EDTC 810 STATISTICS FOR EDUCATION RESEARCH

PROJECT 4

College Basic Mathematics' Online Assessment Statistical Analysis for Fall 2015 and Fall 2018

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Introduction

Mathematics adaptive learning assessment with traditional learning method has been beneficial to many institutions around the country to help close the achievement gap and minimized students' anxiety toward the subject. The adaptive learning assessment for this study is MyMathLab (MML) which was created by Pearson. MyLab and Mastering from Pearson is a convenient online device that enhances, motivates, and engages students in productive learning; when MML is used adequately, the success rate can be very impressive based on the report of their 13 case studies (Pearson, n.d.). Using MML tools such as e-text, homework assignments, videos, study plan, diagnostic tests or quizzes allowed students to understand and personalize their own learning outcome.

Pearson's report indicated that the University of Memphis (UM) Department of Mathematics Sciences and Jackson State Community College (JSCC's) successfully use MML to improve their students' retention, achievement, and withdrawal rate. According to the report, Memphis Mathematics Method's (MMM's) withdrawal rate was lower than their traditional learning method from 17.9 to 8.4 percent; whereas 49 percent of scholars in traditional learning passed compared to 72 percent using MMM teaching method in 2008 (Pearson, n.d.). Furthermore, Jackson State Community College (JSCC's) implemented a SMART Math design with MyMathLabPlus that increased their completion rates by 51 percent, retention rate by 13.5 percent, and decreased their fail and withdrawal rate by 40 percent (Pearson, n.d.). For this study, the researcher analyzed students' College Basic Mathematics' MyMathLab assessment from Fall 2015 and Fall 2018 to explore the remarkable difference or trend based on the gender category. Therefore, the researcher's hypothesis is:

H0: There is no big difference for the Fall 2015 and Fall 2018 Mathematical report, or trend based on gender.

H1: There is a big difference in the Fall 2015 and Fall 2018 Mathematical report, or trend based on gender.

Data Analysis, Collection, and Sampling

The researcher collected data from Fall 2015 and Fall 2018 of a College Basic Mathematics class taught by Professor X. The sample population is based on higher education students from University XYZ. The purpose of the data collection was to determine the significant difference for both years with the same type of class taught by the same professor when using MyMathLab assessment. The categorical variables were gender and student#; while the quantitative variables were homework and final exam scores for both years. In general, the homework and final exam result were based on students' progress and assignments on MML (see Appendix A). The passing score for the final exam is 70 percent or higher. The homework was mandatory; if the homework was not accomplished the tests or final exam was not to be taken. Therefore, the purpose of choosing both homework and final exam as the quantitative variables was to determine if the homework contributed to the students' success; test 1, test 2, and test 3 were also used for the final class calculation. Furthermore, the mean, median, mode, minimum, maximum, range, variance, sum, and standard deviation were calculated using descriptive statistics. The inferential statistics, descriptive analysis, independent t-test, and ANOVA were also performed. Statistical significance is the process in which two or more variables is caused by something other than a random chance. According to Salkind (2017), statistical significance is "the degree of risk you are willing to take that you will reject a null hypothesis when it is actually true" (Salkind, 2017). Statistical significance is based on the interpretation of the p-value which is mainly less than 0.05. Type I and II errors were based on the statistical significance of the data in the research study. If the null hypothesis (H0) is true or false; the study might reject H0 or fail to reject the H0. In the case where H0 is true but there is a rejection, it can become type I error. The null hypothesis for this study is *'there is no big difference for the Fall 2015 and Fall 2018 Mathematical report, or trend based on gender'* when N = 26 for Fall 2015 and N = 29 for Fall 2018 report.

Data Representation and Summary of Statistical Description

The Fall 2015 (N = 26) and Fall 2018 (N = 29) participants' data collection from University XYZ (N = 26) were analyzed. SPSS was used to conduct the statistical analysis for this study. Descriptive statistics such as mean, standard error of mean, median, mode, minimum, maximum, range, variance, sum, and standard deviation were used to structure and describe the data collection (Salkind, 2017). For the Fall 2018 (N = 29) with no missing values, Table 1 indicates the mean score of 73.5697 and 46.810, the median of 95 and 60, mode of 100 and 0, and standard deviation of 36.25 and 35 for the Homework (HW2018) and Final Exam (FINAL2018) respectively (see Table 1). In addition, Table 1 also shows Fall 2015 (N = 26) with no missing value, the mean scores are 85.303 and 67.981, the median of 91.77 and 77.5, mode of 27.72a and 90, and standard deviation of 18.24 and 28.52 for the Homework (HW2015) and Final Exam (FINAL2015) respectively. The minimum for HW2015 was 27.72; the maximum was above 80 percent in each category. The difference means for the homework was - 11.73 and the final exam was - 21.17; these results indicate that both assignments were significantly decreased from 2015 to 2018. Furthermore, Figure 1-4 indicate a clear histogram representation (see *Figure 1*, *Figure 2*, *Figure 3, and Figure 4*).

Table 1. Descriptive Statistics

		HW2018	FINAL2018	HW2015	FINAL2015
N	Valid	29	29	26	26
	Missing	0	0	0	0
Mean		73.5697	46.810	85.303	67.981
Std. Error of Mean		6.73093	6.5004	3.57	5.5936
Median		95.0000	60.000	91.77	77.500
Mode		100.00	.0	27.72[a]	90.0
Std. Deviation		36.24717	35.0057	18.244	28.5221
Variance		1313.857	1225.400	332.813	813.510
Range		100.00	87.5	71.64	90.0
Minimum		.00	.0	27.720	.0
Maximum		100.00	87.5	99.36	90.0
Sum		2133.52	1357.5	2217.90	1767.5

a. Multiple modes exist. The smallest value is shown

Note. Descriptive statistics for Fall 2015 and Fall 2018 College Basic Math scores.

