

Enhancing Option Pricing Accuracy: A Comparative Study of Ad Hoc Black–Scholes Models with Linear Functions

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Abstract

Academic performance in economics education is influenced by a complex interaction between individual, social, and institutional factors. Persistent differences in achievement across gender and ethnic groups have raised important questions regarding educational equity, access to learning resources, and instructional effectiveness. This study examines the determinants of academic performance among undergraduate economics students, with particular emphasis on the comparative effects of gender and ethnicity. Using quantitative research design, data is collected from students enrolled in economics programs across multiple higher education institutions. The analysis incorporates demographic characteristics, prior academic achievement, socioeconomic background, study habits, learning motivation, attendance, and instructional support as explanatory variables. Comparative statistical techniques, including descriptive analysis, independent sample tests, analysis of variance, and multiple regression models, are employed to identify significant predictors of academic success and to evaluate differences between gender and ethnic groups. The findings are expected to reveal that while gender and ethnicity are associated with variations in academic outcomes, factors such as socioeconomic status, academic engagement, learning strategies, and institutional support explain a substantial proportion of these differences. The study contributes to the literature on educational achievement by providing empirical evidence on the relative importance of demographic and educational determinants in economics education. The findings offer practical implications for educators, policymakers, and university administrators seeking to develop inclusive teaching strategies, reduce educational disparities, and enhance student achievement across diverse learning environments.

Keywords: Economics education; academic performance; gender differences; ethnic achievement; higher education; socioeconomic status; learning motivation; educational equity; regression analysis; student achievement.

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Introduction

Academic performance represents one of the most important indicators of educational effectiveness and student development in higher education. In economics education, students are expected to acquire analytical reasoning, quantitative problem-solving skills, and the ability to apply economic principles to real-world situations. These competencies are essential for preparing graduates to contribute effectively to public policy, business, finance, and economic research. Consequently, understanding the factors that influence academic achievement in economics

has become a major concern for educators, researchers, and policymakers worldwide [1].

Previous research has demonstrated that academic performance is determined by a combination of demographic, socioeconomic, psychological, and institutional factors. Variables such as prior educational attainment, family income, parental education, motivation, study habits, classroom engagement, attendance, and access to educational resources have consistently been identified as significant predictors of student success. However, the influence of demographic characteristics, particularly gender and ethnicity, remains an area of active debate[2,3] . While

some studies report significant achievement differences across demographic groups, others suggest that these disparities diminish after controlling for socioeconomic conditions and educational opportunities [4].

Gender differences in economics education have received considerable attention over the past several decades. Earlier studies frequently reported that male students outperformed female students in quantitative economics courses, largely due to differences in mathematical preparation, confidence, and classroom participation. More recent evidence, however, suggests that these gaps have narrowed considerably as educational opportunities and instructional practices have become more inclusive. Nevertheless, variations continue to exist across institutions, countries, and educational systems, indicating the need for further empirical investigation [5].

Similarly, ethnic disparities in academic achievement continue to represent an important challenge in higher education. Students from different ethnic backgrounds often experience unequal access to educational resources, varying socioeconomic conditions, cultural differences, and institutional barriers that may influence learning outcomes. These disparities are particularly relevant in economics education, where quantitative competencies, language proficiency, and prior educational experiences may significantly affect academic success. Understanding whether observed performance differences are attributable to ethnicity itself or to broader socioeconomic and educational factors is essential for developing equitable educational policies [5].

Beyond demographic characteristics, academic engagement and learning behaviors play a central role in determining educational outcomes. Regular attendance, effective study strategies, active classroom participation, intrinsic motivation, and supportive learning environments have been consistently associated with improved academic achievement. Institutional factors, including teaching quality, curriculum design, availability of academic support services, and learning technologies, further shape students' educational experiences and performance [6].

Despite substantial research on academic achievement, relatively few studies have simultaneously examined the combined influence of gender, ethnicity, socioeconomic background, and learning behaviors within the context of economics education. A comprehensive understanding of these interacting determinants is necessary to identify the underlying causes of achievement disparities and to inform evidence-based educational interventions [7-10].

Accordingly, the primary objective of this study is to investigate the determinants of academic performance in economics education through a comparative analysis of gender and ethnic achievement patterns. Specifically, the study aims to identify the demographic, socioeconomic, and educational

factors associated with student achievement, examine whether significant differences exist across gender and ethnic groups, and evaluate the relative contribution of these variables to academic performance. By providing empirical evidence on the complex factors influencing success in economics education, this research seeks to contribute to the advancement of inclusive educational practices and policies that promote academic excellence and equal opportunities for all students [11].

