

**FACTORS AFFECTING THE ACADEMIC PERFORMANCE OF STUDENTS AT HIGHER
SECONDARY SCHOOL LEVEL IN MALAKAND DISTRICT**

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Abstract

This study examines the factors affecting the students' academic performance at the Malakand district's higher secondary school level employing linear statistical modeling. Many predictors of the individual, parental/household, and institutional characteristics have been experimented. The stepwise regression identified the best subset of the covariates in each category. The model fit results show that past academic performance, study at home, and gender was the best subset of predictors and significantly affect the students' academic performance. Further, the models testify that if a student could not perform well, the school should have attained the college level's tuition facility. Similarly, regarding parental/family and college characteristics, education (especially father), separate room, house-size, labs/library, electricity, and moderately small class size significantly affect the college students' academic performance in the Malakand district, Pakistan.

Keywords: Education; Statistical Modeling; Academic Performance; Students.

INTRODUCTION

Education is a process through which a desirable change in the citizens' overall personality is acquired to contribute to the country's socioeconomics development and their families. In other terms, education is a force that can develop the cognitive, affective, and psychomotor domains of an individual. Education may be divided into various subcategories, such as child education, adult education, technical education, health education, and physical education. In Pakistan, the issue is a low literacy rate and a high dropout from the educational institute. One of the main causes of dropout is poor academic performance. Academic performance is the result of education, and it refers to a student's fulfillment in meeting short or long-term objectives in education. The students' academic performance plays a vital role in delivering the best quality graduates who end up in remarkable pioneers and workforce for the nation (Ali et al., 2009).

The social and economic development of the country is directly related to student academic performance. Students are the future workforce of the nation and responsible for the future development of a country. It is the students' responsibility to strengthen and make their skills perfect throughout the whole academic career.

This paper presents an investigation and analysis of the factors affecting the students' academic performance. Academic achievement represents performance outcomes that indicate the extent to which an individual has achieved particular objectives that have been the focus of activities in instructional conditions, particularly in school and college. On the premise of high academic performance, students get selected to good universities, better courses of study, and inevitably get higher-paying jobs. We measure a student's performance by his/her percentage marks obtained in the Higher Secondary School Certification (HSSC) part-1 examination organized by the Board of Intermediate and Secondary Education (BISE), run by the government authorities. The HSSC is also referred to as Faculties of Science or Arts (F.Sc/FA). In Pakistan, HSSC qualification is also known as an Intermediate course consisting of a two-year program.

The outcome of this study provides valuable information to assist government authorities, policymakers, and parents to develop strategies and identify those factors that would enhance students' academic performance. The study draws the college administration's attention to implement those policies that facilitate the teaching and learning process to improve students' performance. Similarly, the study outcomes may also help parents solve the students' problems. Further, it helps the teachers recognize the students' issues with the teaching and learning process.

LITERATURE REVIEW

The performance of students may be affected by several factors. These factors may be classified into two main categories inside the educational institution and outside of an educational institution: the faculty, commitment, motivation, facilities, curriculum, management, and discipline. Similarly, outside of the institute, the factors are associated with family, parents, and individual student characteristics.

Raychudhuri et al. (2010) showed that attendance, financial stability, parents' education, teacher-student ratios, teachers' qualification, gender, and distance-to-schools significantly affect the students' performance. Similarly, various empirical studies such as Dayiyal et al. (2011), Hijazi & Naqvi (2006), Iqbal & Pervaiz (2014), Mushtaq & Khan (2012), Remali et al. (2013), and Suleman et al. (2012) reported the intrinsic and extrinsic motivation, self-efficacy, student attitude, time management, parent's age, and education, institutional facilities, faculty attitude, guidance, family stress and other social factors such as social media: Facebooking., computer factors, utilization of smartphones, university environment, teachers' personality, personal activities, peer relationship, parent's motivation, and co-curricular activities are important factors that affect students academic performance.

Considine & Zappala(2002) showed that school environment and teachers' characteristics strongly influence students' performance. Likewise, Jabbar et al. (2011) identified some demographic factors on the students' performance. The study reports that students living in rural perform poorly compared to the students in the urban area. Ganyaupfu (2013) investigated that student-teacher interaction during the teaching and learning process is the most effective. Krashen (2013) identified that parents' education played a vital role and argued that students whose parents were educated relatively perform better than those who had illiterate parents.