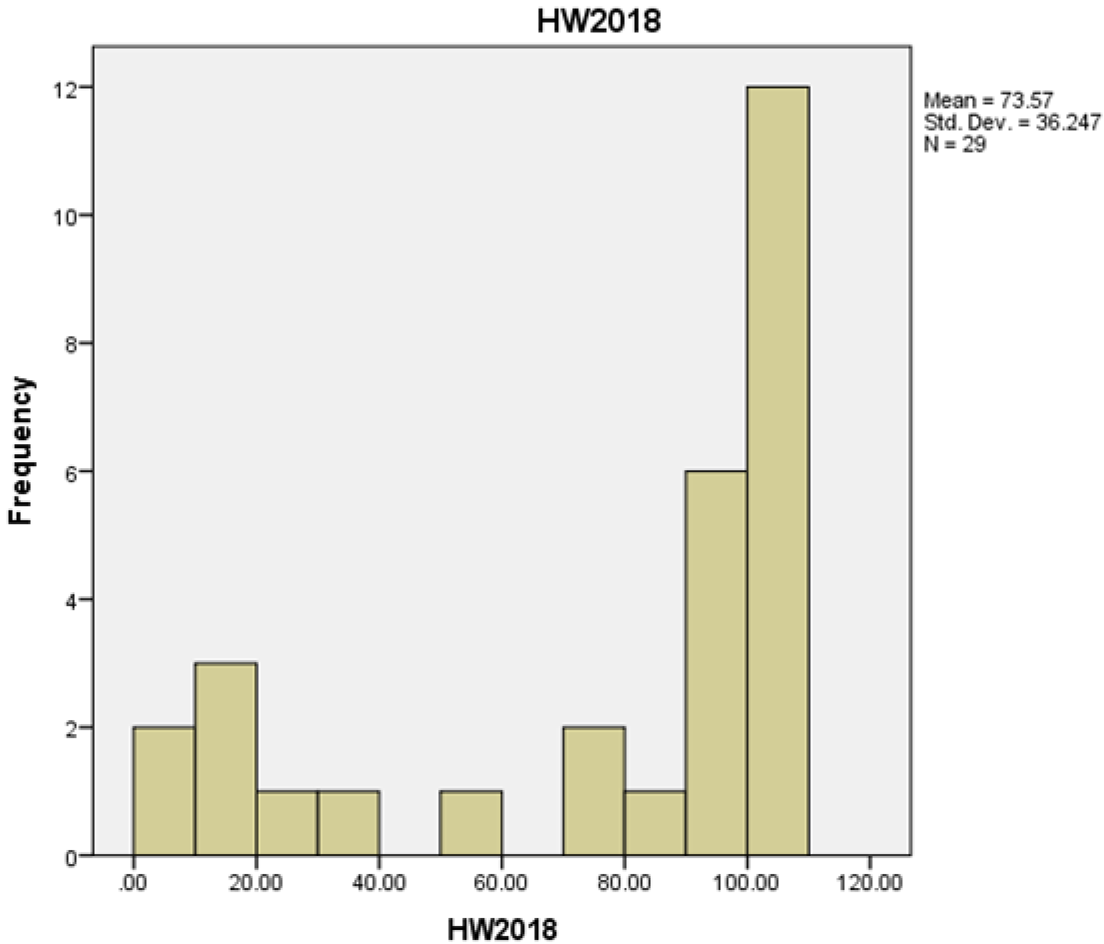

Figure 1. Histogram of Fall 2018 Homework for College Basic Math scores

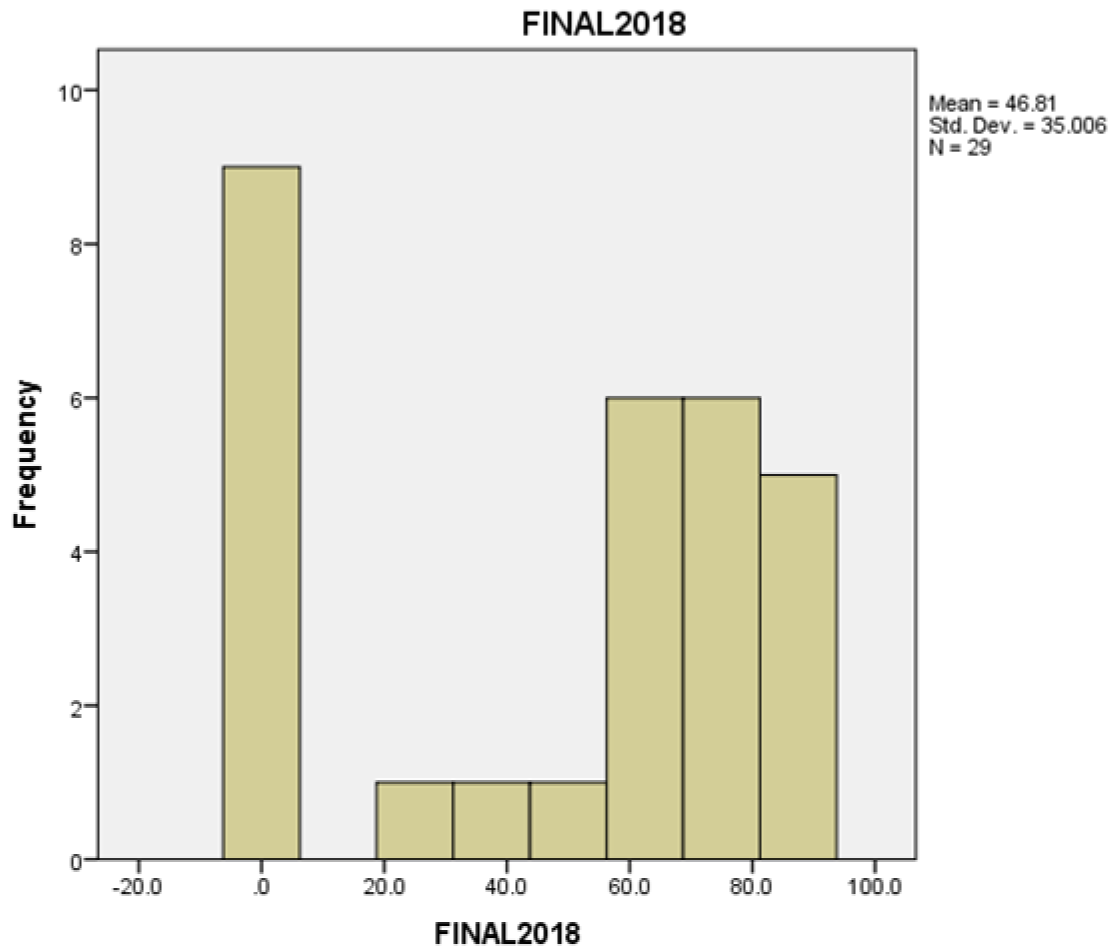

Figure 2. Histogram of Fall 2018 Final Exam for College Basic Math scores

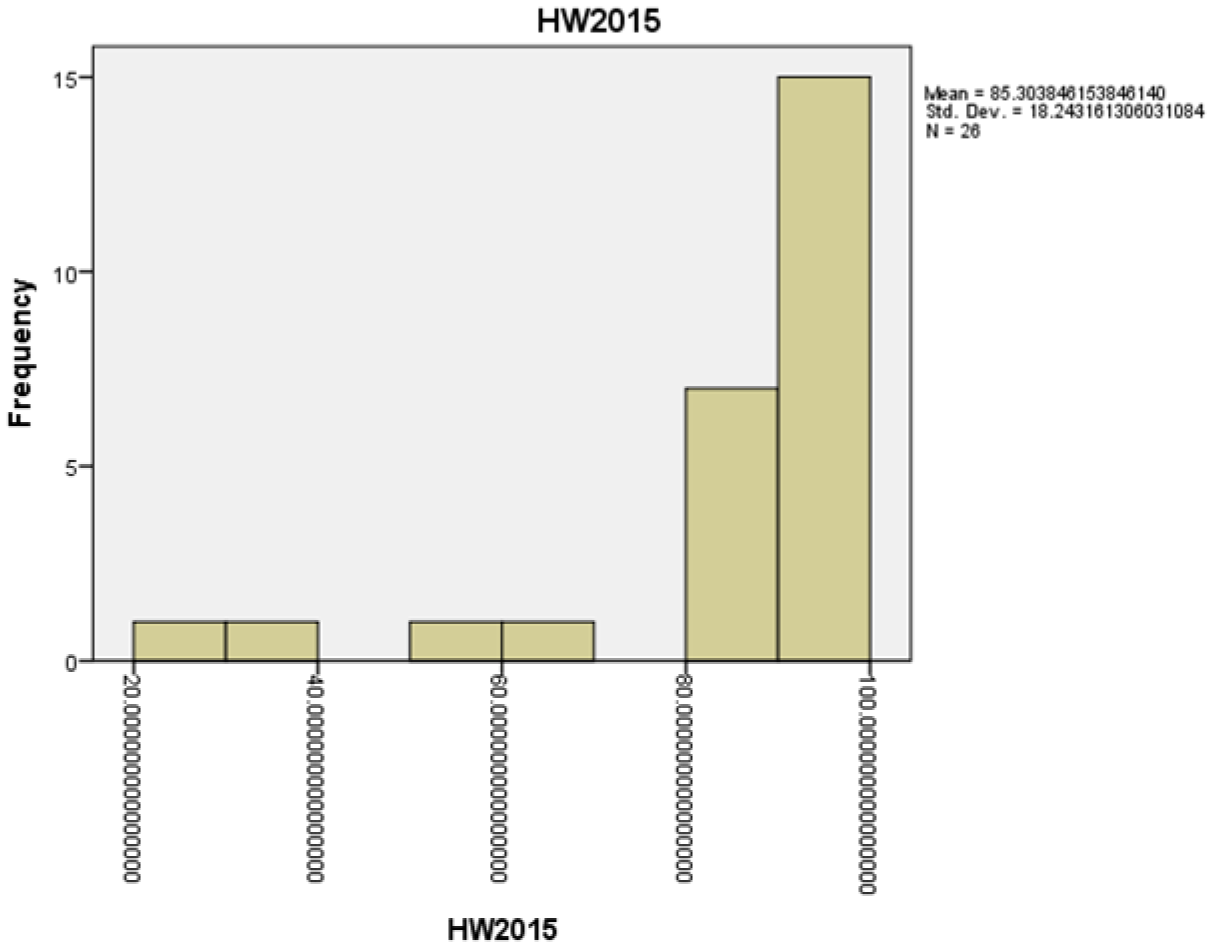

Figure 3. Histogram of Fall 2015 Homework for College Basic Math scores

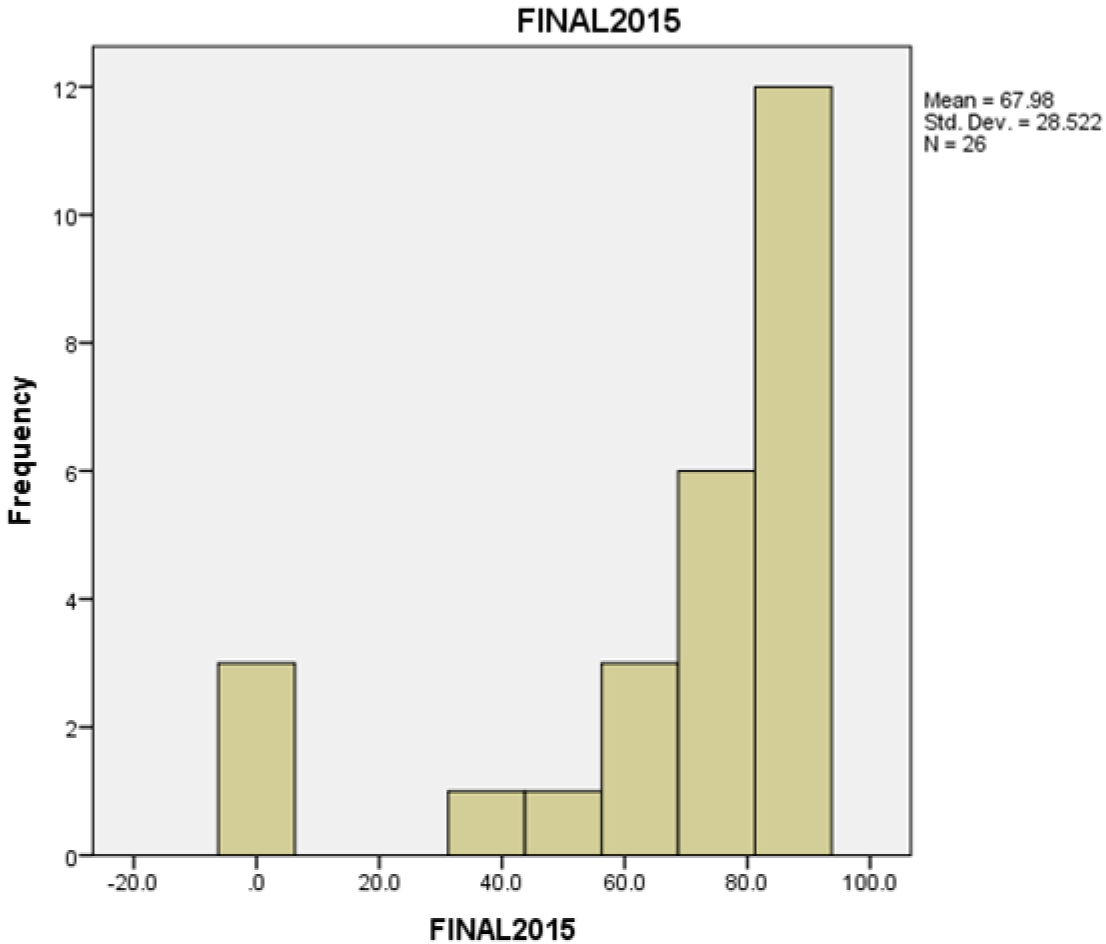

Figure 4. Histogram of Fall 2015 Final Exam for College Basic Math scores

The 2015 and 2018 final exam figures (*Figure 2* and *Figure 4*)shows a huge difference on the number of participants who did not take the final exam and received a grade of zero because their homework was not accomplished or due to absences. In addition, based on both figures, more participants received above 80 percent grade in 2015 than in 2018.

Statistical Description by Gender

The researcher analyzed the Fall 2018 and Fall2015 College Basic Math scores by gender in Table 2 and 3 to statistically differentiate them. Table 2, Fall 2018 data, shows the mean of 80.746 for HW2018 and 49.25 for FINAL2018 in male (N = 10); the mean of 69.79 for HW2018 and 45.53 for FINAL2018 in female (N = 19). In addition, Table 3, Fall 2015 data, shows the mean of 91.34 for HW2015 and 76.818 for FINAL2015 in male (N = 11); the mean of 