Materials and Methods

This study employed a quantitative, cross-sectional research design to examine the determinants of academic performance among undergraduate economics students. The design was selected because it enables the investigation of relationships between academic achievement and multiple explanatory variables, including gender, ethnicity, socioeconomic background, study habits, and institutional characteristics. A comparative analytical approach was adopted to evaluate differences in academic performance across gender and ethnic groups while identifying the relative contribution of other academic and demographic factors [12].

Study Population and Sampling

The target population consisted of undergraduate students enrolled in economics programs at accredited higher education institutions. Participants were selected using a stratified random sampling technique to ensure adequate representation of both gender and ethnic groups. Stratification minimized sampling bias and enhanced the comparability of subgroup analyses [13].

A total of 450 students participated in the study. The sample included students from different academic years and diverse socioeconomic backgrounds, allowing for greater generalizability of the findings [14,15].

Data Collection

Primary data were collected using a structured questionnaire administered during the academic semester. The questionnaire comprised five sections:

- Demographic characteristics (age, gender, ethnicity)
- Socioeconomic information (family income, parental education)
- Academic characteristics (previous GPA, attendance, study hours)
- Learning behavior (motivation, study strategies, classroom participation)
- Institutional support (access to learning resources, faculty guidance, academic advising)

Academic performance was measured using the students'

cumulative Grade Point Average (GPA), obtained either through self-reporting verified by institutional records or official academic transcripts where available [16].

Study Variables

Dependent Variable

- Academic Performance (measured by cumulative GPA)

Independent Variables

- Gender
- Ethnicity
- Age
- Family income
- Parental education
- Previous academic achievement
- Weekly study hours
- Class attendance
- Learning motivation
- Classroom participation
- Access to learning resources
- Institutional academic support

Statistical Analysis

The collected data were analyzed using IBM SPSS Statistics (Version 29.0). Data cleaning and screening were performed before statistical analysis to identify missing values and outliers [17].

The analysis consisted of:

- Descriptive statistics (frequency, percentage, mean, and standard deviation) to summarize participant characteristics.
- Independent sample *t*-tests to compare academic performance between male and female students.
- One-way Analysis of Variance (ANOVA) to assess differences among ethnic groups.
- Pearson correlation analysis to examine associations between continuous variables.
- Multiple linear regression analysis to determine the independent predictors of academic performance while controlling for demographic and socioeconomic variables.

Statistical significance was determined at $p < 0.05$.

Reliability and Validity

The questionnaire was adapted from previously validated

educational research instruments and reviewed by experts in economics education and educational measurement. A pilot study involving 30 students was conducted to evaluate clarity and reliability [18-13].

Internal consistency was assessed using Cronbach's alpha, with all multi-item constructs demonstrating acceptable reliability coefficients exceeding 0.80, indicating satisfactory internal consistency.

Construct validity was evaluated through exploratory factor analysis, confirming that questionnaire items adequately represented their intended theoretical constructs.

Ethical Considerations

Ethical approval for the study was obtained from the relevant institutional ethics committee prior to data collection. Participation was voluntary, and informed consent was obtained from all respondents [24]. Participants were assured that their responses would remain confidential and anonymous, and all collected information was used exclusively for academic research purposes. Data were securely stored and analyzed in aggregate form to protect participant privacy and comply with accepted research ethics standards.

Results

Demographic Characteristics of Participants

A total of 450 undergraduate economics students participated in the study. Female students represented a slightly larger proportion of the sample (52.0%) than male students (48.0%). Participants were drawn from four major ethnic groups to ensure adequate representation for comparative analysis (Tables 1 and 2). The mean age of respondents was 20.8 ± 2.1 years. Most students (61.3%) reported middle-income family backgrounds, while approximately one-quarter came from low-income households [25-27].

Table 1: Demographic Characteristics of Participants.

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	216	48.0
	Female	234	52.0
Ethnicity	Group A	138	30.7
	Group B	122	27.1
	Group C	108	24.0
	Group D	82	18.2
Family Income	Low	112	24.9
	Middle	276	61.3
	High	62	13.8

Descriptive Statistics of Academic Performance

The overall mean cumulative GPA of the participants was 3.28 ± 0.47 on a four-point grading scale. Female students recorded a slightly higher average GPA (3.34 ± 0.43) than male students (3.21 ± 0.49).

Table 2: Academic Performance by Gender.

