STUDENT MOTIVATION AND PERFORMANCE: EVIDENCE BASED ON INTRODUCTORY ECONOMICS CLASSES

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Abstract

A number of studies in economics, education and psychology literature have examined the link between student motivation and educational performance. This paper extends this literature by examining if more motivated students take morning, as opposed to afternoon classes. Based on data for 947 students for 10 pairs of three different introductory economics classes, this study does not find a compelling evidence for such a hypothesis. Instead, the study suggests that the students taking afternoon classes may be more motivated.

INTRODUCTION

For the concerned collegiate instructor student final grades represent more than just a culmination of semester grades. The semester grade signals hours of preparation, lecture time, and follow-up on the instructor's and student's parts. But there are two sides to this story. On one side, are the educators, for whom there are several concerns: attraction and retention of students into their area of specialty, motivation of student interest, and their fulfillment of curriculum requirements. On the other side, are the students, for whom the opposite concerns often exist: how to get the best grade with the least amount of effort (for classes that don't hold their interest) or with the greatest amount of enjoyment (for classes that turn out to be interesting despite previously held beliefs), student's own motivation for achievement, and fulfillment of course requirements. The relationship between motivation and outcomes is a dominant topic in every area of academia.

Many studies consider the relationships that exist between motivation, achievement, and final course outcomes. The impact of teaching techniques on student allocation of time, motivating student learning, and increasing the number of graduating students by increasing retention rates are among the concerns educators hold. *Meta-cognition*, a term used by

educational psychologists, describes the various aspects of awareness and recognition of learning knowledge processes by students (Pintrich and DeGroot, 1990). Proxies for utility maximization, in the form of allocation of study time, and research into student's study time is treated as a block of inventory and allocated across several classes during a semester are among the recent research. But at the foundation of all of these studies is the motivation-performance relationship. This paper extends this literature by examining if more motivated students take morning classes, as opposed to afternoon classes, assuming that more motivated students obtain better grades.

PREVIOUS STUDIES

Within the sphere of economics, the struggle for educators is to present a dismal science such that students find it interesting and ultimately helpful. Recent studies reveal more details. Grimes (2002) finds that students suffer from overconfidence, based on prior course performance, and don't actively participate in their own collegiate education, which contributes to significant misunderstanding of lecture materials, and ultimately results in inaccurate conclusions and poor performance in Principles classes. Gleason and Walstad (1998) reveal that when student study time is treated as a block of inventory and hypothesized to be allocated across several classes during a semester, the model fails.

Felder, Felder, and Dietz (1998), seeking to increase the number of graduating engineering students by increasing retention rates, use experimental structured courses that included extensive active and cooperative learning, open-ended questioning, multidisciplinary problem formulation and solution exercises, criterion-referenced grading, and other features designed to address an array of student learning styles.

An early 1980s research reveals that while attending lecture, discussion groups, and studying for second examinations, have positive effects, student utility maximization, in the form of student learning and allocation of study time within an economics course appears not to be altered (Schmidt, 1983). Much earlier, Kelley (1975) takes the student's time as given, and uses experimental classroom formatting and selected study notes available at a price of $5 to all students, and compares outcomes to the traditional classroom format without the selected notes. The utility-maximizing student, in the experimental course, will experience higher achievement in the Principles of Economics class than the student in the

traditional course. Regression results indicate achievement to be a Giffen-good, where the decline in the price of a good decreases its consumption.

Outside the arena of economics, many studies display consideration of the relationships that exist between motivation, achievement, and final course outcomes. An example of one such study is by Pintrich and DeGroot (1990). The authors examine the relationships between motivational orientation, self-regulation in learning, and academic performance for mid-level grade-schoolers. Vollmeyer and Rheinberg (1999, 2000) developed the cognitive-motivational process model to identify and specify initial aspects of motivation, collect influential mediators of initial motivation on performance, and emphasize the importance of measuring the learning process and outcome. They demonstrate how an interruption of the learning process reveals the interaction of motivational and cognitive variables. Their four aspects of initial learning motivation, described by Vollmeyer, Imhof, and Beierlein (2006) as (1) the probability of success, (2) anxiety, (3) interest, and (4) challenge, posit that learners in a positive initial motivational and functional state during learning choose more effective learning strategies. Learning strategies encompass the time of day for collegial courses. Performance outcomes of collegial courses necessarily hinge on adaptation of the best strategy by a student.

As the preceding paragraph illustrates, the link between student motivation and performance is well documented in many areas of the collegiate atmosphere. We use the motivation-performance supposition to ask: do motivated students take morning classes over afternoon classes, *ceteris paribus*? Using comparison of means, and Bernoulli random variables, this study does not find a compelling evidence for such a hypothesis. Instead, the study suggests that the students taking afternoon classes may be more motivated.

