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THE CORRELATION BETWEEN HOMEWORK COMPLETION AND EXAMINATION GRADES IN UNIVERSITY DEVELOPMENTAL MATHEMATICS STUDENTS

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Abstract

This research investigated the relationships and correlations between 195 university students' developmental mathematics (pre-College Algebra) examination grades and the amount of assigned homework they completed. In order to keep the number of variables to a minimum, the study utilized multiple class sections taught by the same instructor over a three-year period. The course content was based upon a common textbook over the three years of data collection. Using the Spearman Rank Correlation test as well as linear regression, results illustrate a strong positive correlation between the portion of homework completed and students' examination grades. This paper includes two tables, one figure and eleven references.

Introduction

Heated debates over whether homework is helpful or detrimental are ongoing. Most studies agree, however, that older students (high school and college), benefit

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greatly from homework. Previous research by the author while teaching college level developmental mathematics courses showed that students who do the assigned homework tend to do better on examinations than students who do not. Mathematics is one of the areas of study requiring practice to understand it. Students are told at the beginning of each semester, "You won't learn the math by watching your instructor do problems – you'll learn by doing them yourself." This translates to, "Do the homework!"

Students are often asked on the first day of class, "How many of you have ever said, 'I've never been good at math?" Most hands go up within a few seconds. They look around and realize they are not alone in their anxiety. Students in these courses tend to have a very low level of confidence, and one positive effect of doing homework problems successfully is the realization that they really can do it! This builds needed confidence, which in turn encourages them to learn more.

There is often a drastic separation in examination grades – the majority of students either get A's, B's or F's, with very few in the mid-range. The same division exists across homework scores, and evidence indicates this may not be a coincidence. Students who consider themselves defeated on the first day of class and decide that doing homework is not worth the trouble because they have "never been good at math" are the ones who do not do well on examinations, thus perpetuating their self-defeatist attitudes. On the other end of the continuum are those who are eager to learn, attend class every day, and complete every assignment. They often possess the same fear and anxiety as the defeatist group, but they do something about. It is the group in the middle that causes the greatest concern to educators. These students will gravitate to one end or the other by the end of the term, and the direction they travel is heavily influenced by how much time and effort they are willing to spend learning outside of class. The goal is to show those in the danger zone that their success or failure is up to them. Sharing the results of this study should encourage students to assume the responsibility for spending that critical time studying outside of class.

Related Research

Although several studies regarding the effects of homework in grades K – 12 appear in current literature, relatively little research exists at the college level. However, in a 1981 study, Cartledge and Sasser [2] studied freshman algebra students. Of the thirty students who volunteered for the study, fifteen received homework assignments and the other fifteen did not. Researchers administered a pre-test at the beginning of the term, and the mean score on the examination for the homework group was statistically equal to the mean score for the no-homework group. At the end of the term, researchers administered the same test to the group. The post-test mean for those who had done the homework was significantly greater than that for the no-homework group. Although the sample size was relatively small (only thirty students total), these results suggest that freshman algebra students who complete homework assignments generally achieve better results than those who do not. Brender [1] did a similar study on Spanish 101 and 102 students, and found significant positive correlations between homework completion rates and test scores based upon class levels.

Cooper et al. [3] studied kindergarten thru high school students, and found a relationship between time spent on homework and subsequent academic achievement. They concluded that elementary school students showed the most progress when given no homework at all. Middle school students showed some improvement with a minimal amount of homework, with overall achievement increasing as homework time approached one hour per night. Homework in excess of one hour for this group was no longer associated with higher achievement, but this level proved to have a negative effect. High school students benefited most when spending at least an hour per day on homework. Overall, researchers found a significant positive correlation between homework time and level of achievement for high school students $(r = 0.25)$, a less positive correlation for middle school children $(r = 0.07)$, and almost no correlation for students in elementary school $(r \approx 0)$.

