# An Econometric Analysis of CGPA and Its Determinants: A case study of International Islamic University Islamabad, Pakistan

Sayed Alamgir Shah
Department of Statistics
International Islamic University Islamabad, Pakistan

## ABSTRACT

This study aims to model the CGPA of undergraduate students at International Islamic University Islamabad, Pakistan, and to examine the factors associated with academic performance. A stratified random sampling technique was employed to select students from the population, with academic departments treated as strata. 108 undergraduate students were selected for data collection. Multiple Linear Regression (MLR) was used to model CGPA and its associated factors. The results of the MLR analysis indicate that SSC obtained marks; parents' education, parental support, and students' attention in class are significantly associated with students' CGPA. From a policy perspective, the findings suggest several recommendations for teachers, parents, and university administration. Teachers and administration should emphasize improving students' attention in the classroom. Instructors are encouraged to deliver engaging and informative lectures to maintain students' attentiveness, while the administration should ensure that classrooms are well equipped with necessary facilities. Parents should provide moral and financial support and actively contribute to their children's overall development. Additionally, teachers and university administration should offer extra guidance to students whose parents are illiterate, as these students might require additional academic support. Finally, parents should encourage strong academic performance in earlier educational stages to enhance students' success at the university level. This study may be extended to other universities using larger sample sizes. Future research may also incorporate additional factors such as teaching quality, learning environment, and the role of university administration.

## 1. Introduction

Academic success or performance determines how much which determines whether a student, teacher, or organization has met their short- or long-term educational goals and how it is measured Continual evaluation or cumulative grade point average (CGPA) are two such methods (Talib & Sansgiry, 2012). In addition, students with good academic performance have higher incomes, and better work benefits (Tentama & Abdillah, 2019). Moreover, student having high grade are more likely to have greater levels of self-confidence, self-esteem and socially inclined (Regier, 2011). According to a study, growing percentage of students still do not graduate on time, which may indicate that they did not perform as expected (Ab Razak et al., 2019).

Education is necessary for accurate information interpretation since it advances knowledge. An educated individual is more aware of their own and others' rights and roles in society. As a result, there are less conflicts and greater disputes-tolerance for diversity. Academic achievement is one of the major factors considered by employers in achievement of workers especially for fresh graduates (Khan, Gul, & Zeb, 2023). Proper education improves people's understanding of the world around them, making them less susceptible to the influence of others. While also meeting the requirements of the employer, prepare for future career options. Whether a student is able to acquire a teaching position or continues their education at a different university for a higher degree depends on their academic performance at the University. At the basic and secondary school levels,

students' performance also affects the quality of education that potential teachers will impart to them (Zahid Khan & Irfan, 2021).

Proficiency in the English language is one of the most important factors contributing to students' academic performance (Kochhar, 2000). Socioeconomic determinants influencing students' academic achievement include classroom participation, family income, teacher–student ratio, and the availability of qualified teachers for both male and female students. Student performance is also significantly associated with peer effects (Giuliodori, Lujan, & DiCarlo, 2006; Gonzales, Cauce, Friedman, & Mason, 1996; Hanushek, Kain, Markman, & Rivkin, 2003). Goethals (2001) reports that students in homogeneous groups tend to perform better academically than those in heterogeneous groups. Several studies have examined students' academic performance, Satisfaction, and teacher-related factors, particularly in relation to job satisfaction among teachers (Khan, Azeem, & Hussain, 2022; Khan, Haq, & Ali, 2022; Khan, Hussain, & Ijaz, 2022).

In the present study, the CGPA of undergraduate students at International Islamic University Islamabad is modeled along with its associated factors. The primary objective of this modeling is to identify the most significant determinants of academic performance among undergraduate students at the university. Identifying these key factors may assist students and university administration in developing strategies to enhance students' CGPA.

## 2. Literature Review

Noble, Roberts, and Sawyer (2006) investigated perception of students, familiarizing approaches, their academic activities, and background are connected to indirectly their obtained CGPA in university level. Abdullah (2011) found that students who have good and appropriate communication skills expand the students 'good academic performance. Khan (2019) identified significant factors related to academic performance of students, which are; examination system, family size, audio visual aid, in classroom and living status of students.

Zahid Khan and Irfan (2021) examined study habits and their relationship with students' academic performance, finding that note-taking and revising classroom materials have a significant positive effect on academic outcomes. Similarly, Khan et al. (2023) reported a strong positive correlation between students' cognitive engagement and both academic success and productivity.