80.87 for HW2015 and 61.50 for FINAL2015 in female (N = 15). The homework means difference for the males is - 10.59 and females is 11.08. The homework standard deviations are 26.53 in 2018 and 11.49 in 2015 for males with a difference of 15.05; 40.60 in 2018 and 21.21 in 2015 for females with a difference of 19.39. The final exam standard deviations are 37.58 in 2018 and 25.89 in 2015 for males with a difference of 11.69; 34.57 in 2018 and 29.46 in 2015 for females with a difference of 5.11. The researcher determined that the females' mean scores were significantly higher than the males; however, the standard deviation for males was higher differences than females. *Figure 5 - 8* shows the gender scatter plot and regression plot; which clearly shows how the values come together in the figures (See *Figure 5*, *6*, *7*, and *8*). Finally, the results are the scores in 2018 homework for male (N = 10, M = 80.74, SD = 26.53); in 2015 homework for male (N = 11, M = 91.34, SD = 11.49); in 2018 final exam for male (M = 49.25, SD = 37.58); and in 2015 final exam for male (M = 76.81, SD = 25.89). For female, the 2018 homework (N = 19, M = 69.79, SD = 40.60); 2015 homework (N = 15, M = 80.87, SD = 21.21); 2018 final exam (M = 45.53, SD = 34.57); and 2015 final exam (N = 15, M = 61.50, SD = 29.46).