Wong [11] studied middle school students in Hong Kong, and found an insignificant correlation between percent of homework completed and mathematics achievement $(r = 0.03)$. Wong also reported that the amount of time spent on homework had no significant correlation with other variables in the study $(|\, r \,| \leq 0.05)$. Wong’s conclusions were unusual among peers. The consensus among most authors doing similar studies is that older students (high school and college) benefit to some degree by doing a certain amount of homework.

Methodology

Using an ex-post facto design based upon several semesters of instruction, a great deal of data was available for this study in the form of previously recorded grades. This university utilizes two distinct levels of developmental mathematics, which the course catalog lists as Math 1 and Math 2. In the fall of 2007, the university implemented new textbooks for each level. Ten sections of Math 1 data were selected for inclusion in this study consisting of 139 women and 56 men $(n = 195)$. All data reflected coursework from one textbook. Excluding Math 2 data from this study reduced the potential for confounding variables, adding power to the study.

The goal was to determine whether there was a correlation between the proportion of assigned homework completed and students' grades on exams covering that material. Each semester contained four regular examinations as well as a final examination. The lowest grade for the four regular examinations was dropped and not considered in a student's overall grade for the course. Some students chose to forego one examination entirely, and rely only on the grades for the other three examinations. However, because homework counts 10% of the overall grade, it is common for students to turn in assignments even if they do not take the examination. Rather than consider these examination scores to be zero, which would not represent how the student might have faired, this study excluded these pieces of paired data. Although some students drop a class after taking the first or second examination, their grades prior to dropping the course are included in the study. It should be noted that *n* (the number of paired samples in each homework/examination set) decreased successively. For the four examinations, the values were $n_1 = 192$, $n_2 = 185$, $n_{3A} = 76$, $n_{3B} = 102$, and $n_4 = 157$. The "A" and "B" designations for n_3 refer to two separate sets of data. The "A" set was similar in context to the other *n*'s but the "B" set included scores for an optional extra credit project. The extra credit project was a form of homework but its scores added directly to the examination grade, so results from this dissimilar data were considered separately in the analysis.

Because answers to problems are readily available, each homework score represents only the amount of homework completed for each assignment. For an assignment covering five sections of material, students could receive a grade of 0, 1, 2, 3, 4 or 5. Occasionally a student will attempt about half of the problems in the section, but not enough for full credit, so increments of 0.5 are also possible. Because the distribution of scores for these homework assignments is categorical, the Spearman Rank Correlation test was appropriate. Levels of homework completion and examination grades were assigned ranks. The following formula represents the test statistic:

$$r_s = 1 - \frac{6\sum d^2}{n(n^2 - 1)},$$

where

$n =$ the number of sets of paired data in the sample, and

$d =$ the difference between ranks for each pair of data in the sample.

Because n is so large, the following formula was necessary to calculate critical values for $\alpha = 0.01$:

$$CV = \pm \frac{z}{\sqrt{n-1}},$$

where

$n =$ the number of sets of paired data in the sample, and

$z = 2.575$.

The hypothesis is as follows:

H_o: There is no correlation between homework and corresponding examination grades.

H_a: There is a correlation between homework and corresponding examination grades.

Table 1 below contains the test results and critical values.

Table 1. Summary of results from Spearman Rank Correlation test

DATA SET	n	r_s	CV at $\alpha = 0.01$
Homework/Exam 1	192	0.484441	0.186320
Homework/Exam 2	185	0.396792	0.189832
Homework/Exam 3A	76	0.363780	0.297335
Homework/Exam 3B*	102	0.305116	0.256222
Homework/Exam 4	157	0.332452	0.206165

*3B refers to the dissimilar data discussed in the text above.

As the table shows, every data set produced a test statistic (r_s) greater than its corresponding critical value (CV). Therefore, we reject the null hypothesis – there is a significant correlation between homework and corresponding examination grades.

