Student Success in Business Statistics

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Abstract

Many universities require Business Statistics for undergraduate business majors. For students with weak quantitative and critical thinking skills, these courses present a significant challenge that must be met before beginning academic work in their major field. Pearson and partial correlation coefficients are calculated to identify three factors from an initial model of seven that are found to be significantly related to student performance in business statistics courses: class attendance, previous performance in algebra and differential calculus, and overall GPA. Awareness of these factors can provide a basis for improving student performance in Business Statistics.

Introduction

Why do some students excel in Business Statistics while others struggle? In order to address this question and build student interest, a short case study was developed for the regression component of the required sophomore level Business Statistics course at a mid-size regional university. From a prior semester, student absences were selected as the independent variable to attempt to predict a student's final average in the class. This simple regression revealed a strong linear relationship, and number of absences explained 46% of the variation in final student average. This class assignment became the springboard for a more exhaustive study to determine factors relating to student success in Business Statistics.

Undergraduate business majors are commonly required to complete a course in Business Statistics as part of their degree programs. Such courses can be quite challenging for many students, particularly those entering college with weak quantitative and critical thinking skills. Because students view these 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) and can also increase 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 paper identifies factors relating to successful student performance in Business Statistics. A particular focus is on those factors that can be influenced by the instructor and classroom procedures, the role of students' past performance, and whether demographics impact student success.

Literature Review

William E. Becker, Jr. wrote a three-part series (1983a, 1983b, 1983c) 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), and technology (e.g. lectures, computer usage).

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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.

A number of studies have examined student performance 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).

Few articles were uncovered dealing with student performance in a Business Statistics course after a rather exhaustive review of the literature. 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. 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. The literature review indicates a paucity of research on student success for courses in undergraduate Business Statistics.

Methodology and Descriptive Statistics

In order to examine factors that impact the academic performance of business majors at a mid-size regional state university, four sections of Business Statistics taught by the same instructor during the 2004 – 2005 academic year, are selected for analysis. Ninety-three students were enrolled in the four sections. Based on the literature review and professional experience, eight independent variables are included in the preliminary model to predict academic success in Business Statistics.

One initial question is inclusion of the variable Math ACT. Literature supports inclusion of standardized tests in student performance analysis (Park and Kerr 1990). However, 19 of 93 students in the original data set did not submit an ACT score to the university. Examination shows that these tend to be transfer and older students. The initial correlation analysis reveals that Math ACT is correlated to final grade in Business Statistics but is also highly correlated to another independent variable, Grade Point Average. Therefore, Math ACT score is omitted from the overall analysis in order to more fully explore the role of age on performance in Business Statistics, while retaining Grade Point Average.

Table 1 – Summary Statistics

Variable Number	Variable Name	Minimum	Maximum	Mean	Standard Deviation
Independent Variables					
X_1	Number of Class Absences	0	16	3.87	3.750
X_2	Overall Grade Point Average	1.88	4.00	3.03	0.483
X_3	Intro. Quant. Grade	1.0	4.0	2.98	0.978
X_4	Age	19.67	43	23.27	4.270
X_5	Gender: Male = 0, Female = 1	0	1	0.38	0.487
X_6	Method of Instruction: Traditional Classroom = 0, Instructional TV Class = 1	0	1	0.09	0.282
X_7	Ethnicity: Caucasian = 0, Other = 1	0	1	0.05	0.227
Dependent Variable					

Y	Final Average	47.39	100.00	80.81	11.710

Note: Introductory Quantitative Methods is a prerequisite course that reviews algebra and ends with derivative calculus.

Complete information for the remaining seven variables is available for ninety students. The variables are provided in Table 1 along with corresponding summary statistics.

Y Final Average (Dependent Variable) The mean final student average in the four sections is 80.81 with a standard deviation of 11.71.

X_1 *Abs* The mean number of absences, a utilization rate variable, is 3.87. All four sections of Business Statistics met two times per week for fourteen weeks, and attendances were recorded for each class meeting. Therefore, the average student missed just under four class meetings (or two weeks of class). It is anticipated that increased student absences lower the expected final average.

The next two numeric variables are analyzed to determine how the academic characteristics students bring into the course (human capital) impact the outcome in Business Statistics. The final numeric independent variable in the model is the age of the student.

X_2 *GPA* The mean Grade Point Average of students entering Business Statistics is 3.03 on a 4.0 scale. It is anticipated that students with a higher overall GPA are likely to perform better in Business Statistics.

X_3 *Intro Quant Grade* The average grade earned by students in Quantitative Methods of Business I, a prerequisite algebra/differential calculus course, is 2.98 based on a 4.0 scale. Since both Quantitative Methods of Business I and Business Statistics are math-based courses, it is expected that students earning a higher grade in the intro quant course should also perform better in Business Statistics.

X_4 *Age* The average age of the students in the final data set is 23.27 years, with a standard deviation of 4.27 years. The literature is mixed on the effect of age and student performance (Bonello et al. 1984, Anderson et al. 1994); therefore, the direction of this relationship is unclear.

The remaining three variables in the model are categorical dummy variables and include additional demographics (gender and ethnicity) as well as a technology factor.

X_5 *Gender* The data set consists of 57 males and 33 females. Classroom observation in Business Statistics has not revealed an identifiable difference in performance between males and females, and the literature provides mixed results (Siegfried 1979, Bridges and Casavant 2002). Therefore, the direction of this relationship is unclear.

X_6 *ITV* Three of the four Business Statistics sections analyzed are traditional classroom courses. The fourth section was offered via instructional television, but only eight of the 24 students in this section were not physically located in the same classroom with the instructor. While this variable is deserving of future study, the small number of off-site students is likely to make it difficult to reach any definitive conclusions.