Table 2. Group Statistics by Gender for Fall 2018

	Gender2018	N	Mean	Std. Deviation	Std. Error Mean
HW2018	M	10	80.7460	26.53310	8.39050
	F	19	69.7926	40.59687	9.31356
FINAL2018	M	10	49.250	37.5842	11.8852
	F	19	45.526	34.5666	7.9301

Note. Descriptive statistics by Gender for Fall 2018

Table 3. Group Statistics by Gender for Fall 2015

	Gender2015	N	Mean	Std. Deviation	Std. Error Mean
HW2015	M	11	91.34	11.49	3.46
	F	15	80.87	21.21	5.47
FINAL2015	M	11	76.818	25.8866	7.8051
	F	15	61.500	29.4564	7.6056

Note. Descriptive statistics by Gender for Fall 2015

Descriptive Statistics using Independent Sample T-Test

Table 4 and 5 demonstrate the results of the sample t-test comparing the homework and final exam for each year. The sample t-test indicates that there is no significant difference in the scores; conditions for the 2018 homework with $t(27) = 0.76$ with $p = 0.449$; 2018 final exam with $t(27) = 0.268$ with $p = 0.791$; 2015 homework with $t(24) = 1.48$ with $p = 0.15$; 2015 final exam with t(24)= 1.38 with p = 0.18. These results show greater p-value (more than 0.05) exist in the homework and final exam for both years; therefore, the null hypothesis is accepted, *There is no significant difference for the Fall 2015 and Fall 2018 Mathematical report*.