Table 2 below is a summary of the components of the regression lines representing the trends in the data sets. Regression lines are of the form $E = ah + b$, where

$E =$ expected grade

$h =$ homework completed

$a =$ slope of the regression line

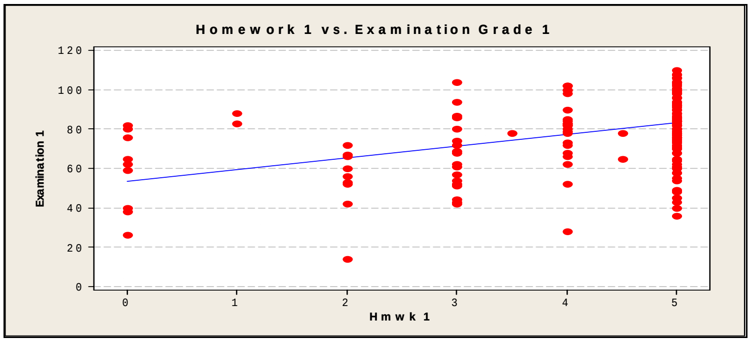
$b =$ intercept (expected grade where $h = 0$).

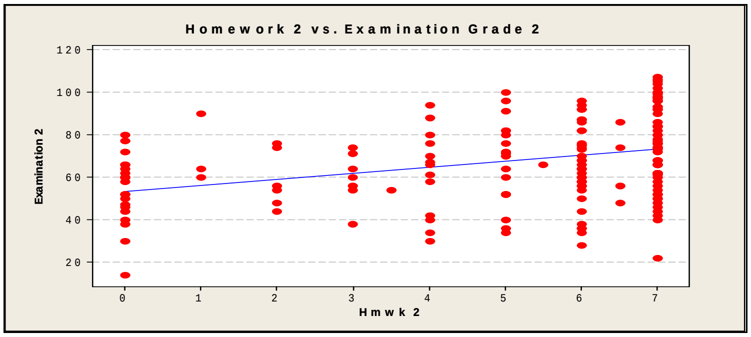
Table 2. Regression line components for the five homework/examination data sets

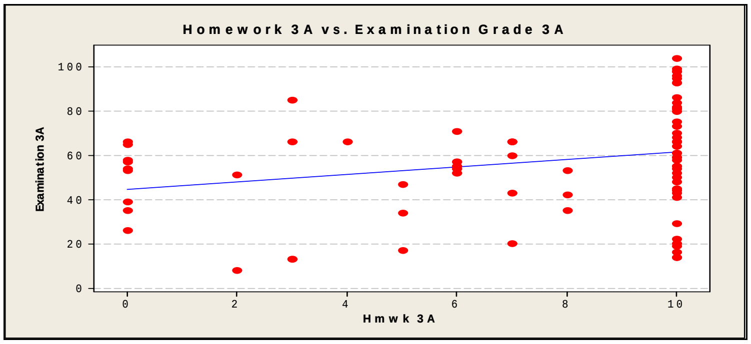
DATA SET	Slope (a)	Intrcpt (b)	Regression Eq.	Possible h	Value at h_{max}
Hmwk/Ex 1	6.00	53.37	$E = 6.00h + 53.37$	5	83.37
Hmwk/Ex 2	2.82	53.30	$E = 2.82h + 53.30$	7	73.04
Hmwk/Ex 3A	1.68	44.62	$E = 1.68h + 44.62$	10	61.42
Hmwk/Ex 3B*	1.41	67.36	$E = 1.41h + 67.36$	12	84.28
Hmwk/Ex 4	4.79	32.53	$E = 4.79h + 32.53$	5	56.48