Moreover, Carbonaro (2005) investigated that three types of effort could significantly affect the students' performance. These are rule-oriented efforts, procedural efforts, and intellectual efforts. Goga et al. (2015) quantitatively found family background and previous academic performance as the most predictive signs of the students' academic performance. Likewise, Haider & Hussain (2014) investigated how teachers' characteristics affect the students' performance. They argued that a teacher's evaluation method, communication skills, and attitude greatly affected students' English,

Chemistry, and Mathematics performance. In addition, Le et al. (2020) concluded that students' motivation, lecturer pedagogy, course organization, learning conditions, and lecturers' knowledge of the content were the factors that affected the students' performance immensely. Santos & Celis (2020), analyzing the institutional factors, argued that the people and infrastructure had a moderate effect. Further, the method of lecture delivery had the highest influence on the students' academic performance. Fajar et al. (2019) suggested that the most contributing factors affecting nursing students' academic performance were teacher factor, student factor, home factor, and school factor. Studies, such as Curcio et al. (2006), Veldi et al. (2005), investigated quality rest on the performance. These research studies show that rest reduction and discontinuity influence learning ability and ultimately decrease academic success. Further, it was exhibited that resting quality, aroused due to tumult, aroused because of the awful dream, feeling tired in the morning, aroused at a youthful hour in the morning, and day-time laziness, all these were affiliated with academic progress. Mulyadi et al. (2016) argued that self-esteem, academic self-efficacy, and better relationships between parents and children played a significant role in the students' learning process. Moreover, they also argued that those parents who teach their children at home or provide tutors result in their children's best academic success.

In literature, the data mining technique is extensively used in educational fields to explore knowledge and predict students' performance. For instance, Hamsa et al. (2016) applied two different approaches in their study: Decision Tree and Fuzzy Algorithm models by using different sets of parameters to predict the students' performance in Bachelor's and Master's Degrees Program. Likewise, Shahiri et al. (2015) used multiple data mining techniques and indicated the important attributes to predict the student's performance.

METHODS AND MATERIALS

The Model

The Linear Regression Model is a statistical technique for investigating and modeling the relationship between a variable of interest, also referred to as the dependent variable, and one or more predictors or explanatory variables (independent variables). Let Y is the response variable (Student's percentage score), and X denotes a vector of predictors (the inputs X_1, X_2, \dots, X_k) that could influence the percentage score. The mathematical form of the model is given by:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k + \epsilon \quad (1)$$

where $\beta_0, \beta_1, \beta_2, \dots, \beta_k$ are the model parameters known as regression coefficient and ϵ is error term also known as disturbance term that is assumed to be normally and independently distributed with constant mean and variance.

Researchers normally collect data for many variables in social science research but desire to build a parsimonious model. The parsimony of the model refers to keep the balance between a too complex and a simple model. In literature, the commonly used method for model selection is the Akaike Information Criterion (AIC) of Sakamoto et al. 1986). The coefficient of determination (R^2) is used to measure the model goodness-of-fit to the data. It measures how the data are close to the fitted regression line. The R^2 is interpreted as the variation explained in the response variable by a linear model.

The Data

Primary data was collected through a questionnaire from a random sample of 476 regular students (Higher Secondary School Level) of Malakand district. A total of thirty-two (Public and Private) educational institutes were available for HSS level students. The sample was collected using a Stratified Random Sampling scheme with a proportional allocation method. The majority of students were registered in the Government Colleges (GCs), 57.4%, followed by the Private Colleges (PCs), 25.4%, and only 17.2% students were from the Government Higher Secondary Schools (GHSS).

In the sample data, most of the students were in the Pre-Medical group (46%) followed by the Pre-Engineering group (21%). Both genders participated; however, the proportion of male students (62%) was higher than that of female students (38%). Table 1 provides the count summary of the different groups (discipline, gender). An approximately 30% of students were living in the joint family system. The average associated family size was 7. The mean age of the father and mother was approximately 50 and 41 years, respectively. In the data, most of the parents were illiterate. For example, only 34% of fathers, while 20% of mothers had completed at least middle (8th Class) qualification. The majority of students had parents with lower financial stability. Most of their parents had a monthly income lower than Rs. 30,000/.

Table 1 Respondent according to gender and discipline wise

Discipline	Count		Percentage	
	Male	Female	Male	Female
<i>Pre- Medical</i>	123	96	25.8%	20.2%
<i>Pre- Engineering</i>	90	11	18.9%	2.3%
<i>General Science</i>	26	6	5.6%	1.3%
<i>Humanities</i>	58	67	12.2%	13.9%
Total	297	180		

RESULTS AND DISCUSSION

Preliminary Analysis

The average performance score was approximately 60% in the data, with a standard deviation (SD) of 11.1. The results show that, on average, the overall students' performance significantly declined in the college compared to the school. For instance, the associated students' matric (Grade-10) average score was 69.2% with SD=10.1. Various factors relevant to the institution, for example, the mode-of-study, may cause such decline; however, examining these factors is beyond this research project's scope. However, future research might be of interest in this regard.

