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When Do Students Work?

Cole R. Gustafson*

Abstract

This study examines test taking patterns of students enrolled in an introductory economics class who could complete their exams electronically at any time-of-day or day-of-week. Exam completion patterns are related to several student characteristics including gender, class rank, major, and whether the student was enrolled online. Statistical differences in both time-of-day and day-of-week were observed across these strata and related to overall performance. The majority of students completed their exams in late evening time periods, which negatively affected overall performance. These results have important implications for educators and may partially explain past anomalous results in other studies of student study habits.

Keywords: distant education, exam completion patterns, learning styles, online classes, students' work, study habits

Introduction

Online and distant education courses are becoming increasingly common in many agricultural economics departments throughout the United States (Dahlgran, 2003). While the costs of offering these alternatives relative to traditional classroom courses has been shown to be considerably higher (Sterns et al., 2005), the value of these alternative offerings to students enrolled is less understood. In particular, do students value the additional flexibility afforded by these alternatives? If so, what features are particularly attractive and does value vary across students with differing demographic or scholastic characteristics? A more important question is whether students in traditional classrooms would utilize greater flexibility in their curriculums if it was provided.

This study examines test taking patterns of students enrolled in an introductory economics class who were afforded complete flexibility with respect to time-of-day and day-of-week for completing coursework. Students could take pretests and chapter exams at any time-of-day or day-of-week until each was due. Exam completion patterns are related to several student characteristics including gender, class rank, major, and whether the student was enrolled in an online section. Statistical differences in both time-of-day and day-of-week completion patterns were observed across these diverse strata and related to overall student performance in the course. Finally, a study of student habits finds that students who routinely complete pretests and chapter exams just prior to the time when they are due, do less well academically. Implications of these results are discussed prior to the conclusion.

* Gustafson is Professor, Department of Agribusiness and Applied Economics, North Dakota State University, Fargo. He gratefully acknowledges comments from Dragan Miljkovic, David Saxowsky, and Cheryl Wachenheim on an earlier draft of this paper and the superb word processing skills of Norma Ackerson and Carol Jensen.

Background

Student performance in agricultural economics classes has been shown to vary by gender, age, academic level, and whether a course is required or elective (Batte et al., 2003; Stephenson et al., 2005). Recently, student performance has also been linked to various personality characteristics. Borg and Stranahan (2002) demonstrate that personality type is an important explanatory variable in student performance in economics at the upper level and that introverts achieve higher grades than identical students who are extroverts. Earlier research by Ziegert (2000) found that personality types are an important determinant of success in economic principles classes which tend to be more analytical than other disciplines. Irani et al. (2000) also found personality to be important in their study of distance education courses.

To the extent that personalities are individual, it is likely that students have differing preferences with respect to course design, content, curriculum delivery methods, communication methods, and assessment. Tailoring each of these elements to the needs of individual students is one goal of the recent emphasis on learning styles. DeBello (1990) defined learning style as the characteristic cognitive, affective, and psychological behaviors that serve as relatively stable indicators of how learners perceive, interact with, and respond to the learning environment. A mismatch between an instructor's teaching style and a student's learning style can result in the student learning less and being less interested in the subject matter (Lage et al., 2000).

In addition to personality, basic human biology may also result in diverse learning style preferences across students. Research on teenage sleep patterns has spurred debate on the interaction between human biology and learning (Lawton, 1999). Research supports the idea that most people respond to circadian rhythms and have a certain time-of-day when they are most alert and able to perform at their best. Circadian rhythms can change throughout a person's lifetime. Thus, ideal study times not only vary greatly from person to person, but can also change over a person's lifetime implying there is no one time-of-day that is ideal for everyone in a particular age group.

Online courses provide an opportunity to accommodate increasingly diverse student learning styles by offering courses at times when students are best able and/or available to learn. Proponents of online and distance education courses argue that they can more effectively teach students with different learning styles and provide more individualized instruction than traditional classroom courses (Navarro, 2000; Stephenson et al. 2005; Wachenheim, 2004).

Much research has been conducted both inside and outside agricultural economics, and economics in general, to determine if online and distance education courses are comparable to on-campus courses in achieving learner outcomes. Roberts et al. (2005) present a synthesis of research on agricultural distance education programs that evaluates planning, instruction, and evaluation. Merisotis (1999) stated that we should give up the "what's the difference" discussion because technology is here to stay. Instead, he argues that we should focus on where it makes a difference and on identifying effective strategies using technology to impact student achievement. The Institute for Higher Education Policy (1999) concurs and feels the technology has revived discussion related to effective teaching and as a result has had a "salutary effect in that a rising tide lifts all boats."

Becker (2000) comments that the internet and online courses are one of two great pedological innovations well-suited for teaching economics students in the 21st century. The other involves more active engagement of students in the learning process. Dahlgran (2003) found that fewer than 23 percent of agricultural economics courses used a website to convey course content however. Makus (2006) comments that while the economics literature has discussed online courses, there has been limited discussion in agricultural economics.

Moore and Wilson (2005) find that a major factor in graduate students' decisions to enroll in online courses was the "convenience" factor. In a study of in-service training, Jackson et al. (1995) found that extension agents preferred self-paced videos over traditional classroom training because of their time constraints. Miller and Pilcher (2002) found that adults were more likely to enroll in distant courses delivered asynchronously because they afforded students the greatest flexibility with respect to time. This is not a recent phenomenon. Agricultural distance education learners have long preferred being able to control the pace of their learning, prefer independent study, have less need for structured learning experiences, and have less need for interaction with instructor and other students (Miller, 1995; Miller and Honeyman, 1993). This is especially true for female distant learners who must balance education with domestic household responsibilities (Effeh, 1999).

School day times for primary and secondary school students have been studied extensively as well. Banks and Atkinson (2004) summarize this body of research and they: 1) match time to student learning preferences, 2) determine that certain subjects should be taught at certain times, and 3) delineate the best time-of-day is to start school for different age groups. Metzker (2003) examines how individual states are making better use of time during the school day.