Abou Naaj, Mehdi, Mohamed, and Nachouki (2023) identified course category, student attendance, and mode of course delivery as key determinants of academic performance. Their findings indicate that a hybrid mode of instruction has a more favorable impact on academic outcomes compared to fully online or face-to-face delivery methods.

Hasan, Ahmad, and Razak (2017) investigated factors influencing university students' CGPA  and revealed that students' attitudes toward courses, self-motivation, and the teaching–learning process are significantly associated with CGPA. Tabassum, Dewan, Shuchi, and Toufique (2022) analyzed factors affecting classroom attendance and academic performance using survey data collected from four universities. Employing multiple regression analysis, their study provided strong empirical evidence supporting the positive effect of class attendance on students' academic performance.

Zulauf and Gortner (1999) applied recursive regression analysis to examine the effects of study time and time management on academic achievement among Ohio State University students.

Their results demonstrated a positive relationship between these factors and the quarterly CGPA of 93 students enrolled in agricultural economics courses. Furthermore, Chen and Lin

(2008) conducted a randomized experiment involving college students to assess the impact of attendance on examination performance. Their findings revealed that higher attendance rates significantly and positively influence academic performance, with students who regularly attended lectures experiencing an increase of approximately 9.4% to 18.0% in exam scores.

# 3. Methodology

**Stratified Random Sampling**
Stratified random sampling is probability sampling, which divides a population into several subgroups called strata, depending on some similar characteristic of sampling units. To ensure that each stratum is included in the sample and to draw conclusions about particular demographic subgroups, stratification is done. This method is useful when the population is heterogeneous and a straightforward random sample might not yield reliable results (Singh & Mangat, 2013).
Multiple Linear Regression Model The goal of multiple linear regression is to model the linear relation between more than one independent variable and dependent variables (Gujarati, 2004). For the multiple linear regression model, the mathematical form is given as:

$$Y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_{3+\ldots} + \beta_p x_p + \epsilon$$

Where n = number of observations $Y_i$ = independent variables
$X_i$ = explanatory variables
$\beta_0$ = y-intercept
$\beta_1$ = slope coefficient for each explanatory variables
$\epsilon$ = the model error terms

To fit a linear regression model, a linear relationship must exist between the dependent variable and the independent variables. If the relationship is not initially linear, the data may be transformed to achieve linearity. Common transformations include taking the logarithm or square root of the response variable. The most effective and straightforward method for assessing linearity is through scatterplots, in which the response variable is plotted against each independent variable. These plots help determine whether the relationship is linear or curvilinear. If linearity is not evident, appropriate data transformations should be applied.
The dependent variable of the present study is CGPA of students, which is, continues, therefore, multiple linear regression model is suitable for modelling of CGPA with its associated factors.

**Ordinary Least Square (OLS) Method**
The Ordinary Least Square (OLS) method is widely employed in regression analysis because it is more theoretically straightforward and intuitively appealing than the method of maximum likelihood. In addition, as we will see in a moment, the outcomes of the two approaches in the context of linear regression are typically comparable (Gujarati, 2004).
Under certain assumptions, the OLS method has some very attractive statistical properties that have made it one of the most powerful and popular methods of regression analysis. The least-squares estimates have certain ideal or optimum properties when fulfilling the standard linear regression model's underlying assumptions. The least-square estimates is linear function of response variable in the linear regression model. In addition, least-square estimates are unbiased,

In addition, has minimum variance in the class of all such linear unbiased estimators; an unbiased estimator with the least variance is known as an efficient estimator (Gujarati, 2004).

**Multicollinearity**

Multicollinearity is the linear relationship among two or more predictor variables in the multiple linear regression model. Due to this linear relationship, standard error of the coefficients increases which makes problem in testing significance of parameters (Gujarati, 2004; Johnston & DiNardo, 1963). Therefore, one of the vital assumptions of linear regression model is no linear relationship among independent variables that in the model those variables must be included that are not exact linear function of one or more variable in the model. Variance Inflating Factor (VIF) is one of the methods used for detection of multicollinearity in regression model.

The VIF is define as,

$$VIF = \frac{1}{1 - r^2 ij} \qquad (2)$$

Due to multicollinearity in regression model, the variance of an estimator is inflated, the extent of which is measure by VIF. As in equation (2), the closer the value of $r^2 ij$ to 1 the VIF tend to Infinity. That is, higher the multicollinearity results the higher variance of an estimator leads to infinite VIF. In case of no multicollinearity between predictor variables $X_i$ and $X_j$, VIF approaches 1.

