Age, Gender, and Race as Predictors of Opting for a Midterm Retest: A Statistical Analysis of Online Economics Students

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The number of students enrolled in online courses continues to grow despite declining overall higher education enrollments. This trend charges educators to focus efforts on improving student outcomes and academic success within distance learning courses. This paper investigates if a midterm exam retest were available to online college students taking introductory principles of economics courses, which students would increase their human capital stock in these distant learning courses and take a retest? We examine, age, race, and gender to examine if these sociodemographic factors affect one's option to retest.

INTRODUCTION

Improving retention and student learning outcomes are among the keynote goals of any higher education institution. This paper addresses a question, "If a midterm exam retest option were available to online college students taking introductory microeconomics and macroeconomics courses, which students would opt to increase their human capital stock and take a retest?" At first blush, some would proffer that individuals who failed the midterm would be candidates for a retest while others may state those who initially devoted a great deal of time and effort would opt for a retest to improve their final course grade. The number of students who engage in online courses continues to grow despite declining overall higher education enrollments. Research shows a 1.3 percent reduction in college enrollments in spring 2016 from the previous year (National Student Clearinghouse, 2016). However, online enrollments in non-profit institutions grew by 26%—or nearly 200,000 students—from 2012 to 2014 (Allen I. E., Seaman, Poulin, & Straut, 2016). Continued increases in online education enrollment necessitate the need to identify trends and participatory groupings to focus efforts on improving student outcomes and academic success.

In order to address online concerns of quality instruction across all principles of economics courses, our department of economics has been using homogenous online courses for many years. Over the past

four years, the principles of macroeconomics and principles of microeconomics courses have become completely homogenized regarding course content with faculty input into each course. With online courses designed to mirror traditional course offerings, these courses were then standardized to preclude students from taking any specific section in an attempt to find an easy "A." This has allowed us to monitor changes in how students perform by course and term, and determine what areas of study prove to be the most difficult for students. (Byrd & Minadeo, 2016)

This paper focuses on students enrolled in academic years 2014 and 2015. This time period included 10 online terms[1] with 15 macroeconomic and five microeconomic courses. Within these sections, the ability to retake the midterm examination was offered. The rationale behind these retests was to stimulate an increase in human capital, improve midterm scores, and provide students with both motivation (Yang, Cho, & Watson, 2015) and an opportunity for positive reinforcement via a successful midterm exam that could ultimately lead to improved student performance and a better course grade. Given this, our objective is to quantitatively determine what impact students' age, gender, or race (Caucasian or African-American), influenced retesting.

We acknowledge that a retest of the midterm constitutes only a small portion of the final grade; however, this research is not solely intended to identify factors that aid in successful course completion; rather, to determine statistically if sociodemographic factors impacted one's decision to opt for or decline a retest. Conclusions drawn from this research are directly applicable to the granting of a retest, and rather a more indirect effect on final course performance. If sociodemographic factors show certain segments of online learners are more effective and use opportunities more strategically, this arms the professor with more knowledge on how to provide incentives to other cohorts.

LITERATURE REVIEW

With the increase in popularity of online courses comes an increase in research to analyze the differences in student outcomes between online and face-to-face courses. (Coates, Humphreys, Kane, & Vachris, 2004); (Gratton-Lavoie & Stanley, 2009). The study of student outcomes is not a recent phenomenon. Research analyzing various factors, to include demographics, (Alhajraf & Alasfour, 2014) (Colorado & Eberle, 2010), GPA, entry criteria, etc., has been ongoing for years to ascertain which factors could or would aid students to do well on exams or pass courses. For example, see (Allgood, Walstad, & Siegfried, 2015) and their cited references. Research into gender differences, a potential outcome of our research, in examination behavior (Nekby, Thoursie, & Vahtrik, 2015) and the study of economics (Ballard & Johnson, 2005) and (Emerson, McGoldrick, & Mumford, 2012), identifies gender differences as somewhat problematic.