Unfortunately, little is known about specific preferences of undergraduate college students for convenience (i.e., learning at different times of the day or week). Makus (2006) anecdotally reports that students in his course tended to do most of their coursework toward the end of the week, generally on Saturday and Sunday. However, no quantitative data was provided. Given the disparity in undergraduate student learning style preferences, personalities, and other demographic characteristics, it is quite likely that preferred times vary substantially across different strata of students enrolled in undergraduate economic principles courses.

Modeling Exam Completion Patterns

Based on the relationships described in the literature above, several variables are expected to influence both the specific day (d) and time (t) when student (j) completes each individual examination (e) in each section of a course (s) during the semester. Thus, exam completion behavior, ($Exam_{e,s,d,t}$), can be modeled as:

$$Exam_{e,s,d,t} = f(Bio_j, Gender_j, Class_j, Major_j, Learn_j, Prep, Other_j) \quad (1)$$

where Bio_j represents student j's biology which includes individual personality traits and learning style preferences, $Gender_j$ is the sex of student j, $Class_j$ is student j's university class rank (e.g., freshman, sophomore, etc.), $Major_j$ is student's declared major program of study and reveals potential interest and aptitude in economics, $Learn_j$ is the degree of learning and

increased familiarity with exam taking that occurs over the semester in the course, Prep is a measure of the student's effort that is devoted to preparing for each exam, and $Other_j$ are the remaining unobserved personal, environmental, and economic characteristics of student j that impact their exam performance. The impact of Bio and Gender variables on examination scores was discussed in the previous section. Class and Major are included as explanatory variables because workloads across various university majors and class levels differ, which in turn impacts specific times when students would be available for exam completion. Learn is a measure of student test taking efficiency that is expected to vary over the semester as students become more familiar with the subject matter and assessment methods of instructors. Prep captures the effort a student puts forth in striving for a high score as measured by hours of studying and related factors.

It is hypothesized that each of these variables is related statistically to $Exam_{i,d,t}$, but the direction of each relationship is unknown. For example, the literature review above suggests that females and males have different biology and learning style preferences. However, it is unknown which gender is most likely to take a course examination at a different time-of-day or day-of-week. Further, the impact of different times or days on examination scores is not known as well. Thus, the sign of each statistical relationship is unknown, a priori. The signs of Learn and Prep are expected to be positive.

Empirical Analysis

Data to estimate the theoretical model described by equation 1 was obtained from two sections of an undergraduate introductory economics class. The class is an overview of both micro and macroeconomics and is targeted primarily to non-majors. The first section was a traditional class that met Tuesday/Thursday mornings from 9:30-10:45 with an enrollment of 116. The second section was a Distance and Continuing Education (DCE) online class of 13 students that covered the same material, but was designed for off-campus students. Students enrolled in both sections were evenly distributed by university class rank. Even though it was a freshman-level course, non-majors of all class rank took the class. Total enrollment for both sections in fall semester 2005 was 129 students, although several students added or dropped each section over the course of the semester.

This class was ideally suited for study because a computerized course management system, DiscoverEcon, was used to administer all exams to students. Forty exams, one pretest, and one chapter exam for each chapter assigned, were completed by students at their convenience over the semester. In general, the chapter reading and pretest were assigned at the end of class (t=0) and due at the start of the next class period (t=1). The chapter exam for that chapter was due the following class period (t=2). Essentially, one week transpired between the time the chapter was assigned and when the chapter exam was completed.

Students could take their exams at any hour-of-day or day-of-week, prior to the deadline for each examination, which was 9:00 a.m. before class on either Tuesday or Thursday. All of the examinations were available to students at the beginning of the course, so students could work ahead if desired. DCE online students were encouraged to follow the same deadlines imposed on students in the regular section, but these deadlines were only suggested. Thus, they could

complete exams at any point over the semester. DiscoverEcon recorded the date and time each exam was taken, along with the score received.

Due to data and privacy limitations, not all variables shown in equation 1 could be directly estimated. Class list information for the course only provided the student's name, major, and ID number. Gender for each student was inferred from their first and middle names, as well as instructor knowledge. Class rank was determined by each student's listing in the university's student directory.

Exam Completion Patterns

Patterns of pretest and exam completion by day are depicted in Figure 1. The data show that most students complete exams just prior to the deadline. A total of 1,185 and 1,471 exams were completed on Mondays and Wednesdays. Recall that exams were due at 9:00 a.m. before Tuesday and Thursday class. Interestingly, the fewest exams were completed on Fridays and Saturdays, with only 194 and 181 exams, respectively. More exams (308) were completed on Sunday, which is normally considered a day off work.

