

Best Model Selection for Determinants of Students' Academic Performance at Tertiary Level in Azad Jammu and Kashmir, Pakistan

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Abstract

The presented study is intended to suggest the best model to predict students' academic performance at university level. For this purpose, primary data was collected from 400 undergraduate and graduate students of eight departments of Mirpur University of Science and Technology (MUST), which were selected through stratified random sampling. CGPA is used as an indicator of students' academic performance. Stepwise linear regression is used to select the best model to predict students' academic performance at tertiary level. The final model selected through stepwise regression includes six variables: the student's IQ, ownership of AC, gender, geographic location, self-study hours and ownership of fridge as significant predictors of students' academic performance at tertiary level. IQ, ownership of assets and self-study hours are found to have a positive effect on CGPA while being male and the distance of the household to nearest market are found to have a negative effect on CGPA.

Keywords: *academic performance, model selection, CGPA, socioeconomic status*

1. Introduction

It is an established fact that the future wellbeing of youth depends heavily on their educational achievements (McLanahan & Sandefur, 1994). Educational achievements determine an individual's potential of earning income, his/her

chances in life and wellbeing (Battle and Lewis, 2002). Therefore, it becomes important to understand what determines students' educational outcomes. Academic performance means the success and failure that students face during their study (House, 2002). Academic performance also means students' ability to write and read that they have learnt in the classroom (Kadeghe, 2000). Grade Point Average (GPA) has most frequently been used as the measure of student academic performance. Gupta and Maksay, 2014; Seow et al., 2014; Remali et al., 2013; Mushtaq and Khan, 2012; Applegate and Daly, 2006 used GPA to measure students' academic performance.

In literature, the following variables are extensively used as determinants of academic performance. Laidra et al. (2007) and Jensen (1998) found that intelligence plays a positive role in students' academic achievement. Several studies focused on the role of personality traits as determinants of academic performance. Personality traits are the characteristics which make individuals different from others (Colman, 2003). Ikpi et al. (2014) found that agreeableness and conscientiousness play a significant role in students' academic achievement. McCrae and Costa (1988) also found that students who had scored low on agreeableness performed poorly in their academic subjects. Richardson and Abraham, 2009; Laidra et al., 2007 used the Five-Factor Model (FFM) and found significant effects of personality traits on academic performance.

Another strand of studies emphasized demographic characteristics as determinants of academic performance. Cole and Espinoza (2008) and Jaeger and Eagan (2007) found that gender significantly affects students' academic performance. Similar results were obtained by Kara et al. (2009); Alfani & Othman (2005). Kekule et al. (2017), too, found that girls have more curiosity. Keith, et al. (2006) and Krause (2005) found age to be positively associated with academic performance. However, Kaur et al. (2010) found that age is an insignificant variable in explaining students' academic performance. Considine and Zappala (2002) found geographic location to significantly explain students' academic performance. However, Ali et al. (2013) did not find any significant effect of geographic location on students' academic performance.

Parental characteristics are another set of determining factors of academic performance. Enweriji et al. (2017) found a significant role of parental involvement in children's academic performance. Kassim et al. (2011) found that the level of parents' education plays a significantly positive role. Hijazi and Naqvi (2006) and Zhan (2005) also found positive effects of mothers' education on students' academic performance. Hijazi and Naqvi (2006), however, found a negative effect of income on students' academic performance, whereas Grinstein-Weiss

et al. (2009) found that income does not play any role in determining students' academic performance.

Extensive research has been carried out on the impact of family socioeconomic status on students' academic achievements. Ali et al. (2013) found that family socioeconomic status significantly affects student academic performance. Akhtar (2012); Raychauduri et al. (2010); Considine and Zappala (2002) also found a positive impact of socioeconomic status on students' performance.

The study aimed to select an econometric model to find out which of the above-mentioned variables are best predictors of student academic performance at Mirpur University of Science and Technology (MUST), AJ&K, Pakistan. CGPA (Cumulative Grade Point Average) is used as a yardstick to examine students' academic performance. A variety of variables related to students' personal and demographic characteristics and family socioeconomic status were used, which were most frequently used in literature. We used stepwise regression analysis to find the best model for predicting students' academic performance. It was found that students' IQ, ownership of household assets (AC and fridge), and self-study hours positively affect students' CGPA at university, whereas being male and the distance to nearest market negatively affect students' CGPA. Our findings reveal what policies and strategies should be employed to improve the academic performance of the students at university level.

2. Material And Methods

2.1 Data

Stratified random sampling technique was used to collect primary data from a total of 410 students (205 from undergraduate and graduate degree programs) from Mirpur University of Science and Technology (MUST), Mirpur, AJK, Pakistan.

2.2 Selected Variables

To select the best model that predicts students' academic performance, a pool of variables was created based on our discussion in section 1. The selected variables are presented in Table 1.