Table 4. Independent Samples T-Test 2018

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HW2018	Equal variances assumed	5.370	.028	.768	27	.449	10.95337	14.26604	-18.31812	40.22486
	Equal variances not assumed			.874	25.492	.390	10.95337	12.53567	-14.83910	36.74583
FINAL2018	Equal variances assumed	.133	.718	.268	27	.791	3.7237	13.9086	-24.8144	32.2617
	Equal variances not assumed			.261	17.102	.797	3.7237	14.2879	-26.4074	33.8547

Table 5. Independent Samples T-Test 2015

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HW2015	Equal variances assumed	2.485	.128	1.480	24	.152	10.4712727272720	7.075290642874477	-4.131409453655149	25.073954908200587
	Equal variances not assumed			1.615	22.421	.120	10.4712727272720	6.482824003396275	-2.958675371650902	23.901220826196340
FINAL2015	Equal variances assumed	.895	.354	1.377	24	.181	15.3182	11.1245	-7.6416	38.2779
	Equal variances not assumed			1.406	23.118	.173	15.3182	10.8979	-7.2195	37.8559

Descriptive Statistics on Analysis of Variance (ANOVA)

The researcher conducted a One-Way Analysis of Variance (ANOVA) for the College Basic Math scores for 2018 and 2015 shown in Table 6 and 7 to compare any significant changes with all test scores. The one way ANOVA shows that in 2018 homework scores ($F (14, 14) = 4.31$, $p = 0.005$), Test 1 ($F (14, 14) = 1.41$, $p = 0.27$); Test 2 ($F (14, 14) = 6.45$, $p = 0.001$), and 2018 Test 3 ($F (14, 14) = 95.14$, $p = 0.000$). Furthermore, the one way ANOVA shows that in 2015 homework scores ($F (11, 14) = 11.73$, $p = 0.000$), Test 1 ($F (11, 14) = 1.83$, $p = 0.14$), Test 2 ($F (11, 14) = 9.084$, $p = 0.000$), and Test 3 ($F (11, 14) = 17.82$, $p = 0.000$). The tests had more significance difference than the homework.

Table 6. ANOVA 2018

		Sum of Squares	df	Mean Square	F	Sig.
HW2018	Between Groups	29858.775	14	2132.770	4.309	.005
	Within Groups	6929.233	14	494.945		
	Total	36788.008	28			
TEST1_2018	Between Groups	15253.245	14	1089.517	1.407	.266
	Within Groups	10842.014	14	774.430		
	Total	26095.259	28			
	Between Groups	34372.893	14	2455.207	6.448	.001

TEST2_2018	Within Groups	5330.556	14	380.754		
	Total	39703.448	28			
TEST3_2018	Between Groups	34883.333	14	2491.667	95.136	.000
	Within Groups	366.667	14	26.190		
	Total	35250.000	28			

Table 7. ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
HW2015	Between Groups	7505.878	11	682.353	11.729	.000
	Within Groups	814.446	14	58.175		
	Total	8320.323	25			
TEST1_2015	Between Groups	7193.670	11	653.970	1.833	.142
	Within Groups	4995.573	14	356.827		
	Total	12189.243	25			
TEST2_2015	Between Groups	19178.440	11	1743.495	9.084	.000
	Within Groups	2687.134	14	191.938		

	Total	21865.574	25			
TEST3_2015	Between Groups	22090.385	11	2008.217	17.815	.000
	Within Groups	1578.125	14	112.723		
	Total	23668.510	25			