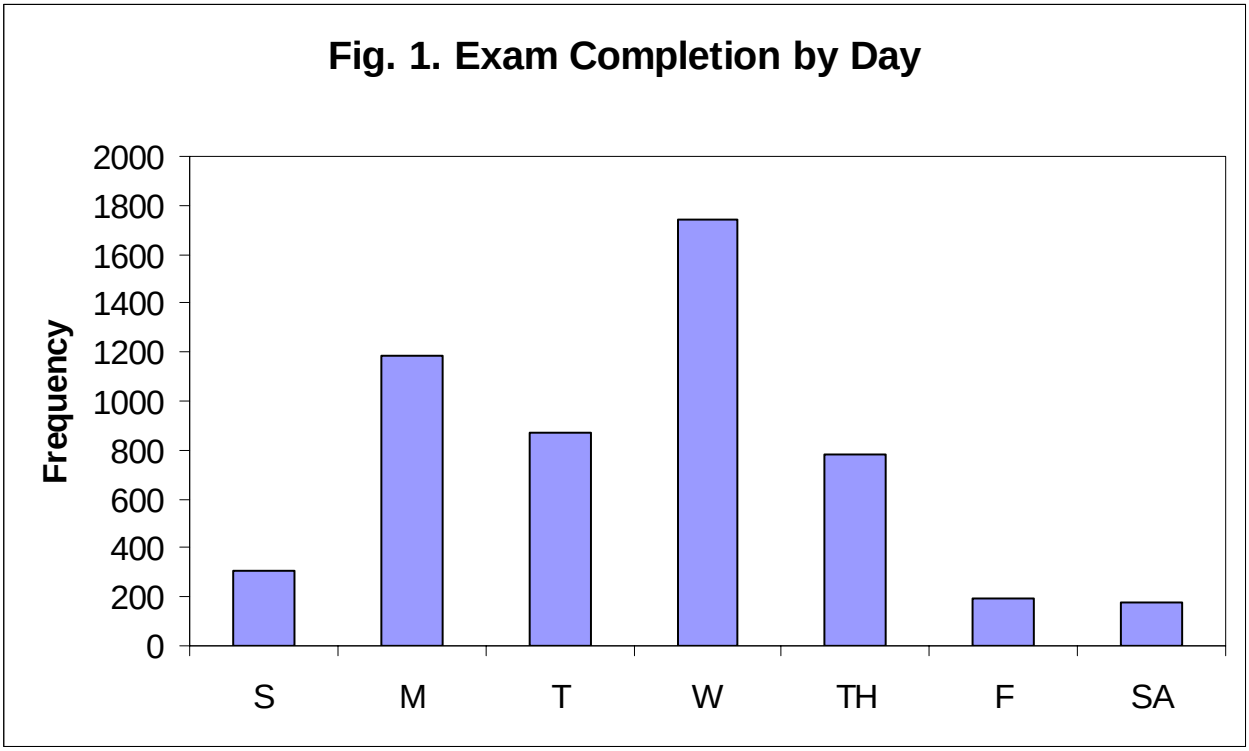
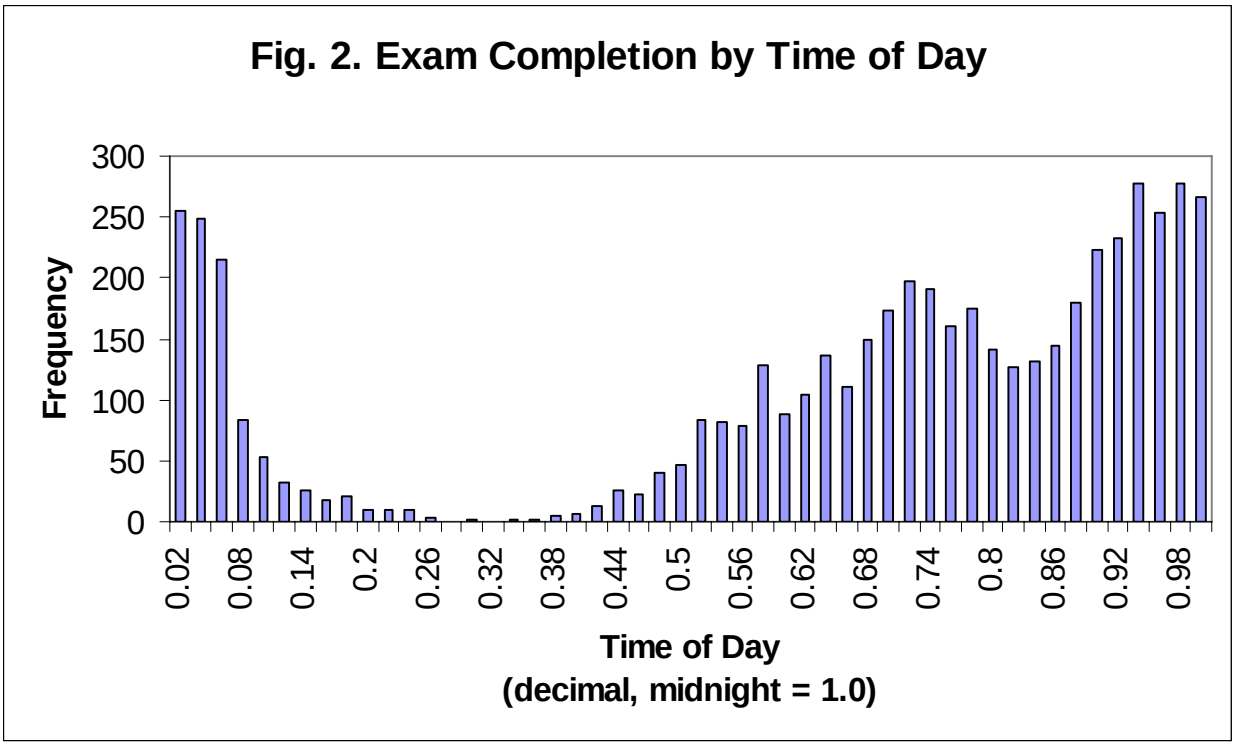


Figure 2 shows the distribution of pretest and chapter exam completion by time-of-day. To compare both hours and minutes of time, the variable t is specified as a decimal with the beginning of the day = 0 and midnight = 1.0. Students in this class took at least one exam in each of the intervals shown in Figure 2.