DATA AND METHODOLOGY

Data Utilized

Data from three areas of 4-credit introductory economics classes (Principles of Macroeconomics, Principles of Microeconomics and combined introductory Micro and Macroeconomics courses), taught by three instructors over the 2002-2008 period was used. The sample consists of 10 pairs of economics classes, wherein a pair consists of the same economics class taught by a particular instructor during a given semester

at two different times – one in the morning and the other in the afternoon. The pair-wise observations of student performance in morning and afternoon classes allow for a comparison of means. For any one class (morning or afternoon), percentage scores by students are used to obtain average score for the class. In doing so, students who did not take the final examination or withdrew from the class are excluded, so as not to have a bias introduced by students who are no more active participants of the class. The total number of students across the 10 pairs of classes was 947. The 10 pairs consisted of 2 Principles of Microeconomics, 6 Principles of Macroeconomics, and 2 combined classes. To avoid the problem due to a non-linear grading scale, we utilize end-of-semester percentage scores, rather than end-of-semester GPA. This is because while many schools grade on a 1.0 (lowest D-grade) to 4.0 (highest A-grade) scale, the scales for Bs and As are shorter than for Ds and Cs.

Methodology Utilized

We utilize both two-tail and one-tail tests for comparison of means. Under the two tail-test, H_o: $\mu_1 = \mu_2$ (the mean grades of both morning and afternoon classes are the same), and H_1: $\mu_1 \neq \mu_2$ (the means of morning and afternoon classes are different), assuming a normal distribution with unknown variances. The standard Z-test is used for all pairs where both n_1 (the number of students in the morning class) and n_2 (the number of students in the afternoon class) are large (≥ 30). All AM-PM pairs of classes, except one, satisfy this constraint. For the AM-PM pair that does not satisfy the large sample assumption, Student's *t*-test with $n_1 + n_2 - 2$ degrees of freedom is utilized, assuming a normal distribution with equal but unknown variances. The null and alternative hypotheses for the two-tail tests can be stated as:

$$H_o: \mu_1(\text{AM}) = \mu_2(\text{PM})$$
$$H_1: \mu_1(\text{AM}) \neq \mu_2(\text{PM}) \qquad (1)$$

The preceding methodology is repeated for one-tail test as well. In this case the null hypothesis is given by H_o: $\mu_1 > \mu_2$ (the mean grade for the morning class is larger than the average for the afternoon class), and the alternative hypothesis by H_1: $\mu_1 \leq \mu_2$ (the mean grade for the morning class is less than or equal to the average for the afternoon class). The *Z*- and *t*-statistics utilized are the same as in the previous paragraph. The null and alternative hypotheses for the one-tail tests can be stated as:

$$H_o: \mu_1(\text{AM}) > \mu_2(\text{PM})$$
$$H_1: \mu_1(\text{AM}) \leq \mu_2(\text{PM}) \qquad (2)$$

Once the differences in means tests are performed, the outcomes are also analyzed based on the ratio test. We assume a Bernoulli experiment where we are testing for one of the two outcomes. We assume that the probability that the morning class average is greater than the afternoon class average is the same as the morning class average being lower than or equal to the afternoon class average. That is,

$$H_0: p\ (\text{AM}>\text{PM}) = 0.50$$
$$H_1: p\ (\text{AM}\leq\text{PM}) = 0.50 \qquad (3)$$

The test statistic for the null hypothesis would be given by

$$t = \frac{\overline{p} - 0.5}{s_{\overline{p}}} \qquad (4)$$

The variance of *p*-bar is based on the assumed value of *p* under the null hypothesis:

$$s^2_{\overline{p}} = \frac{p(1-p)}{n}. \qquad (5)$$

Before we discuss the empirical results, it is useful to point out that the comparison of means test has been utilized by other studies in similar contexts. Felder, Felder, and Dietz (1998), for example, utilized a comparison of means to study the impact on retention rates between their experimental cohort and the traditionally taught cohort. Pintrich and DeGroot (1990) use an adaptation of a general expectancy-value model of motivation, in which the three components of self-regulated learning are linked to three motivational components. The expectancy component links student's own beliefs about performing tasks to motivation, the value component links a student's goals and beliefs about the importance and interest of the task to motivation, and the affective component which links the student's emotional reactions to the task to motivation.

EMPRICAL RESULTS

Differences in Means

The results for the null hypotheses given by expressions (1) and (2) are provided in TABLE 1. The null hypothesis, H_o: μ_1(AM) = μ_2(PM) given in (1), is not rejected at the 5% level of significance for 9 out of the 10 class pairs included in the sample. It is only rejected for one class pair (Fall 2007, Macroeconomics), with a *Z*-value = 2.51. Therefore, based on tests for the null hypothesis in (1), overwhelming evidence supports the view that morning and afternoon students are equally motivated.

Similarly, The null hypothesis, H_o: μ_1(AM) > μ_2(PM) given in (2), is not rejected at the 5% level of significance for 9 out of the 10 class pairs included in the sample. This too is only rejected for one class pair (Winter 2008, Microeconomics), with a *Z*-value = -1.74. Therefore, based on tests for the null hypothesis in (2), overwhelming evidence also fails to reject the view that morning students are more motivated than afternoon students.