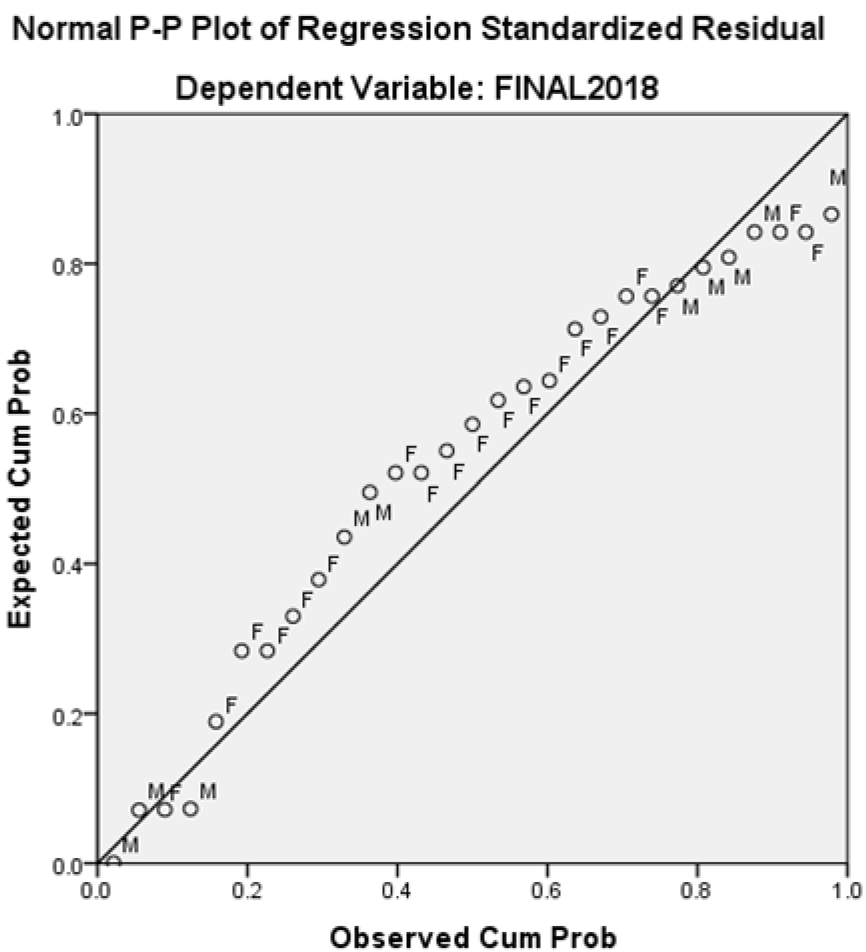

Figure 5. Observed Normal P- Plot for Regression Standardized Residual for Fall 2018 by Gender