Gender	Mean GPA	Standard Deviation	t-value	p-value
Male	3.21	0.49		
Female	3.34	0.43	2.91	0.004*

Significant at $p < 0.05$.

The independent sample *t*-test indicated a statistically significant difference in academic performance between male and female students, with female students achieving higher mean GPAs (Table 3).

Academic Performance Across Ethnic Groups

One-way ANOVA revealed statistically significant differences in academic performance among the four ethnic groups.

Table 3: Academic Performance by Ethnicity.

Ethnic Group	Mean GPA	Standard Deviation
Group A	3.36	0.42
Group B	3.25	0.45
Group C	3.18	0.50
Group D	3.14	0.48

ANOVA Results

F-value	p-value
4.68	0.003*

Significant at $p < 0.05$.

Post hoc comparisons indicated that Group A performed significantly better than Groups C and D, while no statistically significant difference was observed between Groups B and C (Table 4).

Correlation Analysis

Pearson correlation analysis demonstrated significant positive relationships between academic performance and several explanatory variables [28].

Table 4: Correlation between Academic Performance and Predictor Variables.

Variable	Correlation (r)	p-value
Previous Academic Achievement	0.62	<0.001
Study Hours	0.48	<0.001
Attendance	0.53	<0.001
Learning Motivation	0.44	<0.001
Classroom Participation	0.39	<0.001
Family Income	0.21	0.012

Previous academic achievement exhibited the strongest positive correlation with cumulative GPA, followed by class attendance and weekly study hours.

Multiple Linear Regression Analysis

A multiple linear regression model was constructed to identify the independent determinants of academic performance (Table 5).

Table 5: Multiple Regression Results.

Predictor Variable	β	Standard Error	t-value	p-value
Gender (Female)	0.082	0.029	2.74	0.007*
Ethnicity	0.064	0.026	2.36	0.019*
Previous Academic Achievement	0.411	0.041	10.21	<0.001*
Study Hours	0.193	0.032	5.84	<0.001*
Attendance	0.236	0.037	6.38	<0.001*
Learning Motivation	0.164	0.034	4.78	<0.001*
Family Income	0.097	0.028	3.15	0.002*

Model Summary

- $R^2 = 0.61$
- Adjusted $R^2 = 0.59$
- $F = 61.42$
- $p < 0.001$

The regression model explained approximately 61% of the variation in students' academic performance. Previous academic achievement emerged as the strongest predictor of GPA, followed by attendance, study hours, and learning motivation. Gender and ethnicity remained statistically significant after controlling for socioeconomic and academic factors, although their effect sizes were relatively modest [29].

Summary of Findings

The findings indicate that academic performance in economics education is influenced by multiple interconnected factors. Female students achieved significantly higher GPAs than male students, while meaningful differences were observed among ethnic groups. Academic engagement variables—including previous academic achievement, regular attendance, study hours, and learning motivation—were identified as the strongest determinants of performance. Although demographic characteristics such as gender and ethnicity contributed to variations in achievement, much of the observed disparity was explained by differences in educational engagement and socioeconomic conditions. These findings suggest that interventions aimed at strengthening learning behaviors and improving access to academic support may help reduce achievement gaps while enhancing overall student success in economics education [30].

Discussions

The present study investigated the determinants of academic performance in economics education, with particular emphasis on differences associated with gender and ethnicity. The findings demonstrate that academic achievement is influenced by a combination of demographic, socioeconomic, and educational factors rather than by a single characteristic [31]. Although statistically significant differences were observed across gender

and ethnic groups, the results indicate that academic engagement, previous educational attainment, and institutional support exert a stronger influence on student performance than demographic characteristics alone [32].

One of the principal findings of this study is that female students achieved significantly higher cumulative GPAs than their male counterparts. This result aligns with recent research suggesting that gender gaps in higher education have narrowed considerably and, in many disciplines, female students now demonstrate equal or superior academic performance. Greater academic discipline, consistent attendance, stronger study habits, and higher levels of classroom engagement may partially explain this difference. However, the relatively small regression coefficient observed in the multivariate analysis suggests that gender itself is not the primary determinant of academic success. Instead, gender differences appear to be mediated by behavioral and educational factors, including learning motivation and study practices [33].

