Impacts of Prerequisite Proficiency on Student Performance in a Core Business Economics Course

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Abstract

We examine student performance in the managerial economics course in the context of the course prerequisites. To address an issue of the overlap in content between the managerial economics course and the Principles of Microeconomics course, we consider additional academic factors such as grade point average and students' class standing. This study utilizes both multiple regression analysis and two-tailed Pearson correlation tests. Our main findings show that students' performance in the managerial economics course is better explained by their overall academic performance such as GPAs, analytical skills, and students' class standing. However, students' grades in the Principles of Microeconomics course were not a statistically significant predictor of student performance in the managerial economics course even in the presence of a high degree of content overlap between the courses.

Keywords: Course prerequisites, Student performance, Class standing, Correlation

1. Introduction

The structure of higher education curricula relies heavily on the concept of prerequisites - courses that students are required to complete before enrolling in more advanced subsequent courses. This academic practice is based on the premise that a structured learning pathway

can enhance student success in subsequent courses by ensuring that students possess the necessary foundational knowledge and skills before advancing to more complex subsequent courses. These prerequisites, often established by educational institutions, are intended to create a scaffolding effect in learning by promoting a more ordered cumulative learning experience. However, despite its near-ubiquitous presence in college curricula, the actual impact of prerequisites on student performance in follow-on advanced courses remains unsettled. While prerequisites provide students with basic theories and skills for their unhindered learning experience in a related upper-level course, required prerequisite courses might be brought into question if all students were mandated to complete the prerequisites even when some students already possess prerequisite knowledge (Dalton, 2020). According to a 2017 survey conducted by the National Institute of Health, the student's perception of prerequisites in higher education was mixed: the students surveyed at a public university believed prerequisites in college curricula were helpful but not indispensable (Sato et al., 2017).

The studies on the effectiveness of course prerequisites in higher education have evolved largely along two margins. The first margin is testing the validity of prerequisite courses in higher education such as "Are course prerequisites necessary in college?" The second margin is identifying if students' performance or grades earned in a lower prerequisite course correlate with their performance in a follow-on upper-level course. Along the first margin, it has been examined if students' improved learning experience in later courses is attributable to their enrollment in or completion of prerequisite courses. Among the studies that found little statistical evidence of a significant relationship between student exposure to prerequisite knowledge and their success in later courses are Steele and Barnhill (1982), Martin (1989), Caplan et al. (1996), Forester et al. (2002), Kauffman and Gilman (2002), Davis et al. (2006), Wright et al. (2009), and Clark and Chiu (2019). For instance, Kauffman and Gilman (2002) examined the success of students in a business cooperative experiences program and made a comparison between two groups of students: those who completed the prerequisite course and those who did not. Their two-tailed Pearson correlation test results showed no relationship between the completion of the prerequisite course and the success of students in the follow-on advanced course. In a similar study, Martin (1989) used a multiple regression analysis to examine student success in a senior-level elective course in agricultural price analysis. His study showed that none of the three prerequisite courses for the agricultural price analysis course had a statistically significant regression coefficient while students with more preparation in calculus and a higher grade point average (GPA) performed better, respectively. On the other hand, several studies found that the completion of prerequisites or previous learning experience in low-level courses positively impacted performance in subsequent upper-level courses (Eskew and Faley, 1988; Anderson et al., 1994; Hancock, 1999; Dellana et al., 2000, Islam et al., 2008; and Joko et al., 2022). For instance, Dellana et al. (2000) examined the student performance in a college-level financial accounting course and found that their previous accounting experience positively impacted their academic performance in the financial accounting course. A notable limitation of the studies along this first margin is that the assessment of the validity of prerequisite knowledge is limited only to the prerequisite courses that are recommended, not mandatory.

The studies on prerequisite courses in higher education curricula along the second margin centered around the question of whether the student performance or grade earned in a prerequisite course is a statistically significant predictor of student performance in a subsequent upper-level course (Eckel and Johnson, 1983; Bieker, 1996; Caplan et al., 1996; Doyle and Wood, 2005; Davis et al., 2006; Martin et al., 2006; Green et al., 2007; Nolan and Ahmadi, 2007; McMillan-Capehart and Adeyemi-Bello, 2008; Wright et al., 2009; and McRae, 2010, Maksy and Wagaman, 2016). As were the studies along the first margin, the outcome of the studies along the second margin also showed mixed results. For instance, Davis et al. (2006) examined student performance in an introductory soils class at Texas Tech University as a function of several high school and college variables on course success. The study showed no statistically significant relationship between high school chemistry background and the final grade achieved in the introductory soils course. On the other hand, Doyle and Wood (2005) found a small but statistically significant impact of prior knowledge in economics on student performance in an upper-level business study. In a similar study, Nolan and Ahmadi-Esfahanik (2007) examined the first-year student performance of nine cohorts from 1991 to 2004 in the Bachelor of Agricultural Economics program at the University of Sydney. They found that first-year student success in the program was attributable to their earlier success in related courses.

