ONLINE, ITV, AND TRADITIONAL DELIVERY: STUDENT CHARACTERISTICS AND SUCCESS FACTORS IN BUSINESS STATISTICS

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ABSTRACT

Distance education has surged in recent years while research on student characteristics and factors leading to their success has not kept pace. Characteristics of regional university students in undergraduate Business Statistics and factors linked to their success are examined based on mode of delivery: Online, Instructional Television and Traditional classroom. The three groups are similar in GPA, age and gender. Online students are more likely to be repeating the course and have more credit hours. Backward elimination regression identifies GPA and absences% (or an effort proxy) as highly significant predictors of course performance. Students repeating Business Statistics or who have repeated other courses (attempted-earned hours) perform better in a traditional classroom.

INTRODUCTION

Almost 3.2 million students took at least one online class from U. S. institutions in the fall of 2005, double the number in 2002 (Allen and Seaman, 2006). Higher education institutions are offering an increasing percentage of their courses, and even total degree programs, in online and other nontraditional formats. Defined as "any learning that takes place with the instructor and student geographically remote from each other" (Phillips, 2008), distance learning encompasses such diverse delivery methods as correspondence courses conducted by mail to complete online courses and many venues in between. Many factors such as familiarity with technology for traditional students, scheduling issues for nontraditional students, and transportation costs ensure that distance learning will continue to have a prominent role in higher education. Research related to student characteristics and factors leading to their success in these formats has not kept pace.

Undergraduate Business Statistics presents a significant challenge for many students regardless of delivery method. Because students view required quantitative and critical thinking courses as difficult and a major hurdle to overcome, many enter Business Statistics with anxiety and even fear. Professors in Business Statistics courses frequently face unique challenges in their teaching, as students often lack interest or motivation to perform to their full potential. Higher grade requirements for graduation or declaring a major are becoming more common at business schools throughout the country (such as a required minimum grade of "C"

in business foundation courses or 2.5 GPA average to declare a major). These factors are adding to the level of trepidation for many students.

Business Statistics emphasizes application, requiring the student to analyze a business problem, determine the appropriate statistical test, and weigh the risks of each alternative. These are not necessarily the same skills needed in other business disciplines. This study analyzes both student characteristics and success factors for Business Statistics taught in a traditional smart classroom format, online delivery, and instructional television (ITV) where students are located off site from the professor.

LITERATURE REVIEW

William E. Becker, Jr. wrote a three-part series (Part I 1983, Part II 1983, and Part III 1983) on economic education research, addressing such issues as cost-benefit analysis in economic education, development of models, and statistical estimation methods. Davisson and Bonello (1976) proposed a taxonomy for empirical research specifying the categorization of inputs: human capital (e.g. Math ACT score, grade point average), utilization rate (e.g. attendance, study time, review sessions), and technology (e.g. lectures, computer usage).

Numerous studies have been conducted in the business disciplines that examine factors relating to student performance. Park and Kerr (1990) found GPA and ACT score to be the most important determinants of success in a Money and Banking course. Class attendance and a student's perceived value of the course were found to be of lesser importance. Borde (1998) examined student performance in an introductory marketing course. This model found GPA, academic origin, and employment commitments to be good predictors. Bacon and Bean (2006) also found a positive relationship between GPA and marketing education. Wojciechowski and Palmer (2005) found the best predictors of performance in an online undergraduate business course at a community college to be attendance at an orientation session and GPA.

In economics courses, Romer (1993), Durden and Ellis (1995), and Marburger (2001, 2006) found a positive relationship between class attendance and exam performance. Browne et. al. (1991) obtained contradictory results, finding no relationship between attendance in a microeconomic principles course and performance on the Test of Understanding College Economics (TUCE). Both gender differences and the effect of age on student performance have been explored with mixed results in the literature (e.g. Siegfried 1979, Bonello et. al. 1984, Lumsden and Scott 1987, Anderson et. al.1994, Bridges and Casavant 2002).

Fewer articles were uncovered investigating student performance in Business Statistics. Cohn (1972) studied student performance in Economic Statistics, a class with 43 upper level or graduate economics majors. GPA and credits in mathematics positively impacted performance, while credits in economics were negatively related to performance. Rochelle and Dotterweich (2007) found class attendance, previous performance in algebra and differential calculus, and overall GPA to be significantly related to student performance.

