STUDENT PERFORMANCE DETERMINANTS IN A BUSINESS STATISTICS COURSE AT A LARGE URBAN INSTITUTION

Stuart R. Monroe
Metropolitan State College of Denver
Denver, Colorado 80217 USA

Abel Moreno
Metropolitan State College of Denver
Denver, CO, 80217

Mark Segall
Metropolitan State College of Denver,
Denver, CO, 80217

ABSTRACT

Data collected from students over a five year span in a School of Business Advanced Statistics course was used to predict student performance. GPA was the strongest predictor of performance which was consistent with results reported in the literature. The number of hours worked per week was also a significant predictor of performance; the average student worked 27 hours a week. There was also a significant effect of academic major. Gender was not found a predictor of performance contrary to other reports in the literature. Also the number of hours a student studied for exam 1 was not a predicator of success, contrary to the advice given by most instructors to study more to get a better grade.

Keywords: Student, Performance, Statistics, Urban

INTRODUCTION

In this paper, we examine the effect that several variables may have on student performance in a Business Statistics course. In addition to variables found significantly related to course overall performance in previously published studies such as student GPA, other variables associated with the urban nature of the institution where the study was conducted are also considered. In particular, we examine the possible impact that the number of student working hours, number of credits that the student is enrolled in, the status of the student and the declared major of the student, may have on course performance. Other variables considered include gender, class time/day and how recently the course was taken.

We believe that identifying the determinants of student performance serves the dual purpose of possibly assisting faculty in the design and delivery of courses in order to achieve a more effective teaching environment and of assisting students focus on strategies that may be conducive to improved performance in the classroom. The curriculum development process may also benefit from the results of a study like the present one.

In the next section a literature review of studies identifying determinants of student performance on Business Statistics and other courses is included. A description of the data collection process and methodology of the study follows. In the last section results and conclusions are reported.

BACKGROUND

Numerous studies have been conducted to examine the impact on student performance of variables in courses other than Business Statistics. For instance, Brasfield, et al. [1993] and Allison and Thomas [1986] among others, provide a literature review of such studies in economics and psychology courses. Krieg and Uyar [1997] provide an extensive literature review of studies considering variables such as student class standing, test structure, gender, human capital, class attendance and student attitude.

Few published studies examine the impact of variables on student performance in a Business Statistics course. Krieg and Uyar's paper published in 1997 is the first to focus on Business Statistics. The results of their study suggest that variables such as gender, class time, and transfer status of students, do not have a significant impact on overall student performance. On the other hand, variables such as passing homework assignments, college GPA, math ACT scores and parental funding, are statistically significant. Variables such as percentage of Friday classes missed and living in dormitories tended to lower student outcomes. Four years later, Krieg and Uyar [2001] published a study where an examination was made of the test structure on student performance in a business and economics statistics course. The results of the study suggest that scores on multiple-choice portions of exams do not adequately determine overall student performance, and that some students are predisposed to perform better on multiple choice tests depending on personal characteristics. Johnson and Kuennen [2006], conducted a study on student performance in an Introductory Business Statistics course and found that the student's score on the science portion of the ACT exam, the score on a math-quiz, and the student's GPA and gender were all significantly related to performance on the course. The results were robust across course formats and instructors. Rochelle and Dotterweich [2007] published a study on student success in Business Statistics. They concluded that the following three factors were found to be significantly related to student performance in Business Statistics courses: class attendance, previous performance in algebra and calculus courses, and overall GPA.

While not focusing on business statistics courses, similar studies have been published on related statistics courses. Larson [2003] published a study with the objective of determining some common characteristics shown by successful and by unsuccessful students in an Elementary Statistics course. The results of the study suggest that the student's ACT score and high school percentile were the only significant determinants.

METHODOLOGY

Data was collected from an Advanced Business Statistic course taught at Metropolitan State College of Denver (MSCD) over the course of 5 years by the same instructor. MSCD is a primarily four-year undergraduate, urban institution located in downtown Denver (Three graduate programs started in 2011). There are about 3500 students in the school of Business with majors in Accounting, Computer Information Systems, Finance, Management, Marketing, and Economics. All Business students (except for Economic majors) are required to take 2 semesters of statistics as part of the Core business courses and they are required to get a "C" or better in the Core courses. This was the second course in the statistics sequence covering topics such as Chi-square test, ANOVA, Regression Analysis, Forecasting, and Non-parametric analysis.

On the first day of class, students are asked to fill out an index card listing their name, major, year of study (freshman, sophomore, junior, senior), and how many hours they worked each week. These responses were used to review the concepts of data measurement types (Nominal, Ordinal, and Ratio).

Three exams and managerial reports were required of each student. The first report was due week 3 of the semester and the first exam was week 5. On the first exam students were given a survey for extra credit (appendix 1). Questions included a work category (No, Part Time, Full Time), how many hours studied for the exam, how many credit hours student are taking this semester, how many hours they prepared for the exam, their GPA and Gender. Grades for reports (20 possible points) and Exam (100 possible points) were recorded for each student. Some missing data (major, credit hours taken, GPA) was filled in by looking up the student's data in the schools registration system.

The data was initially collected as a way to illustrate to the students the use of simple and multiple regression analysis with data relevant to their life experiences. Early discussions of regression analysis asked students to list factors they thought would predict a student's test performance and illustrated the idea that multiple factors can be used to predict an outcome, even if some factors have more weight than others. Many of these factors would be the data collected in the initial class and exam survey. Using the actual data from each class in the regression analysis illustrated a way to test if the initial concepts held by the students were valid or not. When the number of hours studied proved to NOT be a significant predictor of exam scores, lively discussion would ensue as to the validity of the advise that instructors give that student should study for exams.