Further, the students' mean age in our sample data was approximately 19 years. About half of the students were using public transportation to access the college/school. Further details regarding the data description of the students' characteristics are provided in Table 2. The t-test results show strong evidence that female students perform significantly better than male students ($t=3.612$, $p=0.000$). Further, those students who had tuition facility had statistically significant ($t=4.177$, $p=0.000$) better performance. Interestingly, the religious tendency of the student also significantly affects academic performance. For example, the mean score of the Hafiz-e-Quran is significantly ($t=2.841$, $p=0.006$) lower by approximately 5% marks. However, there is insufficient evidence to conclude that those studying (part-time) in Madrassa affect their academic study.

Regarding the parental/household characteristics, the preliminary analysis results show that the education of both father and mother of a student play a vital role in the performance of his/her college education. For example, the mean score of the student whose parents were educated is statistically significantly higher than the mean score of the students whose parents are illiterate. Further, the results show that a student's performance is declined substantially if the father has more than one marriage. Moreover, a student having a separate room at home performed better than those who do not have such a facility at home. The mean value, standard error of the mean, the test statistic's value, and p-value for all those predictors whose effects were significant in the preliminary analysis are provided in Table 3.

The preliminary analysis results show that PCs students performed better than the other students. For example, the students' mean performance score from the PCs is approximately 68%, significantly greater than the GCs (56%) and HSSs (57%). The results further show that there is

strong evidence in support of the significant effect of the class size. A student in a class with fewer than 45 students is expected to show better performance ($p=0.003$).

Table 2 Descriptive statistics of students' individual characteristics

S. No	Variables	n	Mean	Std. Deviation	
1	HSSC Part-I score (%)	476	59.5	11.1	
2	Matric Score (%)	476	69.2	10.1	
3.	Age	476	18.8	0.92	
4.	Gender	Female	182	61.8	10.6
		Male	294	58	11.1
5.	Sleeping hours	476	8.04	1.37	
6.	Tuition facility	Yes (=1)	82	64.0	10.81
		No (=0)	394	58.5	10.92
7.	Distance time from home/hostel to college	476	29.61	19.38	
8.	Hafiz-e-Quran	Yes (=1)	54	55.6	10.48
		No (=0)	422	59.9	11.08
Sample size		476			

Table 3 Results of the preliminary analysis, testing the significance of mean differentials

Variable	Description	Mean	Std. Dev	t-value	p-value
1. Father education	Upto middle = 0 (314)	57.3	10.7	-5.987	0.000
	Above middle = 1(162)	63.5	10.6		
2. Father's marriages	Only one = 0 (449)	59.7	0.525	2.273	0.023
	More than one =1(27)	54.8	9.362		
3. Mother education	Upto Middle = 0 (382)	58.4	10.89	-4.070	0.000
	Above middle = 1(94)	63.6	10.95		
4. Separate room for study	No = 0 (243)	57.11	10.57	-4.815	0.000
	Yes = 1(233)	61.9	11.11		

The Model fit results

The effect of Individual characteristics

The full model consisted of the eleven predictors associated with the students' individual characteristics, while in the final best-selected model, there were only three covariates. The descriptions of the predictors are provided in Table 8 (Appendix). The best subset of predictors or

covariates were past performance score, *PPS* (measured as the percentage marks in the SSC examination), *study-hours* (daily average hours study), and *gender* (male=1, female=0). The summary of the model, estimated parameters, and goodness of fit are provided in Table 4.