A developing literature is revealing analysis of student performance in distance learning versus the traditional classroom with somewhat mixed results. Lawrence and Singhania (2004) analyzed Business Statistics student performance in distance-learning versus traditionally-delivered courses and found that distance-learning students did not perform as well. In this study the distance learning experience involved 40 pre-recorded PowerPoint modules as well as a CD with lectures. McLaren (2004) studied persistence (completion of the class) and performance in online and classroom business statistics. Although fewer online students persisted to completion

of the course, for those who did, final grade was independent of the mode of instruction. Farinella (2007) found that students in the online section of introductory finance under-perform students in traditional sections of the same course. The mean age of online students was higher, although not statistically significant.

METHODOLOGY AND DESCRIPTIVE STATISTICS

In order to examine both student characteristics and success factors for Business Statistics taught in a traditional classroom, online and via ITV, multiple sections of Business Statistics, taught by two professors at a mid-size regional state university, are selected for analysis. Three data sets - traditional classroom (57 students), online (59 students), and ITV (48 students) - are constructed from 2004 through the summer term of 2008. Based on the literature review and professional experience, six independent variables are used to analyze possible differences in the three data sets, and an additional five variables are examined for factors impacting academic success in Business Statistics.

The variables are provided in Table 1 along with corresponding summary statistics.

Table 1 - Summary Statistics

Independent Variables

Variable	Traditional Classes		Online Classes		ITV Classes	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
X1 GPA	2.82	0.57	2.92	0.47	2.89	0.59
X2 Earned Hours	77.26	24.66	85.8	28.92	73.1	26.72
X3 Attempted - Earned Hours	16.72	26.07	18.2	17.62	12.6	15.04
X4 Age	24.79	3.79	25.83	7.19	25.79	6.18
X5 Absences	0.08	0.08			0.11	0.1
X6 Homework Minutes Online			522.83	246.67		
X7 Review Session			1.56	1.29		

	Proportion	Proportion	Proportion
X8 Gender: M=0, F=1	0.49	0.61	0.52
X9 Repeat Business Statistics	0.14	0.39	0.1
X10 Previous Online Class		0.25	
X11 Previous ITV Class			0.6

Dependent Variable

	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Y Final Average	79.13	11.27	77.66	10.9	73.83	16.38

Six of the independent variables are used to evaluate possible differences in the data sets, and then success factors or academic characteristics students bring into the course (human capital) are examined.

"X_1 GPA" The mean Grade Point Averages of students entering Business Statistics are, on a 4.0 scale, 2.82 (traditional), 2.92 (online), and 2.89 (ITV). It is anticipated that students with a higher overall GPA are likely to perform better in Business Statistics.

"X_2 Earned Hours" In order to determine if progress in the academic career influences selection of mode of delivery for Business Statistics, the number of earned hours upon entry to the course is analyzed. The average number of earned hours is 77.26 (traditional), 85.8 (online), and 73.1 (ITV). No mention of earned hours is found in the literature; therefore, the direction of this relationship is unclear.

"X_3 Attempted – Earned Hours" Attempted minus Earned Hours is also studied as an indication of academic success. It captures information not otherwise available, since poor grades do not appear in the GPA if a class has subsequently been successfully completed. The mean difference between attempted and earned hours is 16.72 (traditional), 18.2 (online), and 12.6 (ITV). No mention of this variable is found in the literature; therefore, the direction of this relationship is unclear.

"X_4 Age" The average ages of the students in years are found to be 24.79 (traditional with a standard deviation of 3.79), 25.83 (online with a standard deviation of 7.19) and 25.79 (ITV with a standard deviation of 6.18). The literature is mixed on the effect of age and student performance (Anderson et al. 1994, Bonello et al.1984, and Rochelle and Dotterweich 2007); therefore, the direction of this relationship is unclear.

"X_8 Gender" The data sets consist of roughly equal numbers of males and females with the proportion of females being .49 (traditional), .61 (online), and .52 (ITV). It is believed that no gender differences will be found.

"X_9 Repeat Business Statistics" Whether on not the student is repeating Business Statistics is analyzed as the final human capital variable. The proportion of students repeating Business Statistics is .14 (traditional), .39 (online), and .10 (ITV). Based on classroom experience, it is believed that this relationship is positive.

The next five variables are measures of student behaviors in Business Statistics or apply to just one or two of the data sets. These variables will be analyzed with those above to identify factors leading to success in Business Statistics.