The ability to succeed in an online course has been studied by many economists and non-economists alike. Familiar student determinants of success move fluidly between traditional face-to-face courses and the online environment. A student's GPA (Cavanaugh & Jacquemin, 2015), GPA and ACT percent ranking, (Brown & Liedholm, 2002), term selection (Gratton-Lavoie & Stanley, 2009), number of previous online courses, and age (Wojciechowski & Palmer, 2005) influence future outcomes. Online students' grades are also determined to be partially dependent on age, gender, (Horvath, Beaudin, & Wright, 1992) ethnic background, and higher education experience (Koch, 2006); (Borg & Stranahan, 2002). Perhaps more important to the online student is the ability to self-regulate and be accountable as student-teacher interaction is more likely to be asynchronous. Research has found when online courses are designed using pedagogically sound practices they may provide equally effective learning environments. (Driscoll, Jicha, Hunt, Tichavsky, & Thompson, 2012). Hence, there is a plethora of information aiming to predict what factors help a student's success in online courses. This information is not only beneficial to the student/professor relationship but also to the institution to help facilitate "best practices" and retention.

This paper focusses on the sociodemographic characteristics of gender, age, race, GPA, and home location[2] and how this cohort of students utilizes the midterm retest option. Research has been done over many disciplines and academic levels regarding the efficacy of allowing midterm retests. These studies

have examined the benefits of retests upon student performance (Paff, 2012), retention, (Juhler, Rech, From, and Brogan, 1998), and motivation, (Wormeli, 2011). (Ryshke, 2011) cites, in the "real world" there are plenty of examples where redoing one's work is totally acceptable. LSAT, MCATs, SATs, and many more organizations have policies that allow an individual to retake the exam for a passing grade. In fact, the SAT's policy is that students can select their highest scores on the language and math sections from multiple sittings and send these to colleges. "The College Board does not average your scores and send the average score as the indicator of a student's ability." Ryshke (2011) states as evidence in his online economics courses with the chance to re-do one's own work he witnesses, "increased motivation, fewer cheating incidences, a sense of hope for lower achieving students, improved test scores, and an increased awareness of *why* they were making mistakes, and positive feedback for the policies on course evaluations." Research is favorable with relation to the outcomes from implementing a retest policy within a college-level course. Our goal within this paper is to go a step further and study whether sociodemographic characteristics of students have an impact on who opts for this opportunity.

Research shows student learning skills do differ depending on gender (Gonzalez-Gomez, Guardiola, Rodriguez, and Alonso, 2012). To add to the debate, Ong and Lai (2006) cite male students having more positive perception of e-learning than female students. According to Lu and Chiou (2010), e-learning valuation and satisfaction are greater among male students than female students. Nevertheless, some research studies suggest that gender has no effect on satisfaction or attitudes towards e-learning (Cuadrado-García et al., 2010 and Hung et al., 2010), (Chu and Kay (2010); Knaack, 2008). Despite the debate regarding gender, the inconclusiveness across the research warrants further investigation into the impact it has upon whether one chooses to retake a midterm examination in online principles of economics' courses. Data suggest that female students assign more importance to the planning of learning, maintain more open channels of communication with the professor, and are overall more satisfied with the course layout (Gonzalez-Gomez, Guardiola, Rodriguez, and Alonso, 2012).

Prior research has linked race and ethnic differences in collegiate performance to family background, early academic achievement (high school grades) and standardized test scores. (Rothstein, 2004, Alon and Tienda, 2007). Both critics and proponents of affirmative action use race and ethnic gaps in standardized test scores to bolster claims that minority students are less prepared than whites (Thernstrom and Thernstrom, 1996). Even though minority students average lower scores on standardized tests, there is ample evidence establishing a positive association between college selectivity and success of minority students (Bowen and Bok, 1998; Kane, 1998; Rothstein, 2004; Alon and Tienda, 2005). A second explanation for race and ethnic disparities in college performance alleges the benefits from distinct college environments are not uniform for minority and nonminority students. Evidence for both claims is mixed, depending on the outcome of interest, the selectivity of institutions in the study, and the timeframe of the study. This study focusses primarily on Caucasian and African-American students based on sample size.