Test Based on Binomial Distribution

The *Z*-statistics provided in TABLE 1, however, show that in 9 out of 10 paired samples, the average score for the afternoon class was higher than those for corresponding morning classes (even though the differences were not statistically significant for 9 out of 10 pairs). We therefore wanted to examine all 10 outcomes together based on a Binomial distribution.

Assuming a random occurrence, 50% of the observations could have AM performance greater than PM performance (i.e., it is equally likely that μ_1(AM) > μ_2(PM) or the other way round), we stipulated the null hypothesis in expression (3). The estimate of *p* (probability of AM grade > PM grade), $\overline{p}$, is 0.1 from TABLE 1. Under the null hypothesis, the the variance of $\overline{p}$ is given by

$$\sigma^2_{\bar{p}} = \frac{p(1-p)}{n} = \frac{0.5x0.5}{10}$$

TABLE 1
Tests of Differences in Student Performance: Morning vs. Afternoon Classes
(# of Students Covered = 947)

Sample #	Semester/Instructor # (Subject)	$\bar{x}_1$	$\bar{x}_2$	*Z*-value*	$H_0: \mu_1 = \mu_2$ (α=0.05)	$H_0: \mu_1 \geq \mu_2$ (α=0.05)
1	2002F/#1 (Macroeconomics)	66.89 (n_1 = 52)	68.53 (n_2 = 40)	-0.88	Not Rejected	Not Rejected
2	2003F/#1 (Macroeconomics)	65.83 (n_1 = 53)	67.19 (n_2 = 48)	-0.64	Not Rejected	Not Rejected
3	2004F/#1 (Macroeconomics)	66.37 (n_1 = 46)	69.69 (n_2 = 49)	-1.46	Not Rejected	Not Rejected
4	2006F/#1 (Macroeconomics)	63.73 (n_1 = 33)	65.71 (n_2 = 28)	-0.61	Not Rejected	Not Rejected
5	2007F/#1 (Macroeconomics)	66.39 (n_1 = 51)	60.83 (n_2 = 47)	2.51	**Rejected**	Not Rejected
6	2008F/#1 (Macroeconomics)	62.40 (n_1 = 53)	65.76 (n_2 = 46)	-1.58	Not Rejected	Not Rejected
7	2007W/#2 (Microeconomics)	67.61 (n_1 = 54)	67.96 (n_2 = 45)	-0.15	Not Rejected	Not Rejected
8	2008W/#2 (Microeconomics)	73.50 (n_1 = 59)	74.29 (n_2 = 59)	-1.74	Not Rejected	**Rejected**
9	2007F/#3 (Combined Intro)	73.68 (n_1 = 54)	76.85 (n_2 = 43)	-1.12	Not Rejected	Not Rejected
10	2008F/#3 (Combined Intro)	72.26 (n_1 = 55)	77.70 (n_2 = 32)	-0.94	Not Rejected	Not Rejected

* Except for Fall 2006 (Instructor #1), all AM-PM class pairs have n_1 and n_2 greater than 30. As a result, the standard *Z*-statistics were used for all tests, and the *t*-test was used for the Fall 2006 pair.

Therefore, the standard error of *p*-bar is equal to 0.158. The *t*-statistic for the null hypothesis in expression (3) is thus given by

$$t = \frac{0.1 - 0.5}{0.158} = -2.53$$

For one tail test, the value of *t* at α = 0.05 is equal to 1.833 (degrees of freedom = 9). As the *t*-statistic of -2.53 is less than the critical value of -1.833, the null hypothesis that the AM performance is better than the PM

performance is rejected at $\alpha = 0.05$. The *t*-statistic and the critical value also tell us that the preceding observations will not reject the hypothesis, H_0: p (AM≤PM) = 0.50 (i.e., morning classes yield grades that are lower than or equal to those from afternoon classes). If more motivated students get better grades, the empirical results based on the Binomial distribution therefore seem to suggest that students taking afternoon classes are more motivated.

SUMMARY AND CONCLUDING REMARKS

Most Principles of Economics students are not majoring in economics -- they are in this class because it's a required course, not because they want to be there. After the semester is over, the final grade signals the outcome of the student's semester-long investment in motivation and performance. Our initial hypothesis was based on the premise that students taking morning classes are more motivated than those taking afternoon classes. However, the results based on the pairwise comparison of student grades in introductory economics classes seem to suggest to the contrary. This paper does not explore what might explain such an anomaly. Is it likely that more motivated students take their *major* classes in the morning and take their required dismal science classes in the afternoon? If this is the case, these motivated students end up doing better even in the afternoon as they are likely being compared to morning students who may not be as motivated as the students who plan their allocation of time slots based on the importance of the classes they are taking.

ENDNOTES

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