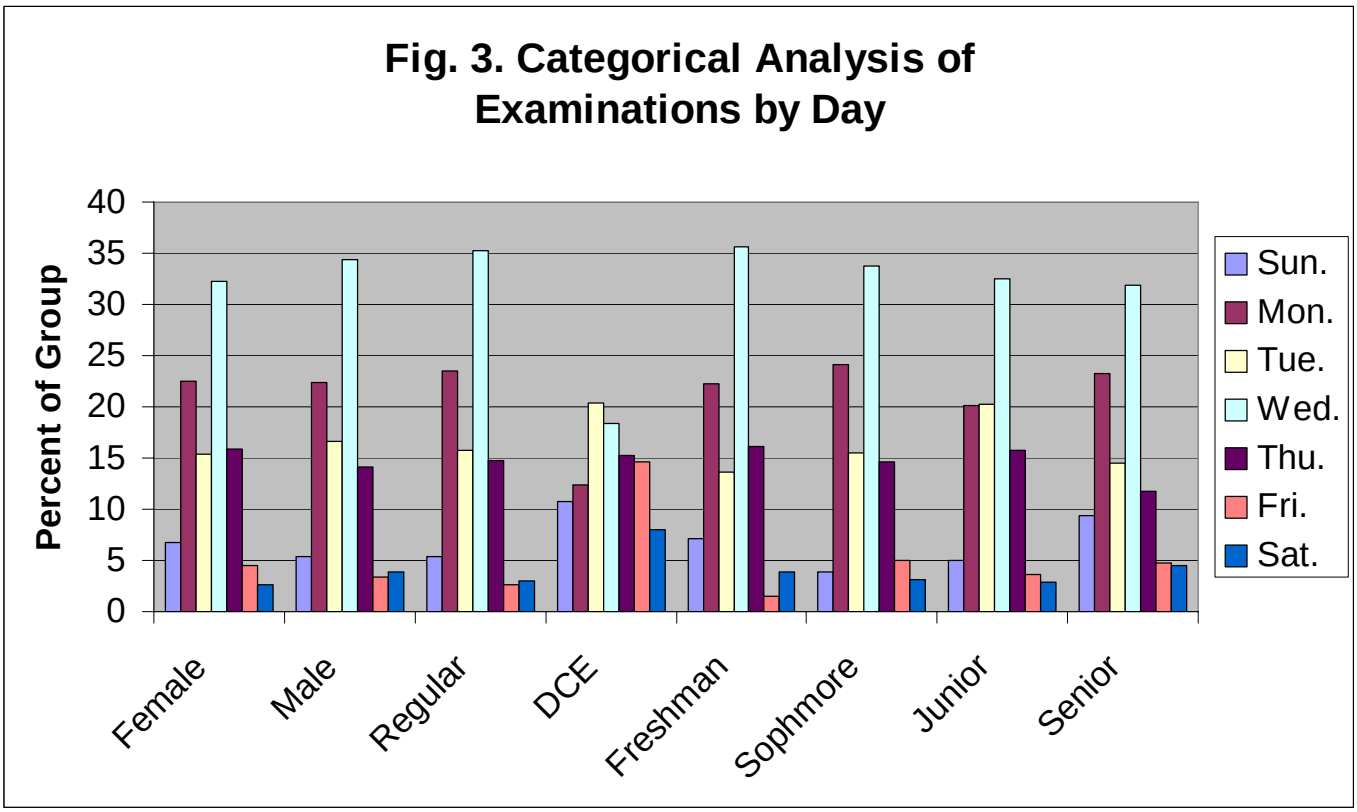
The least popular time for taking exams was from 2:00 a.m. until noon. Only 8 percent of all exams were taken during the morning time period, 2:00 a.m. until noon. Yet, the most popular time for offering college classes, and traditional in-class exams, is forenoon. Competition with other classes may partially explain the lower frequency of exam completion before noon. Interestingly, few students completed exams immediately before the time they were due (9:00 a.m.).

During the normal workday (8:00 a.m. to 5:00 p.m.), only 25 percent of exams were completed. When given complete flexibility, nearly half (46 percent) of students chose to take exams between 9:00 p.m. and 2:00 a.m. A distinct, unexplained, dip in exam completion exists between 7:00 a.m. and 9:00 p.m. Perhaps this is dinner or recreational time for students.

To further understand underlying relationships affecting what time-of-day or day-of-week students take exams, several categorical analyses were conducted to test for mean differences across students with differing personal characteristics. The chi-square statistic was used to discern statistical significance. Separate analyses were conducted for both the pretests and the chapter exams. However, no statistical differences in any of the following analyses were detected between the two. Therefore, only chapter exam results are presented in the rest of this section for brevity.

The day-of-week when students took chapter exams was found to differ statistically depending on class rank (chi-square=50.32, $p<0.0001$), whether the class was online (chi-square=151.80, $p<0.0001$), and the student's major (chi-square=640.50, $p<0.0001$). No statistical difference was found across gender (chi-square=7.96, $p<0.24$). Figure 3 depicts these relationships. The pattern of chapter exam completion by day is shown for each group. For example, when chapter exam

completion patterns were categorized by day for all females in the class, the following percentage of exams were completed by day: Sunday (6.7 percent), Monday (22.5 percent), Tuesday (15.5 percent), Wednesday (32.2 percent), Thursday (15.9 percent), Friday (4.4 percent), and Saturday (2.9 percent). Similar classifications were completed for the other groups shown and graphed. The chi-square test statistic was used to test for differences among the groups shown. Although males were more likely to take chapter exams on Sunday, Monday, Thursday, or Friday, the differences were not statistically significant.



Significant differences in chapter examination completion patterns by day were observed between students who were enrolled in the regular section and the DCE online section. Students enrolled in the DCE online section completed far more exams on Sunday, Tuesday, Thursday, Friday, and Saturday. The percentage of exams completed from Friday to Sunday by DCE online students was 2 to 6 times greater than students enrolled in the regular class.

Another interesting difference was observed across class rank. Juniors and seniors were more likely to complete more chapter exams on Friday and Sunday and fewer exams on Tuesday and Thursday than freshmen and sophomores. Perhaps as students mature or increase employment during the traditional work week, they balance exam completion across the week.

A final analysis was conducted of chapter exam completion dates by major program of the student. Students enrolled in both sections had 35 distinct majors. Graphical presentation of

these results is limited by dimensionality of the matrix (35x7). Several interesting observations are that:

- Accounting, biology, and business students did not take exams on Friday, Saturday, or Sunday.
- Computer science students took 31 percent of exams on Saturday and Sunday.
- History students took 57 percent of exams on Tuesday and Wednesday.
- Microbiology and recreation management students took over 92 percent of exams on Monday and Wednesday.
- Psychology students took 67 percent of their exams on Wednesday and Thursday.
- Accounting, biology, business, computer engineering, English, general agriculture, history, microbiology, psychology, and recreation management did not take any exams on weekends during the semester.