**Autocorrelation**

One definition of the term "autocorrelation" is "correlation between members of series of observations ordered in time [as in time series data] ". The basic linear regression model in the context of regression assumes the absence of such autocorrelation in the disturbances. The disturbance term associated with any given observation is unaffected by the disturbance term associated with any other observation, according to the classical paradigm (Gujarati, 2004).

In a multiple linear regression model, the autocorrelation is found using the Durban Watson test. It calculates the 'd' statistics for the Durban Watson test. The upper and lower critical values, $d_U$ and $d_L$, for various values of k (the number of explanatory variables) and n have been tabulated.

## 4. Results and Discussion

Total of 108 students consisting 63 (58.3%) male and 45(41.7%) female students are randomly identified from the International Islamic University Islamabad. Various characteristics of selected students are presented in Table 1. The Table shows that out of 108 students, 47(43.53%) are selected from age 18 to 20, 53(49.075%) from age 21 to 22, 8 (7.40%) from age 23 and above. According to Table 1, 4(3.07%) students get 40 to 60 percent marks in HSSC examination. Moreover, 78 (72.22%) obtained 60 to 80 percent marks, 26(24.07%) achieved more than 80 percent marks in the examination.

The Table also shows the SSC obtained marks of the students. Five (4.63%) obtained 40 to 60 percent marks, 69(63.9%) achieved 60 to 80 percent marks, 34 (31.48%) get above then 80.

The Table further reveals the level of education of students' parents. Parents having ten years education are 73(67.60%), 24(22.23%) parents have studied 12 years, and 11(10.19%) parents get 16 years education. The Table also revealed that most of the students' parents have low income, that is, approximately 77 percent have below Rs. 60 thousand incomes.

Moreover, most of the students 96 (88.89%) are financially supported by their parents. The Table also shows number of family members of students, 6(5.56%) of the students have 2 to 4 family members, 30 (27.78%) of respondents have 5 to 7 family members, while 72 (66.67%) sample have more than 7 family members in their house.

Table 2 shows the CGPA of the selected students of International Islamic University Islamabad. According to this Table, 2 (1.85%) students obtained 2.50-2.80 CGPA, 9 (8.33%) obtained 2.81-3.10 CGPA, 33(30.56%) obtained 3.11-3.40 CGPA, 51(47.22%) obtained 3.41-3.70 CGPA,13(12.05%) obtained 3.71-4.00 CGPA. Approximately half students obtained 3.41-3.70 CGPA, which shows satisfactory performance. The Table further reveals the obtained CGPA gender wise.

Table 1: Characteristic of selected Students

| Characteristic | Group | Number | Percentage (%) | Cumulative Percentage (%) |
|---|---|---|---|---|
| **Gender** | Male | 63 | 58.3 | 58.3 |
| | Female | 45 | 41.7 | 100 |
| **Age (Years)** | 18–20 | 47 | 43.53 | 43.53 |
| | 21–22 | 53 | 49.07 | 92.60 |
| | Above 22 | 8 | 7.40 | 100 |
| **HSSC Marks (%)** | 40–60 | 4 | 3.07 | 3.07 |
| | 60–80 | 78 | 72.22 | 75.29 |
| | Above 80 | 26 | 24.07 | 100 |
| **SSC Marks (%)** | 40–60 | 5 | 4.63 | 4.63 |
| | 60–80 | 69 | 63.89 | 68.52 |
| | Above 80 | 34 | 31.48 | 100 |
| **Parents' Education** | Matric | 73 | 67.60 | 67.60 |
| | Intermediate | 24 | 22.23 | 89.81 |
| | Master | 11 | 10.19 | 100 |
| **Father's Income (PKR)** | 10–30 Thousand | 45 | 41.66 | 41.66 |
| | 31–60 Thousand | 38 | 35.35 | 76.34 |
| | Above 60 Thousand | 25 | 23.15 | 100 |
| **Financial Support** | Yes | 96 | 88.89 | 88.89 |
| | No | 12 | 11.11 | 100 |
| **Family Members** | 2–4 | 6 | 5.56 | 5.56 |
| | 5–7 | 30 | 27.78 | 33.44 |
| | Above 7 | 72 | 66.67 | 100 |