Table 4 Model fit result summary for covariates associated with the students' individual characteristics

Covariate	Estimates (B)	t-value	p-value
Constant	14.173	5.233	.000
Pps	.638	15.985	.000
Study-hours	.968	4.564	.000
Gender	-2.760	-3.570	.000

R-Square = 0.463 Adjusted R-Square = 0.459 Significant at P < 0.05

The most important predictor in the final model was the previous academic performance (*Pps*) that was found significant and was positively related to current student's performance. Therefore, it was highly recommended that students should work hard during school. The relationship between academic performance in the school and college is depicted in Figure 1. From visual inspection, it can be seen that there exists a positive high degree linear relationship between past and current academic performance. The correlation coefficient was determined as 0.6532

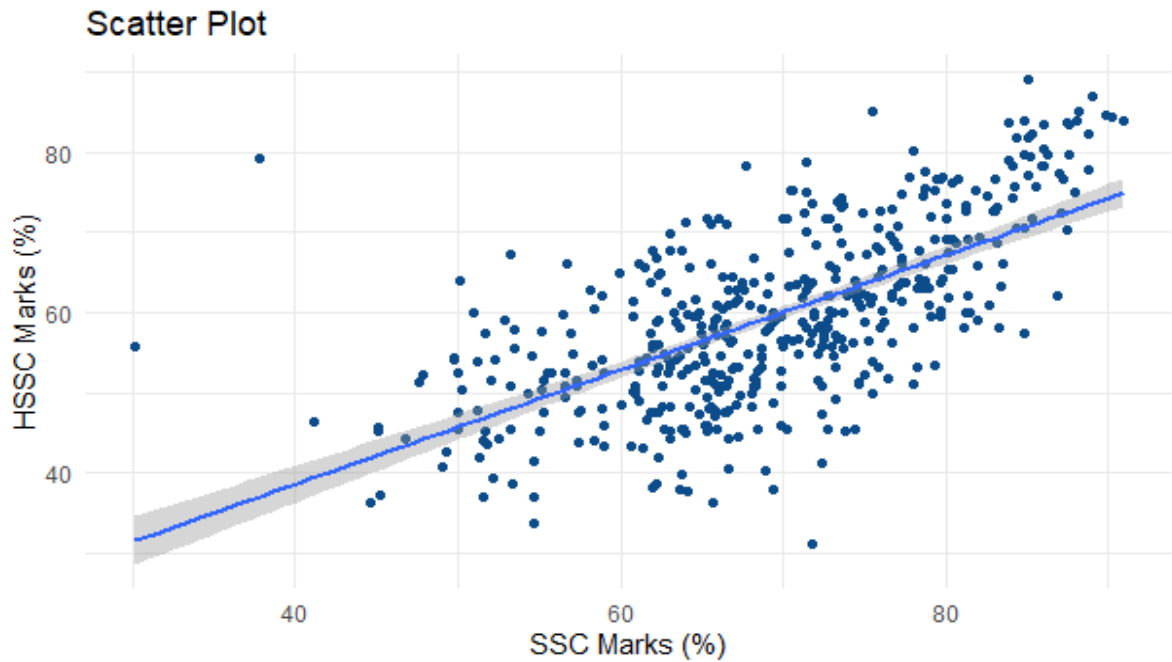


Figure 1 Scatter plot of the HSSC part-I score and SSC percentage score

However, what if a student could not perform well in the SSC examination? We dropped the covariate *PPS* from the full model to identify another predictor and repeat the stepwise regression. Interestingly the *PPS* covariate was replaced by *tuition-facility* and *age*. It is recommended that those students who performed poorly in the SSC examination were suggested to have the tuition-facility. The summary of the alternative best-selected model is provided in Table 5.

Table 5 Summary of the best-selected model after dropping the Pps covariate

Variables	Estimates (B)	t-value	p-value
(Constant)	84.523	8.788	.000
Study hours	1.966	7.925	.000
Gender	-4.082	-4.180	.000
Age	-1.540	-3.014	.003
Tuition facility	3.710	2.888	.004
<i>R-Square = 0.206, Adjusted R-Square = 0.199</i>			<i>Significant at P<0.05</i>

The Effect of Parental/Household characteristics

The stepwise regression results show that *Father-education, separate-room, house-type, and house-size* are the best subset of the covariates among the class of the independent variables, as described in Table 9 (Appendix). Further, the model fit summary is provided in Table 6.

Table 6 Summary of the model with the best subset of covariates (parental characteristics)

Variables	Estimates (B)	t-value	p-value
Constant	52.151	45.638	.000
Father education	4.401	4.331	.000
Separate study room	2.811	2.745	.006
House structure	2.518	2.208	.028
House size	.100	2.275	.023
<i>R-Square = 0.111 Adjusted R-Square = 0.103</i>			<i>Significant at P<0.05</i>

The effect of Institution Characteristics

The model fit results show the library's facilities, electricity, playgrounds, and class size significantly affect the students' performance as these covariates are included in the Stepwise Regression's final step. The results further show that the *library* and *electricity* are positively related to the college students' academic performance while the *playgrounds* and *class size* negatively affect the performance. The summary of the model, including the estimates, goodness of fit, and p-values are provided in Table 7.