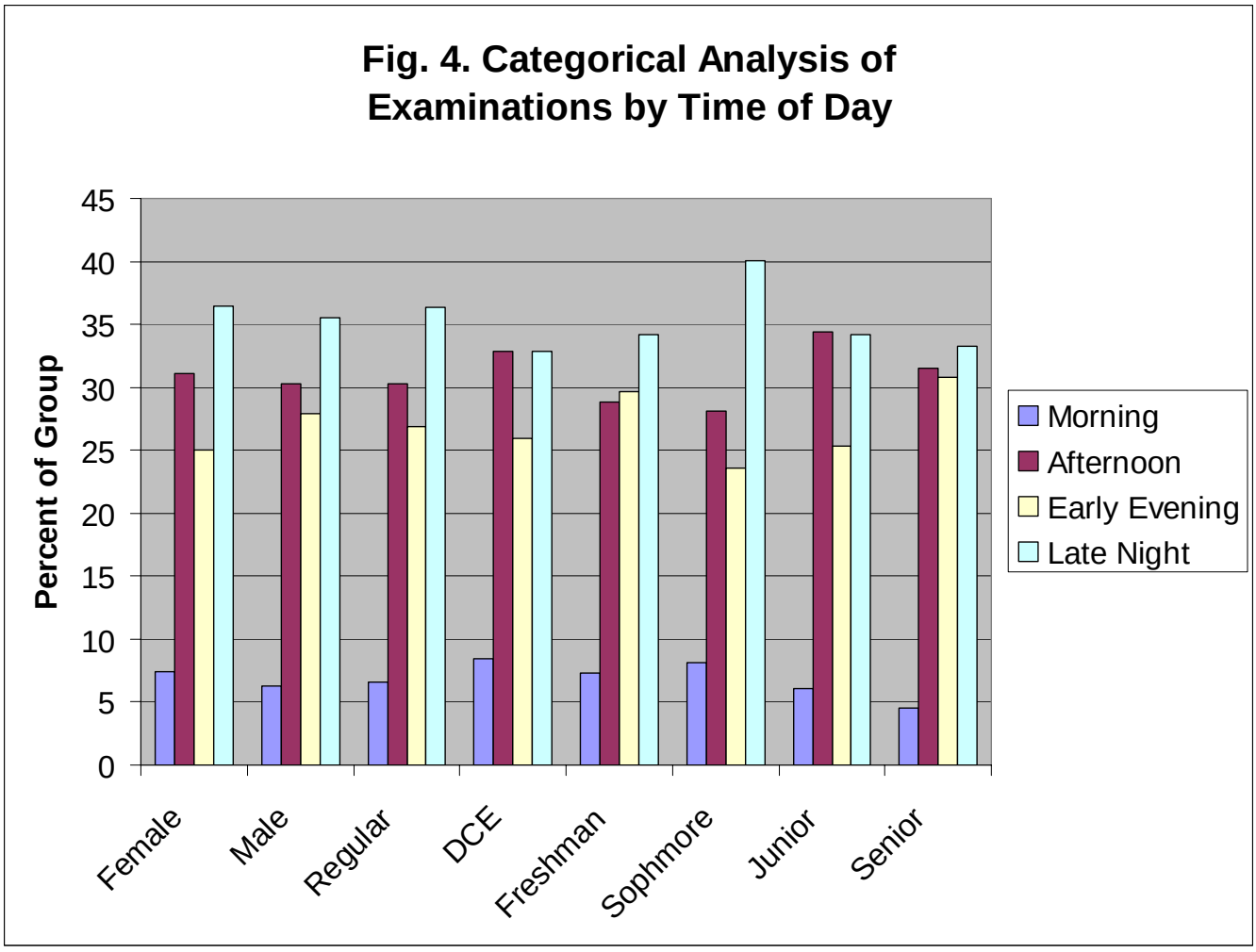
Similar to the above, the time-of-day when students took chapter exams was also found to differ statistically depending on class rank (chi-square=25.79, $p<0.0022$) and the student's major (chi-square=505.56, $p<0.0001$). Time-of-day was defined as morning (2:00 a.m. to noon), afternoon (noon to 6:00 p.m.), early evening (6:00 p.m. to 10:00 p.m.), and late night (10:00 p.m. to 2:00 a.m.). No statistical differences were found across gender (chi-square=3.47, $p<0.32$) or for the DCE online section (chi-square=2.41, $p<0.49$).

Figure 4 depicts these relationships. The pattern of chapter exam completion by the time-of-day is shown for each group. For example, when chapter exam completion patterns were categorized by time-of-day for all females in the class, the following percentage of exams were completed: morning (7.4 percent), afternoon (31.1 percent), early evening (25.0 percent), and late night (36.6 percent). This pattern of completion was not statistically different from all males enrolled in both sections. Likewise, no significant difference occurred between students enrolled in the regular section and the DCE online section.

A statistical difference was observed in time-of-day exam completion across students of differing class rank. Juniors were more likely to complete exams late night and morning; whereas, seniors were least likely to complete exams at these times. Freshmen completed most of their exams during late night, but sophomores completed most of their exams in the afternoon.

Statistical differences also were observed across student majors. Again, the matrix is too large to present here, but notable differences were:

- Accounting and computer engineering students completed all exams in early evening or late night.
- Electrical engineering, general agriculture, mathematics, microbiology, recreation management, and speech students did not complete any exams in the morning.
- Anthropology, architecture, biology, construction engineering, English, industrial engineering, interior design, mathematics, microbiology, pharmacy, psychology, respiratory care, and university studies students completed over 40 percent of their exams in morning or afternoon.