"X_5 Absences" The mean proportion of absences, a utilization rate variable, is .08 (traditional) and .11 (ITV). This variable does not apply to online students. It is anticipated that increased student absences lower the expected final average.

The next two variables are effort variables for online students only. These serve as effort proxies for attendance in traditional and ITV classes.

"X_6 Homework Minutes Online" My Math Lab, the classroom management system used, tracks length of time spent online in the Business Statistics homework module. The mean time is 522.83 minutes with a standard deviation of 246.67 minutes. It is anticipated that more homework minutes online is positively correlated to performance in the class.

"X_7 Review Session" Three on campus review sessions were held by the professor for online Business Statistics students. The mean number of review sessions attended is 1.56 with a standard deviation of 1.29 sessions. It is anticipated that review session attendance is positively correlated to performance in the class.

The remaining two variables are experiential: whether online students have taken a previous online course and whether ITV students have taken a previous ITV course.

"X_{10} Previous Online Class" Twenty five percent of online students have taken a previous online course. While previous online experience might be helpful, the quantitative nature of Business Statistics may offset that experience; therefore, the direction of this relationship is unclear.

"X_{11} Previous ITV Course" Sixty percent of ITV students have taken a previous ITV course. While previous ITV experience might be helpful, the quantitative nature of Business Statistics may offset experience; therefore, the direction of this relationship is unclear.

EMPIRICAL RESULTS

The first portion of the analysis compares the characteristics of students choosing the three modes of delivery in Business Statistics. Two sample t tests of means are performed between each pair of numeric variables among the three data sets, and z tests are performed between pairs of proportions to determine significant differences. Table 2 shows the results of these tests.

Table 2 - Empirical Results - Student Characteristics

Independent Variables

Variable #	Trad vs Online t value (p-value)	Trad vs ITV t value (p-value)	ITV vs Online t value (p-value)
X1 GPA	-1.04 (0.30)	-0.55 (0.58)	-0.36 (0.72)
X2 Earned Hours	-1.71 (0.09)	0.83 (0.41)	-2.34 (0.02)
X3 Attempted-Earned Hours	-0.36 (0.72)	1.73 (0.09)	-1.74 (0.08)
X4 Age	-0.97 (0.33)	-1.01 (0.31)	-0.03 (0.98)
	z value (p-value)	z value (p-value)	z value (p-value)
X8 Gender: M=0, F=1	-1.29 (0.2)	0.3 (0.76)	-0.93 (0.35)
X9 Repeat Business Statistics	-3.03 (0.00)	0.56 (0.58)	-3.34 (0.00)

Of particular interest, there is no significant difference in mean GPA or gender for the three groups. Additionally, the minor differences in ages, with traditional students being slightly younger, are not significant. These results speak to the ubiquity of distance learning in higher education. The minor average age difference is accompanied, however, with significantly lower variances in ages of traditional classroom students compared to both online and ITV students. In

other words, the traditional classroom is more homogenous in age than the other methods of delivery.

Three significant differences did arise among the three groups. The proportion of online students repeating Business Statistics (.39) far exceeds the proportion of traditional classroom students repeating (.14) and ITV students repeating (.10). After getting behind by performing poorly in Business Statistics, it appears that many students choose the increased flexibility of online when retaking the required course. This is consistent with the second significant difference found in the attempted minus earned hours variable. ITV students have a lower average attempted minus earned hours than either traditional classroom students or online students (significant at 90%). ITV students overall are not repeating as many classes (classes prior to enrollment in Business Statistics as well as Business Statistics) as other students. The final significant difference reveals that online students generally have earned about eight more credit hours than the others. This may be partially explained because so many online students (.39) are repeating the course.

Secondly, success factors in Business Statistics are examined among the three delivery methods. A separate regression model is run for each data set - traditional classroom, online class, and ITV class - to determine which independent variables are significantly related to the dependent variable Y Final Average. Backward elimination regression is employed to utilize all independent variables in the first analysis and then remove the least significant variable in the next run. This continues until only significant variables remain.