RESULTS

Dependent and Independent Data Variables

The data set of 530 observations included three separate exam scores as described previously that were highly correlated. These three separate exam scores were combined into Exam Average score, a single dependent indicator of success in the business statistic course.

A correlation matrix for the twenty four independent variables and the dependent variable was generated. It was noted that a large number of the independent variables were highly correlated as determined by a Pearson correlation coefficient $r > .7$ or $< -.7$. To mitigate the effects of multicollinearity in calculating the regression variable coefficients, only one variable from the highly correlated variable sets were used in the analysis.

This variable reduction process resulted in the following fifteen independent variables: grade point average (GPA), weekly work hours (Work Hours), semester credit hours, study hours, year data collected (Year), meeting time of class (Class Time), semester data collected (Semester), junior, senior, gender, accounting major (ACC), computer information systems major (CIS), finance major (FIN), marketing major (MKT), management major (MGT).

Independent Variables Correlations with Exam Average score

Of the fifteen independent variables considered, the nine significant ($p < .05$) independent variables relating to exam average score are shown in Table 1.

Table 1
Independent Variable Correlations with Exam Average score

Variable[a]	Pearson ρ	Sig.	N
GPA	0.552	0.001	530
Work Hours	-0.145	0.001	530
Year	-0.126	0.004	530
Class Time	0.112	0.010	530
Semester	-0.127	0.003	530
ACC	0.110	0.011	530
CIS	-0.085	0.049	530
FIN	0.107	0.014	530
MKT	-0.160	0.001	530

(a) Missing values were replaced with the mean of the variable.

Stepwise Regression Model

Using stepwise regression analysis with a F score of 4.0 to enter or leave the model and the nine independent variables shown in Table 1 resulted in the following final regression model with an adjusted $R^2 = 30.26$.

Exam Average score = 1902 + 11.3 GPA - 0.924 Year - 0.0816 Work Hrs - 2.34 MKT

Interpretation of the Variable Coefficients for the Regression Models

The following Table 2 describes the units of measure for each of the regression model variables. The most important variable for prediction of Exam Average score is Grade Point Average (GPA). Each one point increase in GPA resulted in an increase in Exam Average score of 11.2937. As the variable Year Data collected increased from 2006 to 2011 the Exam Average score decreased by 0.924 points indicating a statistically significant decline in student performance on the statistics exams during the study period. The statistically significant negative weekly work hours coefficient of -0.082 indicated that the more a student works the lower their exam performance. The statistically significant negative coefficient for the indicator variable for the academic major of Marketing (MKT) indicated that these students as a group performed lower than other students in the study population.

Table 2
Regression Coefficients

Regression Variable	Regression Coefficient	Significance (p =)	Units of Measure	Range
Grade Point Average	11.2937	0.001	interval	0 to 4
Data Year	-0.924	0.001	years	2006-2011
Weekly Work Hours	-0.082	0.001	hours	0 to 40
Marketing major	-2.339	0.022	integer	0 or 1

DISCUSSION

The objective of this study was to determine the predictors of success in a business statistics course using 530 observations over a six year period. The data was collected as part of techniques to engage students in the classroom learning environment.

Highly correlated independent variables were eliminated from the study to mitigate multicollinearity influences on the coefficients in the regression analysis. Stepwise regression analysis with a threshold of F = 4.0 was used to construct the final model. The method generated a coefficient of determination of 30.27.

The finding of the variable Academic Major as a significant independent variable in predicting Exam Average score was a new contribution to this body of knowledge. Previous studies had not identified academic major as a significant variable. A possible confounding

factor of individual math proficiency may have biasing the results through the academic major self-selection process. Additional research would be necessary to confirm this relationship.

As with other studies, GPA was found to be a highly influential variable in predicting Exam Average score. Not unexpectedly, Work Hours shows a significant negative relationship with Exam Average score.

Further areas of interest are the significant independent variables that were not included in the final regression model. Even though Class Time and Semester were correlated with Exam Average score they were excluded from the final regression model. The selection of the Marketing academic major in the model apparently excluded the other academic majors from the final model. Other independent variables Junior, Senior, Credit hours, Study hours and Gender were not found to be significantly correlated with Exam Average score. These findings were contrary to other studies on the same area.

REFERENCES

Brasfield, D.W.; D.E. Harrison; J.P. McCoy. "The Impact of High School Economics on the College Principles of Economics Course," *Journal of Economics Education,* 24(2), 1993: 99-111.

Allison, D.E.; D.C. Thomas. "Item-Difficulty Sequence in Achievement Examinations: Examinees Preference and Test Taking Strategies," *Psychological Reports,* 59 (2, Part 2), 1986: 867-870.

Krieg, R.G.; B. Uyar. "Correlates of Student Performance in Business and Economics Statistics," *Journal of Economics and Finance,* 21(3), 1997: 65-74.

Krieg, R.G.; B. Uyar. "Student Performance in Business and Economics Statistics: Does Exam Structure Matter?," *Journal of Economics and Finance,* 25(2), 2001: 229-241.

Larson, T.M. "Statistical Alternatives for Studying Success in Elementary Statistics: A Comparative Analysis of Logit and Linear Regression," *UW-L Journal of Undergraduate Research VI,* 2003: 1-5.

Johnson, M.; E. Kuennen. "Basic Math Skills and Performance in an Introductory Statistics Course," *Journal of Statistics Education,* 14(2), 2006.

Rochelle, C.F.; D. Dotterweich. "Student Success in Business Statistics," *Journal of Economics and Finance Education,* 6(1), 2007: 19-24.