Building on Shaffer et al. (2016), the present study aims to investigate the student performance in a managerial economics course at a regional public university over 9 regular terms from Spring 2019 to Spring 2023. The managerial economics course is required of all business administration majors. Its prerequisites include a two-semester sequence of principles of economics as well as the class standing of junior or higher. All sections of the course have been taught by the same instructor. We assess the student performance in the managerial economics course in relation to their performance in a closely related prerequisite Principles of Microeconomics course. There is a large degree of overlap between managerial economics and principles of microeconomics because the basic elements of principles of microeconomics underpin managerial economics. So, we also consider other factors that are deemed relevant to the course-specific student performance as well as student overall academic performance. To achieve these objectives, this study employs quantitative measures of student performance such as course-specific grades, grade point average (GPA), and cumulative credit hours completed.

2. Data Descriptions

This study was conducted at a 4-year regional public university in the Southeast United States. The managerial economics course is required of all business administration majors and is often viewed as a capstone course for the business administration majors. For this study, we collected students' performance in the managerial economics course from Spring 2019 to Spring 2023 over nine regular terms. Since all sections of the managerial economics course at the university have been taught by the same instructor over the sample period, we were able to collect the final course grade and measure the student performance in the course as two-digit decimals between 1.00 and 0.00 (equivalent of 100% and 0% when formatted as a percentage). In addition, little or no teacher bias is expected in grading because student

performance in all sections of the managerial economics course was assessed by the same instructor with the same grading components and weights. Therefore, it is reasonable that we assume there to be homogeneity of variance across the sample.

Managerial economics is a blend of economics and management in that it applies essential economics principles to business decision-making problems as an effective management tool. The managerial economics course examined in this study requires three prerequisites: a Principles of Microeconomics course, a Principles of Macroeconomics course, and a class standing of junior or higher. Although both principles of microeconomics and principles of macroeconomics are required prerequisites for the managerial economics course, we consider only the Principles of Microeconomics course for two reasons. First, principles of microeconomics studies the behavior of consumers and firms whereas principles of macroeconomics studies how the economy as a whole works. Second, there is a large degree of overlap in concepts between managerial economics and principles of microeconomics. Since managerial economics applies the essential theories of principles of microeconomics to formulating solutions to managerial decision-making problems, the course is often perceived as an intermediate-level applied microeconomics. The Principles of Microeconomics course at the university was taught by multiple instructors, so we collected the data on student performance in the Principles of Microeconomics course in letter grade (A, B, C, and D). Since the letter grades are qualitative and categorical, the letter grades were coded as follows: A=4.0, B=3.0, C=2.0, and D=1.0.

Regarding the class standing prerequisite for the managerial economics course, we measured the total cumulative semester credit hours a student earned at the time of enrollment in the managerial economics course. At our university, junior standing requires at least 60 credit hours earned, and senior standing requires a minimum of 90 credit hours earned. In this study, we assume a positive relationship between student class standing and academic maturity: students of higher class standing are more experienced than those of lower class standing in self-motivation, time management, self-discipline, etc. So, all else remaining the same, a student of higher class standing is presumed to perform better in the managerial economics course.

Besides the required course prerequisites for the managerial economics course, we considered another two potential predictors of student performance in the managerial economics course: student grade point averages (GPAs hereinafter) and student performance in the Business Statistical Model course. The rationale behind this is that some overlaps of course contents as well as possibly exam questions between the Principles of Microeconomics course and the managerial economics course could potentially limit our interpretation of statistical inferences about the effectiveness of course prerequisites in this study (Sato et al., 2017; Shaffer et al., 2016). Regarding the consideration of student GPAs, we believe a student's GPA is a reliable measure of the extent to which the student maximizes his or her academic potential. Although there is no minimum GPA required for enrollment in the managerial economics course at the university, we considered student GPAs at the time of their enrollment in the managerial economics course as a measure of overall learning capacity.