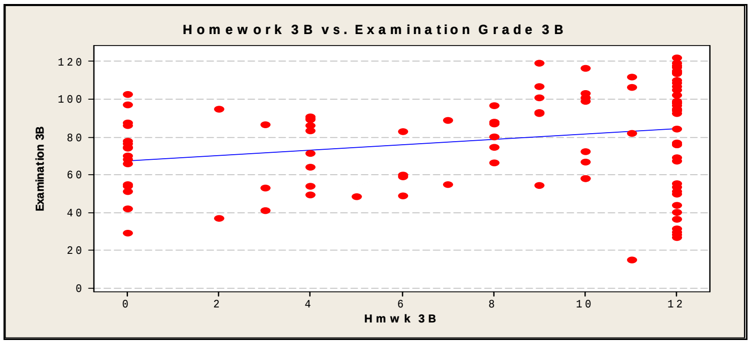
*3B refers to the dissimilar data

Figure 1 displays scatter plots of the data for all five homework/examination sets. Regression lines are superimposed over these scatter plots, each revealing a positive slope, further reinforcing the positive relationship between homework completion and corresponding examination grades. The points in each scatter plot appear in strips because of the categorical nature of the homework values. Some of these points are several layers thick because in many cases, multiple students received the same exam grade and completed the same amount of homework. Because the scatter plots do not clearly express this layering, it should be noted that the regression lines are a representation of the actual data.


Homework 1 vs. Examination Grade 1
Examination 1
120
100
80
60
40
20
0
0
1
2
3
4
5
Hmwk 1


Homework 2 vs. Examination Grade 2
Examination 2
120
100
80
60
40
20
0
1
2
3
4
5
6
7
Hmwk 2


Homework 3A vs. Examination Grade 3A
Examination 3A
100
80
60
40
20
0
0
2
4
6
8
10
Hmwk 3A


Homework 3B vs. Examination Grade 3B
Examination 3B
120
100
80
60
40
20
0
0
2
4
6
8
10
12
Hmwk 3B

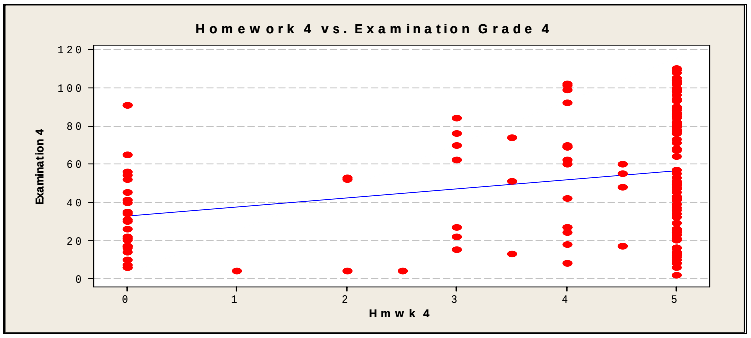


Figure 1. Scatter plots of homework completed vs. examination grades for the five data sets.

Conclusions

Because for each data set, the test statistic in the Spearman Rank Correlation test was larger than the critical value, we can conclude that there is a positive correlation between homework and examination grades. To reinforce this conclusion, it has been shown that all regression lines describing the data sets display positive slopes.

These conclusions open up more questions such as (1) Does doing homework give a student a better understanding of the concepts, thus better preparing him or her for an examination? (2) Do students who are above average do more homework because it is easier for them than average or below average students? (3) Is there an underlying variable that causes a student to do more homework and separately achieve better results on examinations? Kitsantas and Zimmerman [5] found a significant relationship between homework and the development of better study habits. They believe that homework promotes better study skills and greater responsibility toward learning. If their conclusions are correct, then this may explain some degree of the correlation, but certainly there are other forces at work.

We may be temped to claim causation, for example, that doing homework produces better examination grades, but we must be cautious to avoid drawing these conclusions. However, having this information may offer encouragement to students in future classes to complete the homework, not only for the weight for the grade, but also the confirmed positive relationship between homework and their final grades.

In retrospect, it is likely that some students have done homework assignments without turning them in, resulting in a grade of zero, yet may have done well on the examination. Conversely, factors such as illness, distractions, or various random events may have caused a student who completed and turned in the homework to have done poorly on an examination. Obviously, there are more variables in the equation than those covered in this study. The examination of such variables could be a foundation for further research in this area.

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