The factors of age or rather the traditional student versus the non-traditional student have been cited as clear and significant indicators in online course performance. Historically the traditional student was labeled as being in the age range of 18-22, and non-traditional as above. However, The National Center for Education Statistics (2010) defines nontraditional students as meeting one of seven characteristics: delayed enrollment into postsecondary education; attends college part-time; works full time; is financially independent for financial aid purposes; has dependents other than a spouse; is a single parent; or does not have a high school diploma. Those criteria fit a wide swath of today's college students. Adams and Corbett (2010) state traditional and non-traditional students have differing goals and motivations, as well as expectations for pursuing a college degree online, have varying cognitive levels upon entering college, and non-traditional students prefer an option for a more flexible learning environment and schedule (e.g. online classes) than traditional students. Addressing our research sample, this sample is almost entirely non-traditional with the average age of the students at 34.5 years of age; therefore, this is a very different population than what is generally understood to mean "college students." Our institution is known for its service to the "non-traditional" student population. Therefore, this variable is of significance not only in

this research study but also to our institutional focus on improving the experience and retention of this cohort.

RESEARCH METHOD

Each principles of economics course taught online is subject to a nine-week term, eight weeks of instruction and a final exam during the ninth week. Thus, the term system compresses a sixteen-week course into eight weeks of instruction. Each course had a multitude of supplemental tools to aid students in their understanding of the material. These included: worked problems for each chapter, practice tests, flashcards, links to outside videos explaining chapter content, enhanced PowerPoint slides, as well as any tools (apps) found inside of Cengage's Homework Management System (HMS), MindTap, and APLIA products. Course grading was assigned through a midterm, final examination, three discussion board posts, and an APLIA homework for each chapter covered in the course. Online midterm exams were available Monday through Sunday, consisted of 40 multiple choice questions, and had a 90-minute time limit; exams were open book, not proctored, counted 20% towards the final grade, and could not be dropped. Students' had an additional week following the midterm test week for a retest and were advised, via email and announcement(s) posted to Canvas Learning Management System (LMS), of the midterm retest option on Friday of the midterm test week. Thus, they had two days to either enhance their studying tactics to perform on the first attempt, or hedge their bets and opt for a retest. If a student opted for a retest, he/she would not get the same exam. The midterm examination and the retest are both drawn at random from a large test bank pool (exceeding 1,000 questions).

From an economic perspective, midterm retests are additional capital for students to use in their production function. As our students already had a stock of capital (*e.g.* textbook, enhanced PowerPoint slides, *etc.*) adding to it should, if the student utilized the retest, allow for greater returns in production. In this case, those returns are in the form of improved student understanding of the most difficult areas of study, effective use of time in class, retention of course material and, ultimately, improved grades.

SAMPLE SIZE

All students in online introductory economics courses included in these analyses had access to the midterm retest. The sample size consisted of N = 591 students in the combined class sample with N = 329 opting for the retest. Some important considerations must be mentioned. First, the average student age for this analysis was 34.5, many with a fulltime job or children. Lastly, many students who take courses online typically wait until the last day of the week (Sunday) to do their weekly assignments (Byrd & Minadeo, 2016). Given the large amount of time spent on the last day of the week doing course related activity, retests may not actually help the student if they have to prioritize their work effort during the retest week.

RESULTS

We employed discriminant function analysis, which is a parametric technique to determine which weightings of quantitative variables or predictors best discriminate between two groups. Each discriminant function differentiates a case into a dependent variable based on its values on the independent variables. The first function will be the most powerful in differentiating the dimensions and the subsequent functions may or may not represent additional differentiation (Ramayah, Ahmad, Halim, Zainal, Lo, 2010).

Our initial hypotheses were:
- H_{01}: Initial midterm score, GPA, Race, Gender, and Age are not good predictors of taking the opportunity to retest (i.e. function's canonical correlation = 0).

- H_{11}: Initial midterm score, GPA, Race, Gender, and Age are good predictors of taking the opportunity to retest

To measure our hypotheses, we used data obtained from official university records. All identifying characteristics were removed prior to analysis. The list below provides details on the variables included in the study. Table 1 provides descriptive statistics of the variables.

Dependent Variable

The dependent variable is a discrete, dichotomous variable and is measured by the student's choice to either; (Yes), Opted to retake the midterm exam; or (No), Did not retake the midterm exam.

The following are the independent variables included in the study to better gauge the decision to retake or not retake the midterm exam.

Age

The *age* variable is a discrete variable. It measures the precise age of the student at his/her time in the course. There were no groupings in the *age* category.

Grade Point Average (GPA)

The *GPA* variable is a continuous variable. It measures the current GPA of the student at his/her time while enrolled in the course out of a 4.00 scale.