Regarding the Business Statistical Model course as a possible predictor of student performance in the managerial economics course, we collected data on student performance in the course in letter grade (A, B, C, and D). As with the Principles of Microeconomics course, the letter grades were coded as follows: A=4.0, B=3.0, C=2.0, and D=1.0. One of the key skills for success in economics is analytical thinking abilities. Economics shares its roots with statistics to a certain extent, and both courses require strong analytical skills. Especially in an upper-level business economics course like managerial economics, students are often asked to apply their analytical skills to solve quantitative decision-making problems. We expect a positive academic performance correlation between the Business Statistical Model course and the managerial economics course.

3. Data Analysis and Results

In this study, we use two types of inferential statistics: multiple regression analysis and hypothesis testing.

3.1 Multiple Regression Analysis

Ordinary least square regression models are fitted as shown in Table 1. Regarding the dependent variable (student performance in the managerial economics course), all sections of the managerial economics course in the sample were delivered by the same instructor with the same grading components and weights. Hence, it is reasonable to assume that there is homogeneity of variance across the sample. However, to ensure that regression results are valid under relaxed assumptions such as heteroscedasticity in residual distribution, we used the robust standard error estimator.

First, Regression (1) in the table assesses the effectiveness of student performance in the two lower-level courses: the Principles of Microeconomics course and the Business Statistical Model course. Although the Business Statistical Model course is not a prerequisite for the managerial economics course, it is required of all business majors and most students are expected to complete the course by the time they meet the class standing of junior or higher, another prerequisite for the managerial economics course. The results show that there is a positive correlation between student performance in each of the two lower-level courses and student performance in the managerial economics course. However, the adjusted R-square value indicates that more than 70% of the variation is left unexplained. In Regression (2), we added a class standing prerequisite to the regression as a measure of a student's academic maturity. The class standing was measured as total cumulative credit hours students earned at the time of enrollment in the managerial economics course. It's interesting to find that the impact of class standing on student performance in the managerial economics course is negligibly small while statistically significant. For instance, other things being equal, a student with 30 more cumulative credit hours is expected to show a grade improvement of only 1.2 basis point. On the other hand, the estimated coefficients of student performance in the principles of economics and Business Statistical Model course remain virtually unaffected after student class standing was accounted for. Also, as indicated by a negligible increase in the adjusted R-square value, the inclusion of the student class standing variable in the regression hardly added any explanatory power to the variation in student performance in the

managerial economics course.

Lastly, we examine all four potential student performance predictors in Regression (3): student performance in the principles of microeconomics as well as in the Business Statistical Model course, student class standing, and student overall GPAs. Contrary to our presumption that a student's grade in the Principles of Microeconomics course is a significant predictor of student performance in the upper-level managerial economics course, its estimated coefficient is no longer statistically significant. Furthermore, the size of the estimated coefficient has significantly reduced from 0.025 in Regression (1) to 0.0019 in Regression (4). The prerequisite proficiency in the Business Statistical Model course is estimated to have a positive impact on the student performance in the managerial economics course. Its estimated coefficient is statistically significant while its size has noticeably reduced. The estimated impact of student class standing on the dependent variable is statistically significant but almost negligible. Among all potential student performance predictors we controlled for as an independent variable, a student's GPA is estimated to be the most significant predictor, and its estimated coefficient is the most dominant in both size and statistical significance.

Table 1. Regression Results

Student grade in managerial economics (dep. var.)	Regression (1)	Regression (2)	Regression (3)
Principles of microeconomics	.0254*** (.0053)	.0257*** (.0052)	.0019 (.0054)
Business statistical model	.0294*** (.0052)	.0287*** (.0051)	.0156*** (.0053)
Class standing (cumulative credit hours earned)		.0004** (.0002)	.0005** (.0002)
GPA			.0838*** (.0115)
Observations	321	320	317
R^2	.2389	.2453	.3658
Prob>F	.0000	.0000	.0000

Note. Standard errors are in parenthesis. ***, **, and * indicate statistical significance at 1, 5, and 10 percent level, respectively.