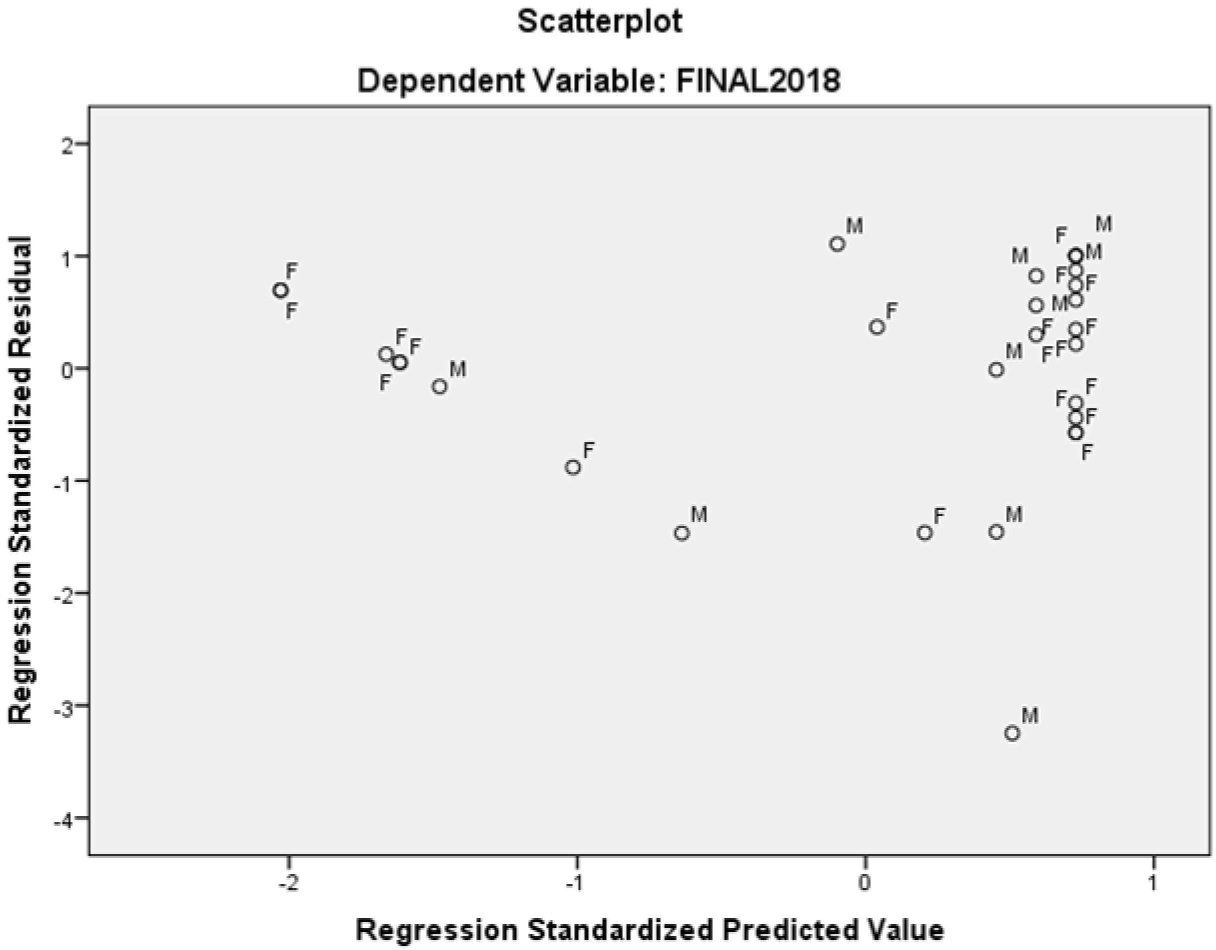

Figure 6. Scatter Plot for Fall 2018 scores by Gender

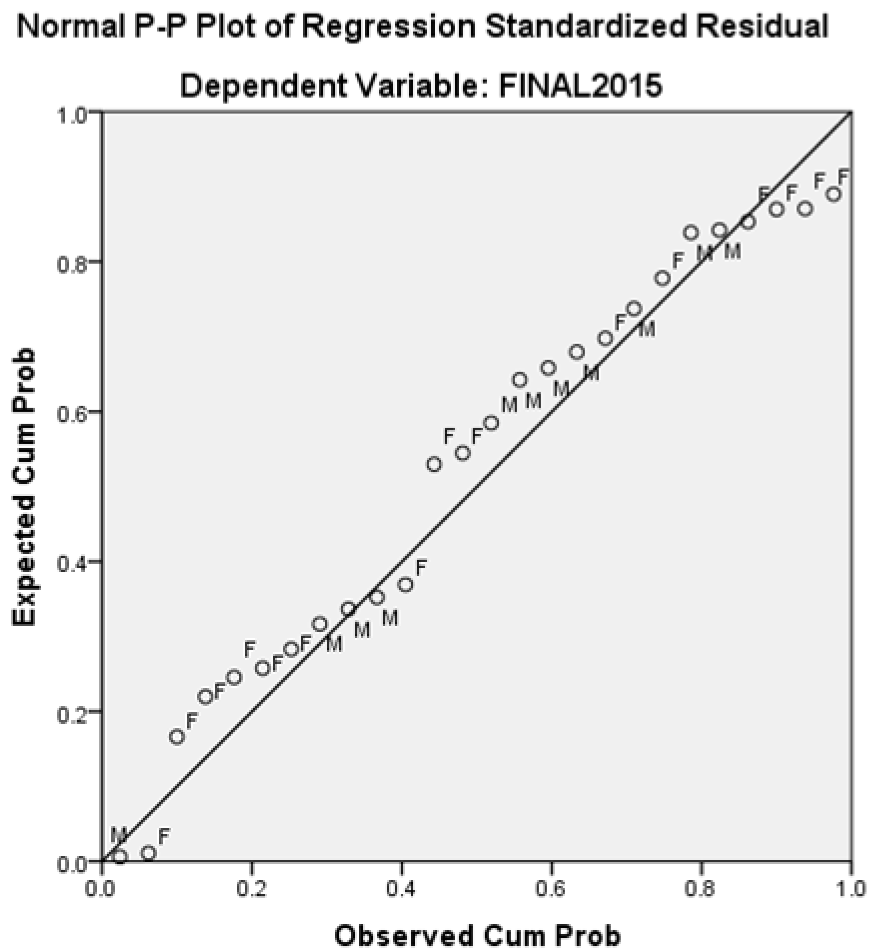

Figure 5 . Observed Normal P- Plot for Regression Standardized Residual for Fall 2015 by Gender