Race

The *race* variable is a categorical variable. Out of the students included in this study, 7 chose "prefer not to answer" with regards to a specific race/ethnicity thus, those cases were omitted, leaving the n = 591 students included in the study. There were very few students who identified themselves as other than African-American or Caucasian. Therefore, the only race categories included were African-American or Caucasian.

Gender

The *gender* variable is a categorical variable. The students were classified as Male (M) or Female (F).

Initial Midterm Score

The *initial midterm score (IMS)* is a discrete variable. This variable registered the exact score of the original midterm exam by students in the study.

TABLE 1
CHARACTERISTICS OF DECISION TO RETEST

Independent variables		Decision to Retest	
		Yes	No
Age (mean)		36 Years	33 Years
GPA (mean)		2.73	2.71
Race	African-American (n=273)	51%	49%
	Caucasian (n=318)	47%	53%
Gender	Male (n=204)	42%	58%
	Female (n=387)	53%	47%
Initial Midterm Score (mean)		58.37	67.43

The discriminant analysis procedure was run to determine how well the model fits the data. The eigenvalues and Wilks' lambda tables below demonstrate how well the discriminant model as a whole fits the data. The 1 in Table 2 is equal to the number of discriminating variables, which is one less than the

number of levels in the group retest variable. Retest has two levels and five discriminating variables were used, i.e., *initial midterm score, GPA, race, gender, and age*. Thus, one function is calculated. The function projects the data onto a dimension that discriminates between the groups. The eigenvalue describes the discriminating ability the function possesses. In this analysis, the % of variance demonstrates that the function accounts for 100% of the discriminating ability of the variables. The results of the discriminant analysis, therefore, causes us to reject the null hypothesis. The high eigenvalue and significant Wilks' Lambda (see Tables 2 and 3) indicate that we have a good model.

TABLE 2
EIGEN VALUES

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	.151[a]	100	100	.362

[a] 0 cells (0.0%) have expected count less than 5. The minimum expected count is 100.10.
[a] Computed only for a 2x2 table

Results show a canonical correlation of .362, with a Wilks' Lambda testing the canonical correlation of .869 (see Table 3). The Chi-square statistic of 82.27 tests the null hypothesis that the function has no discriminating ability, i.e., that the canonical correlation of the given function is equal to zero. Thus, our results clearly indicate the function has discriminating validity ($p < .01$).

TABLE 3
WILKS' LAMBDA

Test of Function(s)	Wilks' Lambda	Chi-square	Df	Sig.
1	.869	82.268	5	.000

Standardized coefficients from Table 4 allow a comparison of variables measured on different scales. Since we measure *age, GPA, race, gender, and initial midterm score*, all with different scales, this test is appropriate. The standardized coefficients with large absolute values correspond to variables with greater discriminating ability. Previous research (Doverspike, 2015, Paff, 2012, Juhler, et. al, 1998, Wormeli, 2011, and Ryshke 2011) has shown that the score on the initial test is a strong driver of retesting. Our results demonstrate initial midterm score ($\beta = .935$) having the largest discriminant ability or impact of the five variables. The "directions" of age and midterm score are apparent from the discriminant score. A high midterm score is related to "not retesting," as is a lower age. The use of a separate analysis on gender in Table 5 was to obtain a better understanding of gender's effect.

TABLE 4
STANDARDIZED DISCRIMINANT FUNCTION COEFFICIENTS

Independent Variables	Standardized Coefficients
Age	-.391
GPA	-.366
Race	-.168
Gender	.224
Initial Midterm Score	.935

Table 5 shows the tests of equality of group means, which measure each independent variable's relationship with the dependent variable, decision to retest. Displayed are the results of a one-way ANOVA for *age, GPA, race, gender, and initial midterm* score using retest as the dependent variable.

The results indicate, age, gender, and initial midterm score in the discriminant model to be significant. Wilks' lambda is another measure of a variable's potential to discriminate between whether or not a subject chose to retest. The results clearly suggest initial midterm score to be the best predictor, followed by age, and gender.