X_7 *Ethnicity* The data set consists of 85 Caucasian students with only five from a different ethnic background. While this variable is deserving of future study, the small variation in the sample is likely to make it difficult to reach any definite conclusions regarding its impact.

Empirical Results

Correlation analysis is performed to determine which independent variables are significantly related to the dependent variable *Y Final Average*. Since several independent variables are to be tested, partial correlation will also be employed. This technique allows the relationship between one independent variable and the dependent variable to be investigated while controlling for the other independent variables.

The second column of Table 2 reports the Pearson correlation coefficients for each of the seven independent variables. These figures indicate that the first three numeric variables are highly related to the dependent variable with the anticipated signs, whereas three of the four dummy variables are not significant predictors of final average. The correlation for the variables X_2 *GPA* and X_3 *Intro Quant Grade* are the strongest and are virtually identical with $r_{y.2} = 0.665$ and $r_{y.3} = 0.603$. The X_1 variable, *Number of Absences*, reveals a strong negative correlation with *Y Final Average* ($r_{y.1} = -0.547$). All three of these variables are highly significant with 99 percent confidence. One of the categorical variables, X_6 *ITV*, is also significant ($r_{y.6} = -.218$) with the expected negative sign.

The possibility remains that some of the selected predictor variables may be significantly related to each other, a condition known as multicollinearity. To test for this, partial correlation coefficients are calculated for each of the independent variables with the dependent variable and are presented in the third column of

Table 2 – Individual and Partial Correlation Coefficients with the Dependent Variable Y		
Independent Variable	**Pearson Correlation Coefficient**	**Partial Correlation Coefficient**
X_1 Absences	-.547**	-.408**
X_2 GPA	.665**	.267*
X_3 Intro Quant. Grade	.603**	.393**
X_4 Age	-.101	-.176
X_5 Gender	-.098	-.092
X_6 ITV	-.218*	.165
X_7 Eth	-.022	.010

Notes: * Significant at alpha equals .05; ** Significant at alpha equals .01

Table 2. Partial correlation coefficients produce a clearer picture of the actual relationship between a particular independent variable and the dependent variable by controlling for the other independent variables.

Before examining those results, it is important to mention the demographic variables found not to be significantly related to student outcomes in this study. Age[2] and gender, consistent with some studies found in the literature as well as the classroom experience of the authors, are not found to be correlated with course performance. Ethnicity is also insignificant but probably warrants future study as the data set displays little ethnic diversity. The technology variable, *X_6 Instructional Television*, which is significant using the Pearson correlation coefficient at -.218, is no longer significant when viewing the partial coefficient (.165). This result may be due to characteristics common to students who tend to take ITV courses. The number of students at the ITV site is too small in this sample to draw any definite conclusions.

The same three predictor variables that appear to be highly related to student performance in Business Statistics using individual correlation coefficients are confirmed by examining the partial correlation coefficients. However, the relative importance of each factor has changed. The strongest predictor of student performance is now *X_1 Absences*, with a partial coefficient of -.408, significant at alpha equals .01. The *X_3* variable, *Intro Quant Grade*, possesses a partial correlation nearly as strong at .393, with a .01 level of significance. *X_2 GPA* remains important in predicting course performance at .267 but now ranks third and is only significant at alpha equals .05.

Conclusion

Three independent variables are found to be significantly related to the final grade earned by students in a Business Statistics course at a medium-size, regional state university. They are the number of student absences, grade earned in a previous introductory quantitative methods course (algebra and differential calculus), and GPA. The grade earned in the previous introductory quantitative methods course and overall GPA might be seen as primarily a function of a student's math background and innate ability. There may be little that faculty can do to impact student aptitude other than encourage changes in college admission requirements. However, this study indicates that quantitative skills, as evidenced by the *Intro Quant Grade*, are strongly correlated to success in Business Statistics. Providing additional departmental resources such as tutoring and extended lab hours for students early in the first quantitative course as well as Business Statistics should strengthen the foundation needed for successful student performance.

The most strongly related independent variable in the data set is the number of student absences. With such knowledge in hand, the instructor has the opportunity to encourage students to attend regularly. A traditional approach is to reward excellent attendance or penalize poor attendance through policies stated in the course syllabus. Another pedagogical tool to encourage attendance in Business Statistics could be to include an analysis of attendance and grades as a case study assignment in the regression component of the course. Such knowledge could increase attendance both in this course and future courses the students take.

The demographic variables studied, age, gender, and ethnicity, are not found to be significant predictors of student success in Business Statistics. Further analysis of student ethnicity might prove instructive as the

[2] Age is also analyzed as a dummy variable using traditional age (<25 years) and nontraditional age (≥25 years). The results are also insignificant when related to student performance.

sample data set was rather homogeneous. Continuing rapid changes in technology are impacting modes of course delivery such as instructional television or on-line courses. Further study of the effect of these methods on student outcomes is warranted.

Business Statistics emphasizes application of statistical techniques to business situations through critical thinking and analysis, rather than memorization of theory or deriving of formulas that may be required in some courses. Analyzing a business problem, determining an appropriate statistical procedure, and weighing the risks of each alternative are very difficult skills for most students to learn on their own by reading or studying a textbook. Rather, effective understanding involves the use of numerous examples and practice through homework sets and case studies, something that can be done most effectively in a classroom setting. Therefore, the three factors found to be related to student success in Business Statistics (class absences, performance in a prerequisite math course, and overall GPA) may not be identical or of equal importance in other business disciplines.

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