3.2 Hypothesis Testing

Assessment of prerequisite effectiveness or student readiness can be tested in a variety of forms (Sato et al., 2017). In this section, we use a two-tailed Pearson correlation test for the correlation between students' performance in a lower-level prerequisite course and their performance in the managerial economics course. Most ex-post facto research compares student performance between two groups: students who completed a prerequisite and those who did not. In this study, however, the Principles of Microeconomics course is a mandatory requirement; thus we cannot perform such a typical ex-post facto study. Instead, we conduct a relationship study by grouping student performance in the Principles of Microeconomics course: those who earned a letter grade of an A or a B (Group 1) and those who earned a passing grade of a C or a D (Group 2). While testing the equality of mean values of the two groups, we do not assume that the variances are equal between the two groups. So, for a more robust hypothesis test, we use Welch's formula for unequal variances (Welch, 1947). Table 2

shows the results of the two independent samples t-test with unequal variances in the context of student grades earned in the principles of microeconomics. Out of 330 observations, 134 students earned a C or a D in the Principles of Microeconomics course and their mean score in the managerial economics course was 0.759 (75.9%). On the other hand, 196 students received an A or a B in the Principles of Microeconomics course and their mean score in the managerial economics course was 0.824 (82.4%). The two-tailed t-test statistic clearly rejects the null hypothesis that there is no difference in the mean student performance in the managerial economics course between the two groups.

Table 2. T Test Results by Grade earned in Principles of Microeconomics

Group	Observations	Mean	Std. Dev.
0	134	.759 (75.9%)	.0995
1	196	.824 (82.4%)	.0870
Ho = mean (0) – mean (1) = 0		t (Satterthwaite's df) = 259.984	
Ha = mean (0) – mean (1) ≠ 0		t = -6.099, Prob. ($|T| > |t|$) = .0000	

Table 3. T Test Results by Grade earned in Business Statistical Model

Group	Observations	Mean	Std. Dev.
0	120	.762 (76.2%)	.0915
1	210	.818 (81.8%)	.0951
Ho = mean (0) – mean (1) = 0		t (Satterthwaite's df) = 255.698	
Ha = mean (0) – mean (1) ≠ 0		t = -5.298, Prob. ($|T| > |t|$) = .0000	

In Table 3, we also performed a similar two-tailed Pearson correlation test for the correlation between students' performance in the Business Statistical Model course and their performance in the managerial economics course. 120 students out of 330 observations earned a C or a D in the Business Statistical Model course (Group 0) and their mean score in the managerial economics course was 0.762 (76.2%). On the other hand, 210 students received an A or a B in the Business Statistical Model course (Group 1) and their mean score in the managerial economics course was 0.818 (81.8%). Again, the two-tailed t-test statistic clearly rejects the null hypothesis that there is no difference in the mean student performance of the two groups.

The above Pearson correlation test results confirm that there is a statistically significant difference in the mean student performance in the managerial economics course between those who earned an A or a B in a lower-level prerequisite course and those who earned a C or a D, respectively. However, the results should not be interpreted that students' performance in a prerequisite course is a statistically significant predictor of their performance in an upper-level follow-on course. Any conclusions that can be drawn regarding prerequisites should be limited with caution because these Pearson correlation or hypothesis tests did not take into consideration a measure of students' overall academic performance such as GPAs. Students with relatively high GPAs indicate that they perform relatively well in the majority of courses - even in upper courses that do not have a high degree of content or concept

overlap with a lower-level prerequisite course (Shaffer et al., 2016).

4. Conclusion

This study investigated student performance in the managerial economics course at a 4-year regional public university in the context of two lower-level prerequisite courses as well as students' overall GPAs and their class standing at the time of their enrollment in the managerial economics course. For our study, we performed multiple regression analysis as well as two-tailed Pearson t-tests. One of the key findings from our study is that students' performance in the managerial economics course is better explained by their overall academic performance such as GPAs and analytical skills, not their performance in a closely related course with a large degree of concept overlap such as the Principles of Microeconomics course. However, much variation in student performance in the managerial economics course is left unexplained in our multiple regression analysis. There are multiple factors in play in the academic performance of students in higher education. Some factors are measurable while many factors are intangible or qualitative. In the literature of education, personality traits or inborn skills have long been identified as one of the important factors affecting college students' overall academic achievements (Harsha et al., 2015; Wang et al., 2023). Although limited in that respect, this study's statistically significant results provide future researchers with added incentive to examine the validity and effectiveness of course-specific prerequisites in higher education. Perhaps future research could examine if the overall general education requirements in higher education are truly conducive to priming students in their first year or two at university for their success in future advanced study.

Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Macrothink Institute.

The journal's policies adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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