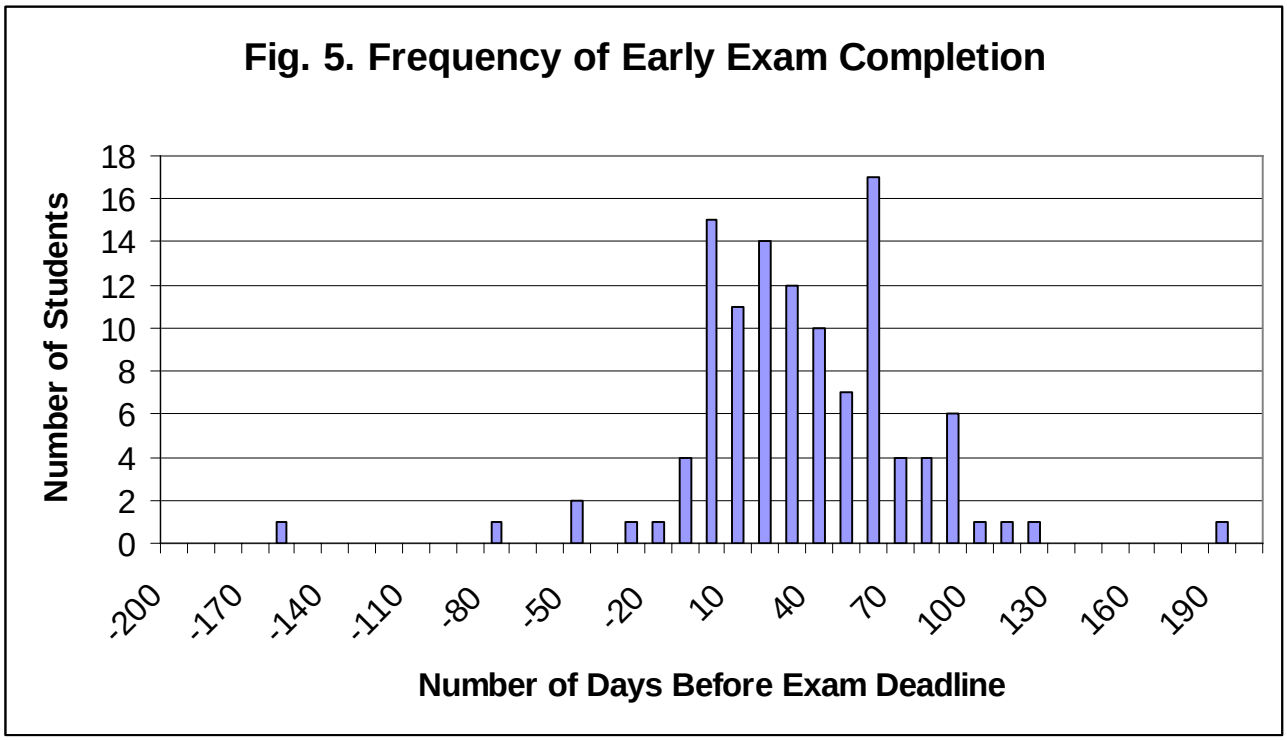
Preparedness

In addition to the time-of-day or day-of-week that students complete exams, another potentially important determinant of exam scores is preparedness. In this study, preparedness (PREPIND) will be gauged by the number of days that a student completes each individual pretest or chapter exam before its actual due date. The following analyses in this section do not include DCE online students, as the only deadline for completion of their exams was the end of the semester.

The value of PREPIND was determined for each pretest and chapter exam by student. For each pretest or chapter exam, the value could be either positive or negative (e.g., if they took the exam before or after the deadline). Then, a composite value (PREP) was computed over the semester for each student, based on the sum of all of their individual pretest and chapter exam values of PREPIND.

Figure 5 displays the distribution of PREP for all students in the regular class. The average value of PREP over the semester was 28.8 days. Given there were 20 exams, the average student completed their assignment 1.4 days in advance of the deadline. Six students had a negative

value of PREP which implies that, on average, none of their exams were completed on time. These were generally students who received an incomplete for the class and finished their coursework after the semester was over.



The variance of PREP is an indication of whether students have routine study habits. A low variance in PREP would imply that students routinely complete their pretests and chapter exams the same length of time before a deadline. Alternatively, a high variance indicates substantial variability in student study habits.

Figure 6 depicts the variance of PREP for this course. Although a few students routinely took pretests and chapter exams at the same time, as evidenced by a variance of PREP that was zero or slightly positive, the most frequent variance was 15. Several students had a very high variance and were primarily the students with incompletes.

A regression model was estimated to determine if PREP varied across different strata of students. The dependent variable, PREP, was related to dummy variables reflecting each student's gender and class rank. Results of the regression are shown in Table 1. Adjusted R^2 for the model was 0.06, with 110 d.f.

The only statistically significant coefficient was Junior which implies that juniors completed their exams 42 days earlier than freshmen over the entire semester. However, this value was only significant at $p<0.09$. Thus, other demographic and economic factors likely explain the variation in student preparedness.