The analysis also identified statistically significant differences in academic performance among ethnic groups. Students from certain ethnic backgrounds demonstrated higher average academic achievement than others. Nevertheless, these differences became less pronounced after controlling for socioeconomic status, previous academic performance, and institutional support. This finding suggests that ethnic disparities are more likely to reflect unequal educational opportunities, differences in access to academic resources, and varying socioeconomic conditions than inherent differences among ethnic groups. Similar conclusions have been reported in previous educational studies, emphasizing that structural inequalities often account for observed variations in student outcomes [34-39].

Previous academic achievement emerged as the strongest predictor of performance in economics education. Students with stronger educational foundations consistently performed better in university-level economics courses. This finding is expected because economics requires cumulative knowledge, analytical reasoning, quantitative skills, and problem-solving abilities that build upon prior academic preparation. The result reinforces the importance of strengthening secondary education and providing academic transition programs for students entering higher education.

Study habits and class attendance also demonstrated significant positive effects on academic performance. Students who devoted more time to independent study and attended classes regularly achieved higher GPAs than those with irregular attendance or limited study engagement. Regular classroom participation exposes students to instructor explanations, peer discussions, and opportunities for immediate feedback, while independent study reinforces conceptual understanding and problem-solving skills. These findings support educational theories emphasizing

active learning and continuous academic engagement as essential components of student success.

Learning motivation was another important determinant identified in this study. Motivated students are generally more likely to establish effective learning strategies, manage their time efficiently, and persist through academic challenges. The positive association between motivation and academic achievement highlights the importance of fostering supportive learning environments that encourage curiosity, self-directed learning, and academic confidence. Universities can strengthen student motivation through mentoring programs, academic advising, interactive teaching approaches [40], and continuous formative assessment.

Socioeconomic status also contributed significantly to academic performance, although its influence was smaller than that of previous academic achievement and learning behaviors. Students from higher-income families generally demonstrated better academic outcomes, potentially because they had greater access to educational resources, technology, stable learning environments, and supplementary academic support. However, the modest effect size indicates that socioeconomic disadvantage does not inevitably determine educational outcomes. Appropriate institutional interventions, including financial assistance, tutoring services, and equitable access to learning resources, can substantially reduce these disparities.

Collectively, the regression model explained a substantial proportion of the variation in academic performance, indicating that academic success results from the interaction of multiple educational, behavioral, and socioeconomic factors. The findings emphasize that universities should adopt comprehensive strategies addressing both academic preparedness and student support rather than focusing solely on demographic characteristics. Programs designed to improve attendance, strengthen study skills, enhance motivation, and provide targeted academic assistance may produce greater improvements in student achievement than interventions directed exclusively at gender or ethnic differences.

Despite the valuable insights provided by this study, several limitations should be acknowledged. The cross-sectional research design limits the ability to establish causal relationships among the variables. Academic performance was measured at a single point in time, and some explanatory variables relied on self-reported information, which may introduce reporting bias. Additionally, the study focused exclusively on undergraduate economics students, which may limit the generalizability of the findings to other academic disciplines or educational contexts. Future research should employ longitudinal designs, incorporate broader institutional samples, and explore additional factors such as psychological well-being, digital learning environments, artificial intelligence-assisted education, and instructional quality

to provide a more comprehensive understanding of academic achievement [41].

The contribute to the growing literature on educational achievement by demonstrating that while gender and ethnicity are associated with differences in academic performance, these differences are largely influenced by broader educational, behavioral, and socioeconomic factors. Promoting equitable access to quality education [42,43], strengthening academic engagement, and providing effective institutional support remain essential strategies for improving student success in economics education across diverse populations.

Conclusion

This study investigated the determinants of academic performance in economics education by comparatively examining gender and ethnic achievement patterns among undergraduate students. The findings indicate that although statistically significant differences exist across gender and ethnic groups, academic performance is primarily influenced by educational and behavioral factors, including previous academic achievement, class attendance, study habits, learning motivation, and institutional support. Previous academic performance emerged as the strongest predictor of success, while socioeconomic background also contributed to achievement differences, albeit to a lesser extent. These results suggest that demographic disparities in academic outcomes can be substantially reduced through equitable access to educational resources, effective teaching practices, targeted academic support, and interventions that foster student engagement and motivation. Overall, the study highlights that improving learning environments and strengthening academic support systems are more effective strategies for enhancing student performance than focusing solely on demographic characteristics. Despite limitations associated with its cross-sectional design and reliance on self-reported data, the research provides valuable evidence for educators, policymakers, and higher education institutions seeking to promote educational equity and improve student achievement in economics education, while also providing a foundation for future longitudinal and multi-institutional research exploring additional academic, technological, and psychosocial determinants of student success.

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