Table 3   Empirical Results - Success Factors

	Traditional	Online	ITV
	Coefficient (p value)	Coefficient (p value)	Coefficient (p value)
Variable			
X1 GPA	13.171 (.000)	7.756 (.001)	14.869 (.000)
X2 Earned Hours		.075 (.054)	
X3 Attempted - Earned Hours	.079 (.061)		
X5 Absences	-69.908 (.000)		-41.174 (.039)
X6 Homework Minutes Online		.014 (.004)	
X7 Review Session		3.817 (.000)	
X8 Repeat Business Statistics	5.954 (.051)		
Adjusted R Square	0.575	.472	.422
F Statistic (p value)	19.948 (.000)	13.957 (.000)	18.144 (.000)
n	57	59	48

Table 3 provides the empirical results for the final backward elimination model for each data set. Coefficients and corresponding p values for the significant variables in each model are reported. Additionally, adjusted r squares, F statistics with corresponding p values, and sample sizes are shown for the three regression results. All models explain a significant amount of variation in final grades of Business Statistics students as shown by the adjusted r squares: Traditional $r^2 = .575$, Online $r^2 = .472$, and ITV $r^2 = .422$.

Variable X_1 GPA shows the expected positive sign and is highly significant for all three modes of delivery. Additionally, X_5 Absences is highly significant with the expected negative sign for the two modes of delivery, traditional classroom and ITV, where attendance is expected. Both of these results confirm previous studies (Rochelle and Dotterweich, 2007). In the online class, both X_6 Homework Minutes Online and X_7 Review Session Attendance are significant with the expected positive sign. These two factors serve as proxies for attendance for online students by measuring effort expended in the class. Thus, the significance of absences / attendance or its proxy is consistent for all three modes of delivery of Business Statistics.

There are important differences in success factors in Business Statistics among the modes of delivery. First, students repeating Business Statistics (variable X_8) have an advantage in the traditional classroom setting. Reinforcing these results is a positive significant coefficient X_3 Attempted – Earned Hours for the traditional classroom. This value measures the number of hours taken with no credit awarded. This advantage does not carry over for ITV students, although no negative effect is found for students who have repeated this or other classes. Online students repeating the course show a positive, although not statistically significant, coefficient. This may be important because variable X_2 Earned Hours is significant for online students only. The positive coefficient indicates that more experienced online students (those with more credit hours) tend to perform better in Business Statistics than other online students. Since repeating students are likely to have more earned hours, this implies that students repeating Business Statistics may have a small advantage in an online class. This information can be used when advising students registering for Business Statistics.

Before concluding, it is important to mention the variables not related to student outcomes in any of the modes of delivery of Business Statistics. Age is not correlated with course performance for any of the three data sets. This finding is of particular note for online students since a natural question would involve computer ease and literacy for older students. Since many nontraditional aged students have varied outside responsibilities and may be well suited to online courses from a scheduling perspective, this result will be encouraging to such students and helpful in the advisement process. Additionally, men and women do equally well in Business Statistics regardless of mode of delivery. Finally, previous online or ITV experience appears to have no significant impact on success in Business Statistics for students choosing these options.

CONCLUSIONS AND RECOMMENDATIONS

The analysis reveals that a significantly higher proportion of online students are repeating Business Statistics than either those enrolled in a traditional or ITV class. Consequently, online students tend to have more earned credits before taking the required course, and ITV students have repeated fewer classes overall (attempted – earned hours) than either of the other groups.

Regression analysis is employed to determine success factors in Business Statistics. With similarities in the three data sets, it is not surprising to find that two major predictors of success

are uniform across the delivery modes. GPA is of positive statistical significance for all three groups, and Absences is of negative statistical significance for both the traditional and ITV classes. Using Homework Minutes and attendance at Review Sessions as proxies for attendance, the same relationship is found for online students.

These findings lead to several concrete recommendations for student advisors prior to enrollment in Business Statistics.

- Students repeating Business Statistics are likely to benefit by taking the course in a traditional rather than non-traditional (ITV or online) environment.
- Students early in their college career might be encouraged to opt for a traditional or ITV section of Business Statistics while those with more experience might be better prepared for an online course.
- Older students and those without previous non-traditional course experience should not be deterred from attempting the course in an ITV or online format. In fact, those students who need the flexibility of online or ITV classes to complete their education may find it to be a good option.

This paper also suggests a specific recommendation to instructors in Business Statistics.

- Instructors of traditional or ITV sections might encourage or reward students who attend class regularly while on-line instructors could recommend that students spend significant time working the online homework and attending the review sessions before each exam. These measures of effort are strongly related to course performance.

Business Statistics is a difficult quantitative course which requires critical thinking and logic as well as mathematical analysis. The problem solving nature of the course adds to its complexity. Research into student characteristics and success factors in Business Statistics may not transfer to other disciplines just as research from other fields may not generalize to Business Statistics.

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