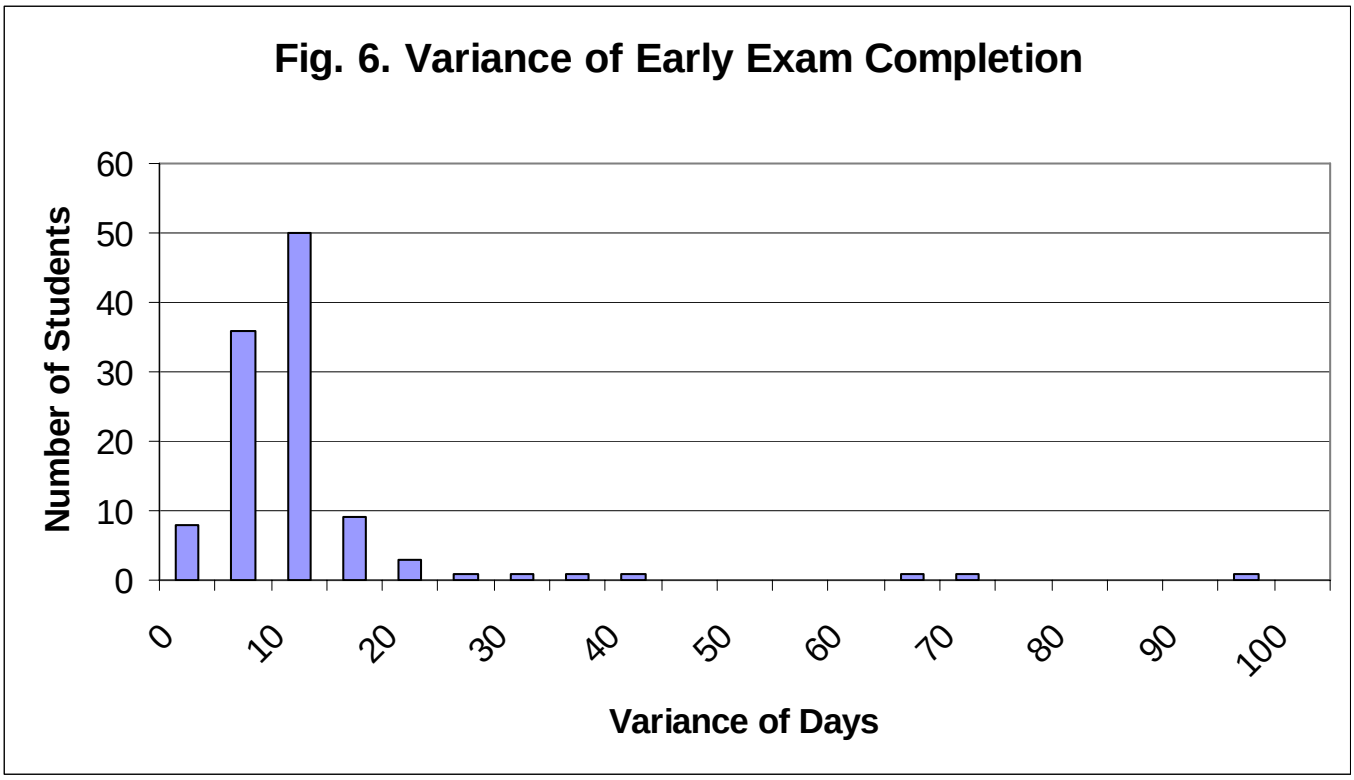


Table 1. Exam Preparation Regression Results

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-0.81322	20.49793	-0.04	0.9684
Female	1	-31.70431	20.04345	-1.58	0.1166
Sophomore	1	39.82348	25.83737	1.54	0.1261
Junior	1	42.50016	25.48629	1.67	0.0982
senior	1	47.87102	29.82107	1.61	0.1113

Adj. R2 = 0.55
D.F. Error = 110
Model F Value = 1.60

Relating Exam Completion Patterns to Overall Student Performance

The results above found statistically significant differences across various student characteristics as it affected both the day-of-week and the time-of-day when both pretests and chapter exams were completed over the course of the semester. However, it is unknown if these differences affected overall student performance in the class as measured by total points scored on pretests and chapter exams.

To test the impact that various pretest and chapter exam completion times and dates have on overall student performance, two regression models are estimated. The first regression relates individual student's characteristics and exam completion times to each of their individual pretest scores. Each observation in the regression was an individual pretest for a student. The dependent variable was the pretest score with maximum possible points of 100. Dummy variables were created if the student was female, took the exam on a day besides Sunday, completed the exam at a time other than morning, was not a freshman, took a pretest for chapters 2 to 32, and was enrolled in the DCE online section. Julian is the Julian calendar date that the pretest was completed on and represented the degree of learning that transpired over the semester. Prep was the number of days that the exam was completed before the deadline when it was due.

Results of this regression are shown in the left columns of Table 2. Overall R^2 for the model is 0.12 with 2,485 d.f., a relatively low level of explanatory power for a dataset this large. Thus, most of the variation in pretest scores across students is due to other factors not reflected in the model.

Females in the class scored 3.99 percent less than their male counterparts. This relationship was the most significant in the regression with a $p<.0001$**.** Students completing pretests on Monday, Wednesday, and Thursday had lower scores while pretests completed on Tuesday, Friday, and Saturday had higher scores. None of these relationships were statistically significant at $p<0.10$. Students completing exams at any other time besides morning did less well. In fact, students taking exams late night received 1.32 percent fewer points which was significant at $p<0.10$. Sophomores fared less well; whereas, juniors and seniors received higher pretest scores than freshmen, on average. The latter two relationships were statistically significant at $p<0.10$.

Parameter estimates for each individual chapter dummy variable generally reflect the difficulty of the respective chapter. Students did less well on the first pretest as they were not familiar with the computerized assessment procedure. DCE online students performed 2.6 percent worse than students in the regular section, which was statistically significant. The coefficient of Julian was positive indicating that students improved performance over the semester, but the value was not significant. Prep was significant at $p<.0001$ indicating that students completing their exams early could expect an increased score of .38 percent per day.

Regression model results of chapter exam scores were virtually identical, both in terms of sign and magnitude, to those of the pretest as shown in Table 3. Overall R^2 for the model increased slightly to 0.14.

Table 2. Pretest Score Regression Results

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-103.26732	106.77167	-0.97	0.3335
female	1	-3.99013	0.37700	-10.58	<.0001
Monday	1	-1.07340	0.83037	-1.29	0.1962
Tuesday	1	0.34507	0.86684	0.40	0.6906
Wednesday	1	-0.61237	0.82658	-0.74	0.4589
Thursday	1	-0.59895	0.89495	-0.67	0.5034
Friday	1	1.06867	1.20850	0.88	0.3766
Saturday	1	1.96750	1.20821	1.63	0.1036
Afternoon	1	-0.30224	0.77952	-0.39	0.6983
Early evening	1	-0.48581	0.79781	-0.61	0.5426
Late night	1	-1.31655	0.75939	-1.73	0.0831
Sophomore	1	-0.20845	0.50795	-0.41	0.6816
Junior	1	2.65091	0.49085	5.40	<.0001
Senior	1	0.94317	0.56860	1.66	0.0973
Chapter 2	1	3.39277	1.21217	2.80	0.0052
Chapter 3	1	1.20552	1.21326	0.99	0.3205
Chapter 4	1	5.59302	1.23071	4.54	<.0001
Chapter 5	1	3.06467	1.25770	2.44	0.0149
Chapter 6	1	4.48875	1.26932	3.54	0.0004
Chapter 7	1	3.55574	1.30937	2.72	0.0067
Chapter 8	1	3.05495	1.34647	2.27	0.0234
Chapter 9	1	1.48752	1.45179	1.02	0.3056
Chapter 10	1	2.03914	1.39884	1.46	0.1450
Chapter 11	1	2.83064	1.40740	2.01	0.0444
Chapter 12	1	3.89503	1.49539	2.60	0.0093
Chapter 13	1	4.39879	1.50638	2.92	0.0035
Chapter 14	1	3.54760	1.53649	2.31	0.0210
Chapter 15	1	2.16672	1.61031	1.35	0.1786
Chapter 16	1	1.67987	1.66239	1.01	0.3123
Chapter 17	1	5.59583	1.67093	3.35	0.0008
Chapter 20	1	0.97398	1.82085	0.53	0.5928
Chapter 21	1	1.34611	1.86530	0.72	0.4706
Chapter 22	1	0.69678	1.84009	0.38	0.7050
Chapter 23	1	1.66854	1.96629	0.85	0.3962
Chapter 24	1	1.16778	1.96393	0.59	0.5522
Chapter 32	1	4.75804	2.06202	2.31	0.0211
DCE	1	-2.62979	0.93025	-2.83	0.0047
Julian	1	0.02621	0.02033	1.29	0.1974
Prep	1	0.38198	0.06129	6.23	<.0001