Table 2: Obtained CGPA of Students International Islamic University Islamabad

| CGPA Range | Male | Female | Total | Percentage (%) |
|---|---|---|---|---|
| 2.50 – 2.80 | 1 | 1 | 2 | 1.85 |
| 2.81 – 3.10 | 5 | 4 | 9 | 8.33 |
| 3.11 – 3.40 | 25 | 8 | 33 | 30.56 |
| 3.41 – 3.70 | 22 | 29 | 51 | 47.22 |
| 3.71 – 4.00 | 8 | 5 | 13 | 12.04 |
| **Total** | **61** | **47** | **108** | **100** |

## Results of multiple linear regression model
## Durbin-Watson statistic

Autocorrelation in the fitted model is assessed by the Durbin-Watson test. The value of 'd' is equal to 1.82, the Durbin-Watson tabulated values are $d_L$=1.64 and $d_U$=1.68. We found that 4- $d_U$<d<4-$d_U$, thus the test is inconclusive about the autocorrelation in the model.

## Estimated Co-efficient of Multiple Linear Regression Model

The result of multiple linear regression is presented in Table 3. The model shows that HSSC- obtained marks, parents' education of the students, attention in class, and parents' support are significant factors affecting the academic performance of the students of International Islamic University Islamabad. Moreover, the Table shows VIF which shows moderate multicollinearity in SSC marks, parents' education, and attention in class, because their VIF is between 1 to 5. While, the predictor variable, parents' support shows no multicollinearity as VIF<1.

Table 3: Estimated Coefficient of Multiple Linear Regression Model

| Term | Coefficient | Standard Error | t-value | p-value | VIF |
|---|---|---|---|---|---|
| Constant | 1.568 | 0.216 | 7.26 | 0.000 | — |
| Log HSSC Marks | 0.3114 | 0.0707 | 4.41 | 0.000 | 1.02 |
| Parent Education | 0.001751 | 0.0009 | 1.92 | 0.050 | 1.12 |
| Parents' Support | 0.0759 | 0.0543 | 1.40 | 0.160 | 1.07 |
| Attention in Class | 0.1049 | 0.0529 | 1.98 | 0.050 | 2.88 |

## HSSC Obtained Marks

Students who performed well on the early exam performed well on a high level on the final exam. According to our data, students who scored well on the HSSC exam did well on all of their semester exams for university. This result holds true not only for the population of the area but also for the population in our sample. Our outcome agrees with Khan, Hussain, et al. (2022).

### Parents Education

Academic success of the student is greatly influenced by the parents' education. Parents' education includes a lot of love, care, personality development, and instruction for their kids. According to Glad, mothers serve as their children's first teachers.

The findings of this study reveal a significant relationship between parents' educational attainment and students' academic performance. The results indicate that parents' education exerts a substantial influence on their children's academic outcomes. In the multiple regression model, the explanatory variable representing parents' education has an estimated coefficient of 55.781. As this variable is binary in nature, the result implies that students whose mothers are educated score, on average, 55.781 points higher than those whose mothers are illiterate. The effect of this variable is statistically highly significant, suggesting that the observed relationship is also valid at the population level. This finding is consistent with the results reported by Khan, Azeem, et al. (2022).

### Parents' Support

Parental support plays a crucial role in students' academic performance. The findings of this study indicate a positive relationship between parental support and students' academic achievement. This result is consistent with the findings of Shahzad, Abdullah, Fatima, Riaz, and Mehmood (2015), who also reported a significant association between parental support and students' academic performance.

### Attention in Classes

Students' attention during classes is a key determinant of academic performance. The extent to which students effectively apply learned concepts largely depends on their level of focus during the learning process. Learning outcomes are not always fully achieved, particularly when students lack concentration in the classroom. The results of this study suggest that many students do not maintain adequate attention during lectures, which adversely affects their academic performance. This finding is in line with the results reported by Al'Omairi and Al Balushi (2015).

## 5. Conclusion

This study examined the factors associated with the academic performance of students at International Islamic University Islamabad. Academic performance was measured using students' CGPA from their most recent examinations. The findings reveal that academic performance is significantly influenced by four key factors: HSSC grades, parents' education, parental support, and students' attention in class.

The results suggest that improving students' academic performance at the HSSC level can contribute to higher achievement in subsequent academic stages. Students with educated parents tend to achieve higher academic outcomes compared to those whose parents are illiterate.

Therefore, teachers and university administration should place special emphasis on supporting students from less-educated family backgrounds by providing additional academic guidance and examination preparation. Furthermore, the university administration should ensure the availability of well-equipped and high-quality classroom environments to enhance students' learning experiences.

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