H_0 : There is no linear relationship between Prep-MATH and MATH-101 final exam results.

H_1 : There is linear relationship between Prep-MATH and MATH-101 final exam results.

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 Engineering MATH courses. 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.[7]

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 [3,4,5,22].

.

RESULTS AND DISCUSSION

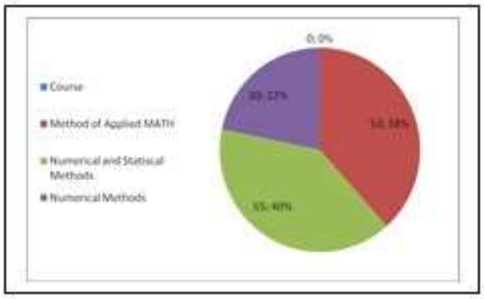

Figure 1. : Number of Students Enrolled in each MATH Course After the Prep-Year

Figure 1 shows the distribution of 138 students to the MATH courses studied in the Faculty of Engineering after Prep-Year.
100% Studied MATH-101 as a first course after Prep-Year.
25% Studied Numerical Methods – 3rd Grade –Faculty of Engineering.
14% Studied Methods of applied MATH -4th Grade – Faculty of Engineering.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

53% Studied Numerical and Statistical Methods – 3rd Grade - Faculty of Engineering
36% Studied Discrete MATH – 1st Grade – Faculty of Computer Sciences
All the Scores following the Normal distribution as shown by the normality test in Minitab like in figure 2.

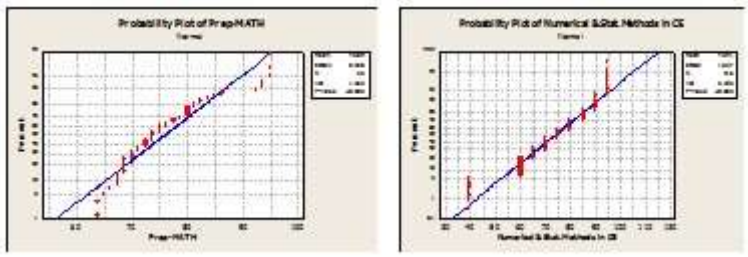

Figure 2. Normality Test for Prep-MATH and Numerical Methods

Figure 2 shows the normality test that was run with Minitab (16) , similarly of the rest of the courses scores. We ensured that the data is normally distributed.

.

Paired t-Test

Difference	**Mean Difference**	**SD Difference**	t-test	**Sig (p-value)**
MATH-101	-2.211	5.284	-6.15	0.000
Numerical Methods	-2.16	10.21	-1.57	0.023
Numerical &Statistical Methods	-5.938	13.325	-6.55	0.000
Discrete Math	-3.56	15.58	-2.02	0.047
Methods of Applied Math	-16.46	11.49	-7.84	0.000

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

Table 1 indicates the results for paired samples t-test and *Pearson* product-moment correlation coefficient of the pair variables Pre-MATH and each Engineering MATH course. The corresponding two-tailed p-value for each Engineering –MATH courses 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 Engineering MATH courses [11, 13,15]

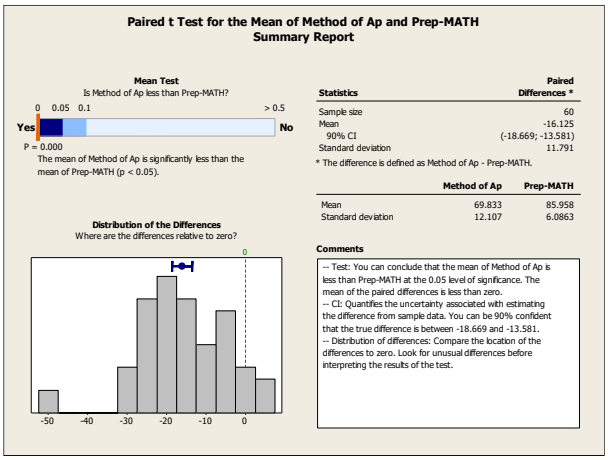

Figure 3 : Paired t Test for the Mean Of Methods of Applied MATH and Prep-MATH

Similarly this test has been done for the rest of the courses with Minitab (16) showing significant mean differences as P-valuie < 0.05.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

.

Pearson Correlation:

Prep-Math			
Engineering Math Courses	N	Person Correlation	P-Value
MATH-101	216	0.855	0.000
Numerical Methods	55	0.361	0.007
Numerical &Statistical Methods	53	0.448	0.001
Methods of Applied Math	30	0.295	0.013

Table 2. Pearson product-moment correlation coefficient for each engineering Math course.