Adj. R2 = 0.124
D.F. Error = 2,485
Model F Value = 9.29

Table 3. Exam Score Regression Results

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	364.99636	159.61678	2.29	0.0223
female	1	-4.66965	0.60866	-7.67	<.0001
Monday	1	-2.80126	1.30035	-2.15	0.0313
Tuesday	1	0.20851	1.36250	0.15	0.8784
Wednesday	1	-1.51356	1.28050	-1.18	0.2373
Thursday	1	-1.22662	1.39656	-0.88	0.3799
Friday	1	0.03610	1.89050	0.02	0.9848
Saturday	1	-0.04178	1.91051	-0.02	0.9826
Afternoon	1	-0.15274	1.30418	-0.12	0.9068
Early evening	1	-1.37993	1.33208	-1.04	0.3003
Late night	1	-4.13097	1.28761	-3.21	0.0014
Sophomore	1	-0.25038	0.81308	-0.31	0.7582
Junior	1	4.49648	0.78467	5.73	<.0001
Senior	1	0.77135	0.91379	0.84	0.3987
Chapter 2	1	15.79334	1.95035	8.10	<.0001
Chapter 3	1	11.46988	1.96417	5.84	<.0001
Chapter 4	1	16.52132	1.97445	8.37	<.0001
Chapter 5	1	12.26312	1.99958	6.13	<.0001
Chapter 6	1	13.92755	2.02091	6.89	<.0001
Chapter 7	1	15.04879	2.07290	7.26	<.0001
Chapter 8	1	12.07520	2.12074	5.69	<.0001
Chapter 9	1	12.32017	2.21436	5.56	<.0001
Chapter 10	1	9.43898	2.21773	4.26	<.0001
Chapter 11	1	10.96928	2.23794	4.90	<.0001
Chapter 12	1	11.93102	2.32854	5.12	<.0001
Chapter 13	1	16.24102	2.34191	6.93	<.0001
Chapter 14	1	15.41940	2.41637	6.38	<.0001
Chapter 15	1	12.22400	2.48097	4.93	<.0001
Chapter 16	1	14.91723	2.58048	5.78	<.0001
Chapter 17	1	17.19666	2.61571	6.57	<.0001
Chapter 20	1	12.23439	2.79566	4.38	<.0001
Chapter 21	1	11.78416	2.85589	4.13	<.0001
Chapter 22	1	12.35163	2.84577	4.34	<.0001
Chapter 23	1	14.16129	3.02687	4.68	<.0001
Chapter 24	1	15.40538	3.01072	5.12	<.0001
Chapter 32	1	19.61295	3.17791	6.17	<.0001
DCE	1	-3.86597	1.50497	-2.57	0.0103
Julian	1	-0.05507	0.03038	-1.81	0.0701
Prep	1	0.41419	0.09644	4.29	<.0001

Adj. R2 = 0.137
D.F. Error = 2,499
Model F Value = 10.44

Females in the class again performed less well than males with 4.67 percent lower scores. Completing chapter exams on Monday, Wednesday, Thursday, or Saturday resulted in lower scores. Similar to pretests, students who completed chapter exams at any other time besides morning, scored less. Those completing chapter exams late night scored 4.13 percent less, which was significant at $p<.001$. Again, sophomores did less well than freshmen; whereas, juniors and seniors received higher scores. DCE online students received scores 3.8 percent less than peers in the regular class. Julian also had the unexpected negative sign. The earlier the students completed their exams before the deadline (Prep), the higher their exam score was. This relationship was highly significant at $p<.001$.

Conclusion

This study evaluated the time-of-day and day-of-week when students complete both pretests and chapter exams in an undergraduate introductory economics class. Results of the analysis show that students generally complete their tests in the evening during midweek. However, results differed significantly by class rank, major, and whether they were enrolled in an online section. Importantly, no significant difference was found across gender. Moreover, exam completion patterns had little impact on overall student performance in the course. The only exceptions were students who completed exams late night, online, or near a deadline, and they did less well.

To the extent that a large portion of students choose to complete most of their coursework in evening or late evening time periods, and that it did negatively affect overall student performance, has a number of important implications for educators. First, even though curricula provide student's with the flexibility to work any time at their convenience, other student support services may not be as available. Kretovics (2003) outlines implications for student services. Students in this class encountered difficulty with the delivery of computer services, as systems were taken off-line for backup during periods of student need.

Students who choose to complete coursework outside traditional class hours are expected to face increased competition for their scarce time. Nielsen recently announced that they are now including college students in their 2007 television ratings and expect broadcasters to develop new programming targeting this market (Aspan, 2006). Enticing students away from coursework could impact student performance negatively.

Results of this study may also explain past anomalous results in other studies of student study habits. For example, Loyacano (2000) investigated the effects of caffeine on study habits and obtained the unexpected result that caffeine actually was positively correlated with healthy study habits. Since most students work at night when they may be tired, being more awake could improve performance. Likewise, since alcohol consumption typically occurs in evening hours, which competes with student work time, its effect on student performance may be understated. Powell et al. (2002) find only minor effects of consumption on class attendance and getting behind. Re-framing the study design to test the degree to which it competes with student study time in evenings, might yield more significant findings.

Finally, these study results have broad implications for curriculum development. Students often comment that workload for individual courses is too high (E-CUE, 2004). Providing students

with more flexibility to complete their work when they have time may partially alleviate this pressure. Following Makus (2006), instructors might have to tailor the timing of new pedagogy, such as chat sessions, to the day-of-week or time-of-day when students are available, which often differs from traditional the 9:00 a.m. to 5:00 p.m. midweek classroom times.

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CONTACT INFORMATION

We would be happy to provide a single copy of this publication free of charge. You can address your inquiry to: Carol Jensen, Department of Agribusiness and Applied Economics, North Dakota State University, P.O. Box 5636, Fargo, ND, 58105-5636, Ph. 701-231-7441, Fax 701-231-7400, e-mail Carol.Jensen@ndsu.edu. http://agecon.lib.umn.edu/ndsu.htmlThis publication is also available electronically at: http://agecon.lib.umn.edu/.

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Department of Agribusiness and Applied Economics
Agricultural Experiment Station
North Dakota State University
Fargo, ND 58105-5636