TABLE 5
TESTS OF EQUALITY OF GROUP MEANS

Independent Variables	Wilks' Lambda	F	df1	df2	Sig.
Age	.967	19.885	1	589	.000
GPA	.999	.342	1	589	.559
Race	.998	.992	1	589	.320
Gender	.990	5.997	1	589	.015
Initial Midterm Score	.911	57.267	1	589	.000

The significance of age is not surprising. Older students tend to be non-traditional, to have jobs and/or families, to have more maturity, and therefore may be more amenable to opportunities to raise their grades. To determine the differences among genders, we performed cross tabulations with Chi-squared tests. This technique offers tests of independence and measures of association for nominal and ordinal-level data. The results shown in Table 6 indicate females to be much more likely to opt for a retest than males.

TABLE 6
CROSSTAB AND FREQUENCY RESULTS FOR GENDER AND DECISION TO RETEST

Decision to Retest	Gender		Total
	Male	Female	
Yes	70% (n =204)	30% (n = 86)	n = 290
No	61% (n=183)	39% (n =118)	n = 301
Total	65% (n = 387)	35% (n = 204)	n = 591

The crosstabulation alone does not determine significance. Thus, Table 7 shows the chi-square test results to determine whether the differences in gender are actual or due to chance variation. The results suggest a significant difference between male and female decisions to retest, with females being significantly more likely to retest.

TABLE 7
CHI-SQUARE TEST RESULTS FOR GENDER

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.956[a]	1	.015		
Continuity Correction	5.542	1	.019		
Likelihood Ratio	5.976	1	.015		
Fisher's Exact Test				.016	.009
N of Valid Cases	591				

A final analysis, considered post hoc, was conducted relating to how race and gender jointly influenced the likelihood of a midterm retest. We knew that race overall was not significant, but we did notice some differences between the two racial groups in our study and wondered if that had an impact on the gender differences. Thus, a second cross tabulation was conducted (see results in Table 8) which indicated that the overall significance of gender was due to the stronger differences between African-American males and African-American females. That is, African-American females were much more likely to opt for the retest than African-American males (56% and 38%, respectively).

TABLE 8
CROSSTAB AND FREQUENCY RESULTS FOR GENDER AND RACE ON DECISION TO RETEST

Race	Decision to Retest	Female	Male	Total
African-American	Yes	83% (n = 116)	17% (n = 24)	n = 140
	No	70% (n = 93)	30% (n = 40)	n = 133
	Total	76% (n = 209)	24% (n = 64)	n = 273
Caucasian	Yes	59% (n = 88)	41% (n = 62)	n = 150
	No	54% (n = 90)	46% (n = 78)	n = 168
	Total	56% (n = 178)	44% (n = 140)	n = 318
Total	Yes	70% (n = 204)	30% (n = 86)	n = 290
	No	61% (n = 183)	39% (n =118)	n = 301
	Total	65% (n = 387)	35% (n = 204)	n= 591

CONCLUSION

The overriding objectives of making a midterm exam retest available to all students was for students to increase their human capital stock and improve midterm exam outcomes. This research focused solely on the midterm exam retest by determining what sociodemographic factors impacted a student's decision to opt for or decline a retest. There were numerous graded elements in the courses used for the midterm analysis; however, evaluation of factors, other than the midterm exam retest, necessary to influence a final grade, were beyond the scope of our research. Using discriminant function analysis, we determined that the initial midterm score, GPA, race, gender, and age are good predictors of which individuals would opt for a midterm retest. Further analysis, using ANOVA and Wilks' lambda, ranked predictors with initial midterm score found to be the best predictor, followed by age, and gender.

Intuitively, students have already invested a great deal of human capital in the class and the desire to improve outcomes to capitalize on the investment of their human capital would encourage a retest. Age was significant, especially when greater than 25, since many of these individuals are non-traditional, mature students who are employed and with families. These students may be more amenable to a retest as an opportunity to possibly improve their midterm exam grades.

Gender was significant with females opting to retest more than males. Race, per se, was not found to be a significant factor. However, the overall significance of gender was due to the stronger differences between African-American males and females, with African-American females much more likely to opt for the retest than African-American males.

ENDNOTES

1. The institution under study utilizes 9-week terms across the academic year. There is a total of 5 terms, in the fall (terms 1 and 2), spring (terms 3 and 4), and the summer (term 5) for a total of 5 terms per academic year.
2. There are 4 physical campus location sites a student can take courses as well as online. The data delineates between a physical home location for the student or an online status. The coding does not disqualify students from taking a course at any location, for records purposes the student is assigned to only one category.

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