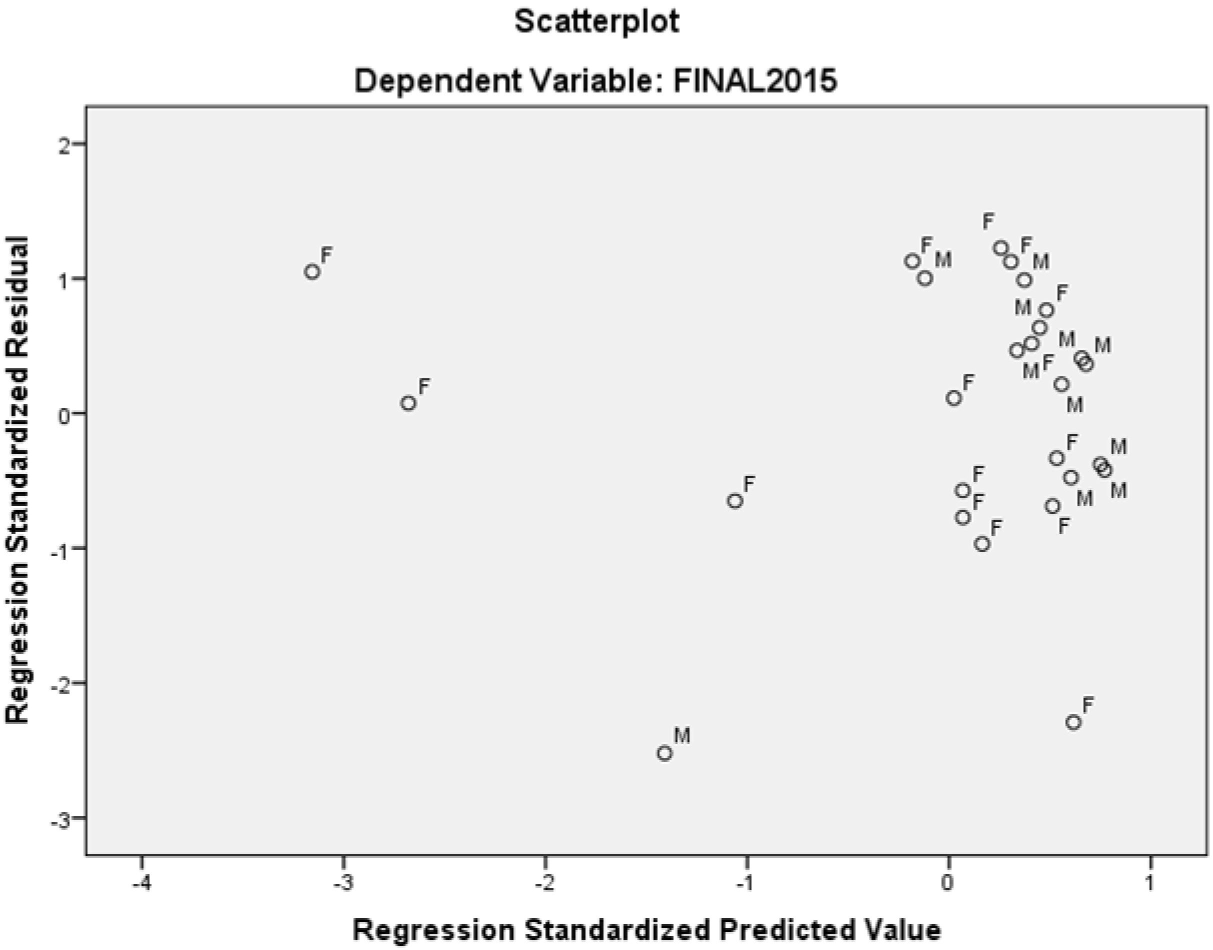

Figure 8. Scatter Plot for Fall 2015 scores by Gender

Conclusion

Finally, the results for this study showed that the descriptive analysis for 2018 homework for male (N = 10, M = 80.74, SD = 26.53); in 2015 homework for male (N = 11, M = 91.34, SD = 11.49); in 2018 final exam for male (M = 49.25, SD = 37.58); and in 2015 final exam for male (M = 76.81, SD = 25.89). For female, the 2018 homework (N = 19, M = 69.79, SD = 40.60); 2015 homework (N = 15, M = 80.87, SD = 21.21); 2018 final exam (M = 45.53, SD = 34.57); and 2015 final exam (N = 15, M = 61.50, SD = 29.46). The results and figures (*Figure 1 - 8*) above indicated that there was not much difference in the results of both years. The sample t-test also indicated that there is no significant difference in the scores; conditions for the 2018 homework with $t(27) = 0.76$ with $p = 0.449$; 2018 final exam with $t(27) = 0.268$ with $p = 0.791$; 2015 homework with $t(24) = 1.48$ with $p = 0.15$; 2015 final exam with $t(24)= 1.38$ with $p = 0.18$. A greater p-value (more than 0.05) showed in the homework and final exam for both years; therefore, the null hypothesis was accepted, *there is no significant difference for the Fall 2015 and Fall 2018 Mathematical report*.

The one-way ANOVA did show a slight difference in the tests. 2018 homework scores ($F(14, 14) = 4.31$, $p = 0.005$), Test 1 ($F(14, 14) = 1.41$, $p = 0.27$); Test 2 ($F(14, 14) = 6.45$, $p = 0.001$), and 2018 Test 3 ($F(14, 14) = 95.14$, $p = 0.000$). Furthermore, the one way ANOVA shows that in 2015 homework scores ($F(11, 14) = 11.73$, $p = 0.000$), Test 1 ($F(11, 14) = 1.83$, $p = 0.14$), Test 2 ($F(11, 14) = 9.084$, $p = 0.000$), and Test 3 ($F(11, 14) = 17.82$, $p = 0.000$). The researcher would have been able to have better results if the sample size was greater.

References

Pearson (n.d.). Raising the bar - A Compendium of Case Studies on the Effectiveness of MyLab and Mastering from Pearson. Retrieved from https://www.pearsonhighered.com/resources/Pearson_Global_Whitepaper.pdf

Salkind, N.J. (2017). *Statistics for people who (think they) hate statistics (6th edition)*. Thousand Oaks, CA: Sage Publications

Appendix A

	Course:	**College Basic Math - Fall2015**					
	Book:	MyMathLab eText					
	Instructor:	Professor X					
	Enrollment:	26		26 enrolled in MyMathLab			

	STUDENT2015	Gender2015	TEST1_2015	TEST2_2015	TEST3_2015	HW2015	FINAL EXAM_2015
1	Student1	F	75	39.17	45	81.98	77.5
2	Student2	F	33.75	37.5	25	65.94	32.5
3	Student3	M	70	52.5	70	83.11	77.5
4	Student4	M	90	57.5	85	99.36	82.5
5	Student5	F	80	90	100	90.88	90
6	Student6	F	80	57.5	87.5	94.65	72.5
7	Student7	M	85	95	85	97.66	90
8	Student8	F	100	45	55	86.54	60
9	Student9	F	71.25	0	0	27.72	0
10	Student10	F	65	0	0	36.42	0
11	Student11	F	90	95	95	94.09	90
12	Student12	F	95	67.5	70	89.98	90
13	Student13	F	53.75	35	75	88.29	60
14	Student14	M	90	75	75	96.31	77.5
15	Student15	M	87.5	90	80	98.98	82.5
16	Student16	F	85	75	62.5	85.72	70
17	Student17	M	85	80	100	93.48	87.5
18	Student18	F	70	72.5	70	96.53	55
19	Student19	M	90	70	95	91.44	82.5

20	Student20	F	95	75	80	95.03	77.5
21	Student21	M	95	80	90	92.09	90
22	Student22	F	85	21.67	45	86.53	62.5
23	Student23	M	100	95	90	97.28	90
24	Student24	M	100	52.5	90	95.45	85
25	Student25	F	85	85	87.5	92.74	85
26	Student26	M	0	1.67	0	59.58	0

Course:	**College Basic Math - Fall 2018**		
Book:	MyMathLab eText		
Instructor:	Professor X		
Enrollment:	29		23 Enrolled in MyMathLab

	Students2018	Gender2018	TEST 1_2018	TEST 2_2018	TEST 3_2018	HW2018	FINAL EXAM_2018
1	Student1	M	85	85	85	100	85
2	Student2	F	70	80	70	100	57.5
3	Student3	F	65	70	80	100	62.5
4	Student4	F	92.5	90	60	100	80
5	Student5	F	70	70	75	100	57.5
6	Student6	M	47.5	40	50	90	32.5
7	Student7	M	90	95	90	100	87.5
8	Student8	M	50	70	0	50.46	0
9	Student9	F	70	75	65	100	60
10	Student10	F	0	0	0	15	0
11	Student11	F	0	0	0	13.28	0
12	Student12	M	85	90	55	95	80
13	Student13	M	85	0	0	92	0
14	Student14	F	45	35	55	75	55

15	Student15	F	65	0	0	15	0
16	Student16	F	70	60	70	100	72.5
17	Student17	F	90	90	95	95	70
18	Student18	F	90	100	55	95	75
19	Student19	M	80	70	70	90	60
20	Student20	F	45	40	0	36.78	0
21	Student21	F	0	0	0	0	0
22	Student22	F	92.5	95	75	100	87.5
23	Student23	F	0	0	0	0	0
24	Student24	M	55	60	55	70	65
25	Student25	F	75	85	40	100	75
26	Student26	F	20	0	0	81	25
27	Student27	F	95	95	95	100	87.5
28	Student28	M	80	0	0	20	0
29	Student29	M	65	75	65	100	82.5