Pearson product-moment correlation coefficient of the paired variables Prep-MATH and each Engineering MATH course shown in Table 2. Generally, the *Pearson* correlation for each course is positive and p-value is less than 0.05 but the highest value of *Pearson* product-moment correlation coefficient of 0.855 which is for MATH-101 , a course of calculus , the first course studied by the students in the faculty of engineering after Prep-Year , whilst the lowest is 0.295 for the Methods of Applied Math ,studied in the 4th Grade , containing more advanced topics in MATH like Calculus of variations ,PDE ,Integral Equations , Green's Function ,Eigen Functions Expansions , even though still there is a positive significant correlation between Prep-MATH and all Engineering MATH. The highest positive value of the correlation in MATH-101 means that students who scored high on the Prep-MATH course tend to score high on the MATH-101 course.

Referring to Table 1, we have found that the corresponding two-tailed p-value for all courses is less than level of significance (α) 0.05. Therefore, we can conclude that there is significance difference in final exam marks between Prep-MATH and all Engineering MATH courses. The value of mean difference with all the negative values suggested that mean marks for Prep-MATH course is greater than Engineering MATH courses but the highest mean differences is for Numerical Methods whilst the lowest is for Methods for Applied MATH. 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 the Engineering MATH courses.

Linear Regression

Engineering MATH Courses	P-Value	Linear Regression Equation	Score in Prep-Math When Score In Engineering MATH = 60
Numerical Methods (Y)	0.007 < 0.05	Y=42.48+0.4118 x	42.5
Methods of Applied MATH (Y)	0.019 < 0.05	Y=18.08+0.6021 x	69.6
Numerical and Statistical Methods (Y)	0.000 < 0.05	Y=33.36+0.5054 x	52.71
MATH-101	0.026 < 0.05	Y=7.411+0.9168 x	57.36

Table 3. Regression for Engineering MATH Vs Prep-MATH

In table 3 the fitted equations that are describe the linear model that describe the relation between Prep-MATH (X) and each of Engineering MATH (Y) are given by Minitab (16) , these relations are statistically significant but can't imply that X causes Y .Using these equations for predicting the required score for passing Engineering MATH with (60 Marks) showed all students who pass Prep-MATH with (60 Marks) can Pass MATH-101 , Numerical and Statistical Methods , Numerical Methods but may face some problems in Passing Methods of Applied MATH course the reasons after content analysis is that this course needs more skills on problem solving , creative thinking , which should be the focus in any plan for development

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

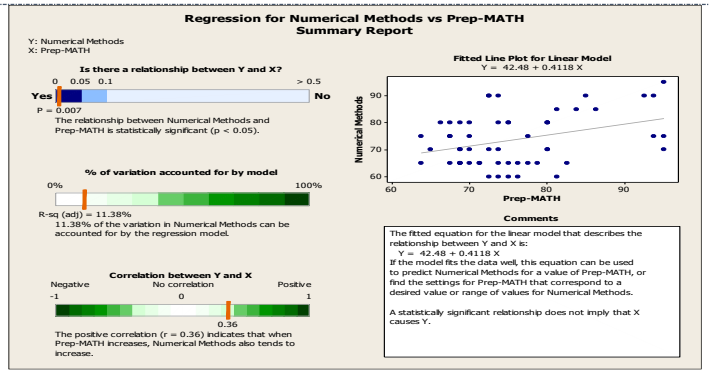

Figure 4. Regression for Numerical Methods Vs Prep-Math

Figure 4 is an output result of line regression run with Minitab (16) , a summary was given in Table 3

CONCLUSION

An analysis on students' performance based on their final exam results in Prep-Math and four Engineering Mathematics courses: Numerical Methods, Numerical and Statistical Methods, MATH-101 and Methods of Applied Math were conducted. Based on analysis and results, the t-test and Pearson correlation shows that Numerical and Statistical Methods, MATH-101 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 in Numerical& Statistical Methods , 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 Engineering Math courses . This shows that students have to give more concentration on these topics before they proceed to the Engineering Mathematics courses. As conclusion, Prep-Math achievement is important and very effective in Engineering Math courses

ACKNOWLEDGEMENT

This is research is in the way of seeking the best practices that improve the faculty of engineering incomes as a consequence of developing Preparatory Mathematics .

A project funded by the Deanship of Scientific Research in University of Hail. The authors would like to thank the University of Hail for supporting this work via research grants, in the effort of improving the quality of teaching and learning of mathematics in Prep-Year and in the faculty of Engineering.