Table 1. Selected Variables

Category	Variable	Measurement	Literature
Dependent Variable	CGPA	0 to 4 (0= Lowest, 4= Highest)	Applegate and Daly, 2006; Abdullah, 2005
Explanatory Variables	Gender	Binary (0= Female, 1= Male)	Ali et al., 2013; Cole and Espinoza, 2008; Jaeger and Eagan, 2007
	Type of school (previously attended)	Binary (0= Government, 1= Private)	Ali et al., 2013 and Considine and Zappala, 2002
	IQ	Marks in previous degree (0% to 100%)	Mudasir and Yatu, 2013; Zax and Raees, 2006
	Self-Study Hours (weekly)	Scale	Gupta and Maksay, 2014; and Ali et al., 2013
	Mothers' Education (Years)	Scale	Hijazi & Naqvi, 2006
	Income (Annual)	Scale	Ali et al., 2013; and Hijazi and Naqvi, 2006
	Geographical location	Distance to nearest market (KM) Scale	Ali et al., 2013; and Considine and Zappala, 2002
	Household Assets	Binary	Grinstein-Weiss et al., 2009;
	i)Air Conditioners (AC) ii)Fridge iii)No rooms in house	(0= No, 1= Yes)	Page-Adams & Sherraden, 1997

2.3 Best Model Selection

Following Hassan et al. (2016), Chin and Fitrianto (2013) and Nasir (2012), Stepwise Regression Method was used for selecting the best model for the present study. Stepwise regression is a method in which entry or deletion of regressors is carried out automatically based on some predetermined criteria. These criteria can be the values of: F-statistic, t-statistic, Adjusted R², Akaike information criteria (AIC), Bayesian information criteria (BIC), Mallows's C_p or false discovery rate, etc. Stepwise regression ensures that the best regressors stay in a model and all redundant regressors are dropped out from it (Draper and Smith, 2003). The variables shown in Table 1 are used for this purpose.

3. Results And Discussion

3.1 Descriptive Statistics

Table 2 presents the students' mean CGPA by their characteristics. The results show that the mean CGPA of the female students is higher than that of the male ones (3.30 compared to 3.19). Alfani and Othman (2005); Considine and Zappala (2002) obtained similar results. However, Nyikahadzoi et al. (2013); Kara et al. (2009) found that male students outperform female ones. The students who previously attended public schools were found to perform poorly compared to their counterparts who previously attended private schools (with average CGPA of 3.17 compared to 3.30).

Table 2. Mean CGPA of Students by Various Characteristics

Variable		Mean CGPA	SD	N
Gender	Male	3.19	0.383	139
	Female	3.30	0.417	261
Type of School	Private	3.30	0.401	279
	Govt.	3.17	0.414	121
AC	No	3.19	0.398	255
	Yes	3.39	0.394	145
Fridge	No	3.01	0.471	15
	Yes	3.27	0.403	385
No Rooms in house	2-3	2.77	0.440	47
	4-5	3.24	0.439	166
	6-8	3.29	0.371	144
	9-11	3.33	0.382	31
	12-14	3.41	0.319	12
IQ	40.00-50.00	3.10	0.411	42
	50.10-60.00	3.15	0.401	140
	60.01-70.00	3.30	0.412	116
	70.01-80.00	3.41	0.410	68
	80.01-90.00	3.51	0.414	34
Self-Study Hours (Weekly)	1-3	3.23	0.409	119
	4-6	3.30	0.410	130
	7-10	3.17	0.411	64
	11-30	3.34	0.411	87

Variable		Mean CGPA	SD	N
Mother's Education (Years)	0-4	3.24	0.409	136
	5-9	3.24	0.410	101
	10-14	3.31	0.410	142
	15-16	3.24	0.410	21
Income (Annual)	0-300000	3.25	0.409	102
	300001-500000	3.28	0.411	125
	500001-800000	3.22	0.410	101
	800001-2400000	3.33	0.410	72
Geographic loca- tion(Distance to near- est market in KM)	0-1	3.32	0.409	121
	1.1-3	3.25	0.410	129
	3.1-5	3.26	0.412	57
	5.1-30	3.22	0.410	88

The students from the households with AC have substantially higher average CGPA than those from the households without AC (3.39 compared to 3.19). Similar results were obtained for the ownership of fridge. Another important measure of household economic status, i.e., the size of family house as measured by the number of rooms in the house, was also found to be positively correlated with CGPA. Grinstein-Weiss et al. (2009) found a positive impact of socioeconomic status on students' academic performance.

The students' intelligence was found to have the most profound and visible effect on their academic performance at university. The students with higher IQ were found to perform better at university. The positive impact of intelligence on students' academic performance was also found by Laidra et al. (2007); and Jensen (1998). The students' mean CGPA was also found to increase with an increase in their self-study hours. These results are in accordance with the results of Gupta and Maksy (2014) and Ali et al. (2013).