Table 7 The summary of the best-selected model using AIC

Variables	Estimates (B)	t-value	p-value
Constant	58.122	31.872	.000
Library	.965	2.487	.013
Electricity	1.386	3.469	.001
Playground	-1.480	-4.504	.000
Class size	-2.250	-2.123	.034
<i>R-Square = 0.084 Adjusted R-Square = 0.076</i>			<i>Significant at P<0.05</i>

CONCLUSION

This paper focuses on identifying and investigating those factors that contribute to the academic performance at the higher secondary school level in the Malakand district. The study addresses several socio-demographic factors affecting the student's performance. The predictors were related to the students' individual, parental/household, and institutional characteristics. Separate models were fitted for using covariates associated with each distinct category. The best subset of the predictors was determined using the stepwise regression.

Regarding the effect of covariates related to individual characteristics, past-performance-score (PPS), average daily study hours, and gender found significant predictors. The results show that a student will be expected to perform well in college if his/her past academic performance at school was good. Further, also those giving more time at home to study may get better results. Interestingly, female students' performance was significantly better than male students' academic performance. Moreover, suppose a student did not perform well at school. In that case, it is suggested to have the tuition facility as the tuition-facility (binary variable) was among the best-selected covariates after dropping the variable PPS from the class of the potential predictors.

Similarly, parental/family characteristics, parents' education (especially father), separate room for study, and house-size were significantly affecting the students' performance at the college level. Finally, the factors associated with the college characteristics were examined. The results show that college students with all facilities, such as labs/library, electricity, and moderately small class size, performed better.

As past performance scores significantly affect student's performance, so it is recommended that parents should support their children in education from an early age for their successful future. Parents should take care of their children and make them habitual of study at home. Extra responsibility at home should be avoided. The availability of a separate room at home significantly affects students' performance. It is recommended that parents should provide a separate room and a peaceful environment for study. The availability of learning facilities at college plays a vital role in students' performance, so it is recommended that the Government should provide an effective learning environment. An overcrowded class badly affects students' performance, so the Government should provide accommodation, physical resources, and teaching staff for improving the teaching and learning process.

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Appendix

Table 8 Covariates relevant to the students' characteristics, experimented in the stepwise regression

S. No	Covariate	Values
1	Previous performance score (PPS)	Percentage of the matric marks
2	Student age	In years (rounded off to nearest integer)
3	Gender	Male = 1, female = 0
4	Sleeping hours	Total no. of sleeping hours day and night
5	Tuition facility	Yes = 1, No = 0
6	Study hours	No. of hours allotted to study at home
7	Distance from home to college	Time taken (in minutes) to reach the college
8	Transport facility	Public transport = 1, others =0
9	Five times Prayer offered	On time =1, qaza =0
10	Quran hefaz	Completed/progress =1, none = 0
11	Religious knowledge	Completed/progress =1, none = 0

Table 9 Covariates relevant to the Parental/Household characteristics experimented in the stepwise regression

S. No	Variable	Description	Values
1	P_1	Joint family	Yes = 1, No = 0
2	P_2	Family size of the student	Number of persons in a family
3	P_3	Students position	Student position among siblings
4	P_4	Father age	Age in years
5	P_5	Father dead	Yes = 1, No = 0
6	P_6	Father no. of marriages	No. of marriages

7	P_7	Father education	(0=illiterate, 1=Primary, 2=Middle, 3=SSC, 4=HSSC, 5=BA/BSc, 6= MA/MSc or above)
8	P_8	Mother age	Age in years
9	P_9	Mother dead	Yes = 1, No = 0
10	P_{10}	Mother education	(0=No education, 1=Primary education, 2=middle, 3=matric, 4=intermediate, 5=graduation, 6= post graduation and above)
11	P_{11}	Relationship between father and mother	Likert scale: 1 (Strongly Disagree) to 5 (Strongly Agree)
12	P_{12}	Students motivation by father and mother towards education	Likert scale: 1 (Strongly Disagree) to 5 (Strongly Agree)
13	P_{13}	Monthly income	(Less than 20000=1), (greater than 20000 and less than 30000=2), (greater than 30000 & above=3)
14	P_{14}	Students residence	(Own Home =1), (others =0)
15	P_{15}	Rooms in house	Number of rooms
16	P_{16}	Separate room for study	Yes=1, No=0
17	P_{17}	House structure	Mud house=0, Concrete=1
18	P_{18}	House size	Size in Marla's