REFERENCES

[1] Achieve Inc. 2013. Closing the expectations gap: 2013 annual report on the alignment of state K–12 policies and practices with the demands of college and careers. Washington, DC. www.achieve.org/ClosingtheExpectationsGap2013. Accessed February 2015
[2] Adams, P. A., Kaczmarczyk, S., Picton, P. & Demian, P (2007). Improving Problem Solving and Encouraging Creativity in Engineering Undergraduates. *International Conference on Engineering Education, Portugal*.
[3] A. Awodun, O. J. O. Omotade, and O. Adeniyi, "Mathemtics skills as predictors of physics student's performance in senior secondary schools," International Journal of Science and Research, vol. 2, no. 7, pp. 391–394, 2013. View at Google Scholar
[4] Brent Bridgeman, Laura McCamley-Jenkins, and Nancy Ervin. Predictions of freshman grade-point average from the revised and recentered SAT I: Reasoning test. ETS Research Report Series, 2000(1):i–16, 2000.
[5] Belfield CR, Crosta PM. 2012. Predicting success in college: The importance of placement tests and high school transcripts. CCRC Working Paper No. 42.
[6] Elizabeth Fennema and Julia A. Sherman *Journal for Research in Mathematics Education* Vol. 7, No. 5 (Nov., 1976), pp. 324-326
[7] Gaertner MN, Kim J, DesJardins SL, McClarty KL. 2014. Preparing students for college and careers: The causal role of algebra II. Research in Higher Education 55(2):143–65.

ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

[8] Gamoran A, Hannigan EC. 2000. Algebra for everyone? Benefits of college-preparatory mathematics for students with diverse abilities in early secondary school. Educational Evaluation and Policy Analysis 22(3):241–54.
[9] Gray L, Thomas N, Lewis L. 2010a. Educational technology in U.S. public schools: Fall 2008. NCES 2010-034. Washington, DC: National Center for Education Statistics. http://nces.ed.gov/pubs2010/2010034.pdf. Accessed December 2014.
[10] Green, D., Harrison, M. & Ward, J. (2003). .Mathematics for engineers - the helm Project. Conference on Strategies for Student Achievement in Engineering. UK. Available: http://www.hull.ac.uk/engprogress/prog3papers/progress3_HELM_final.pd
[11] Ely, D. P., & Hittle, L. (1990). The impact of math background on performance in managerial economics and basic finance courses. *Journal of Financial Education*, *19*(2), 59–61.
[12] Green, J. J., Stone, C. C., Zegeye, A., & Charles, T. A. (2007). Changes in Math Prerequisites and Student Performance in Business Statistics: Do Math Prerequisites Really Matter? *Journal of Economics and Finance Education*, *6*(2), 27–38.
[13] Henderson, S. & Broadbridge, P. (2009). Engineering Mathematics Education in Australia. MSOR Connections 9(1): 12 – 17.
[14] Johnson, D. W., Johnson, R. T. & Stanne, M. B. (2000). Cooperative Learning Methods: A Meta Analysis. Available:http://www.tablelearning.com/uploads/File/EXHİBİT-B.pdf
[15] Johnson, M., & Kuennen, E. (2006). Basic Math Skills and Performance in an Introductory Statistics Course. *Journal of Statistics Education*, *14*(2). Retrieved from www.amstat.org/publications/jse/v14n2/johnson.html Research in Higher Education Journal Calculus and success, page 7
[16] Klymchuk, Sergiy & Norbert Gruenwald (202) , Investigating The Ways Of Reducing The Gap Between The School And University Mathematics--An International Study
[17] Lopez, A. (2007). Mathematics Education for 21st Century Engineering Students: Literature Review. Australian Mathematical Sciences Institute. Available: http://www.amsi.org.au/carrick.php.
[18] Merriman, B., Shiel, G., Cosgrove, J., & Perkins, R. (2014). Project Maths and PISA 2012: Performance in Initial Project Maths schools and in Non-initial schools on PISA 2012 Mathematics and Problem-solving and on Junior Certificate mathematics. Dublin: Educational Research Centre
[19] Mustoe, L. & Lowson, D (Editors) (2002). Mathematics for the European Engineer A Curriculum for the Twenty –First Century. SEFI Mathematics Working Group. SEFI HQ, Brussells, Belgium, ISBN 2-87352- 045-0.
[20] Weisberg S. Applied Linear Regression. 2nd. ed. New York, NY: John Wiley & Sons; 1985.
[21] Reason, R. (2003). Student variables that predict retention: Recent research and new developments. *The NASPA Journal, 40* (4), 172- 191. Retrieved May 3 1, 2005, from:http://publications.naspa.org/naspajournal.v040/iss4/art 10
[22] Zimmerman, D. W. (1997). Teacher's corner: A note on interpretation of the paired-samples t test. *Journal of Educational and Behavioral Statistics*, 22(3), 349-360.