Contrary to what was expected, mothers' education was not found to have any significant effect on the students' academic performance. Hijazi and Naqvi (2006), on the other hand, found positive effects of mothers' education on students' academic performance. Income was not found to play any significant role in determining students' academic performance. Grinstein-Weiss et al. (2009) also found an insignificant effect of income on students' academic performance. However, Ali et al. (2013) and Akhtar (2012) found a positive effect of income on students' academic performance, whereas Hijazi and Naqvi (2006) found a negative effect of income on students' academic performance.

Distance to market (measure of geographic location) was found to have a negative impact on students' mean CGPA. Considine and Zappala, (2002) also found a positive impact of living in urban areas on students' performance. Ali et al. (2013), however, found that living in an urban area does not have any significant effect on students' academic performance.

3.2 Best Model for Determinants of Students' Academic Performance

Results of stepwise regression are presented in Table 3.

Table 3. Best Model for Students' Academic Performance

Model B		Unstandardized Coefficients		Sig. Tolerance	Collinearity Statistics	
		SE			VIF	
1	(Constant)	2.47	0.12	0.00		
	IQ	0.01	0.00	0.00	1.00	1.00
2	(Constant)	2.45	0.11	0.00		
	IQ	0.01	0.00	0.00	0.99	1.01
	AC	0.18	0.04	0.00	0.99	1.01
3	(Constant)	2.40	0.11	0.00		
	IQ	0.01	0.00	0.00	0.95	1.06
	AC	0.19	0.04	0.00	0.99	1.01
	Gender	-0.19	0.04	0.00	0.95	1.05
4	(Constant)	2.45	0.11	0.00		
	IQ	0.01	0.00	0.00	0.94	1.06
	AC	0.20	0.04	0.00	0.99	1.01
	Gender	-0.18	0.04	0.00	0.94	1.07
	Geographic location	-0.01	0.00	0.01	0.98	1.02
5	(Constant)	2.40	0.12	0.00		
	IQ	0.01	0.00	0.00	0.94	1.07
	AC	0.20	0.04	0.00	0.99	1.01
	Gender	-0.18	0.04	0.00	0.94	1.07
	Geographic location	-0.01	0.00	0.01	0.98	1.02
	Self-Study Hours	0.01	0.00	0.03	0.99	1.01

Model B	Unstandardized Coefficients		Sig. Tolerance	Collinearity Statistics	
	SE			VIF	
(Constant)	2.20	0.15	0.00		
IQ	0.01	0.00	0.00	0.94	1.07
AC	0.19	0.04	0.00	0.98	1.02
6 Gender	-0.17	0.04	0.00	0.89	1.12
Geographic loca- tion	-0.01	0.00	0.01	0.97	1.03
Self-Study Hours	0.01	0.00	0.03	0.99	1.01
Fridge	0.21	0.10	0.03	0.94	1.06

Variables Excluded:

Model 01: Gender, School, AC, Fridge, Rooms, Self-study hours, Mothers' Education, Income, Geographic Location

Model 02: Gender, School, Fridge, Rooms, Self-study hours, Mothers' Education, Income, Geographic Location

Model 03: School, Fridge, Rooms, Self-study hours, Mothers' Education, Income, Geographic Location

Model 04: School, Fridge, Rooms, Self-study hours, Mothers' Education, Income

Model 05: School, Fridge, Rooms, Mothers' Education, Income

Model 06: School, Rooms, Mothers' Education, Income

Table 3 presents the results of stepwise regression conducted to select the best model for the determinants of students' academic performance at university. The students' IQ was found to be the most important predictor of their academic performance at university and therefore it was the first to enter the model. Laidra et al. (2007) also found that students' IQ is the most important predictor of students' academic performance. Ownership of AC was found the second most important predictor of the students' academic performance at university and therefore it was the second to enter the model, along with IQ. This entry of AC, an asset, in the second place implies that households assets play a pivotal role in students' academic performance even at tertiary level. The role of gender in determination of the students' academic performance was found the third most important predictor of their academic performance, so it was the third to enter the model.

Geographic location as measured by distance to market was found to be the fourth important variable to determine the students' academic performance. Self-study hours and ownership of fridge entered the model. So, in the final model, IQ, AC, Gender, Geographic Location, Self-Study Hours, and Ownership of Fridge are included. According to stepwise regression, the above-mentioned six variables are the most important predictors of the students' academic performance. Among the

six selected variables, in the final model three of them (AC, Geographic Location, fridge) measure the economic wellbeing of households. This shows the importance of parental wealth and family resources in determination of the students' academic performance. Four variables, i.e., type of school previously attended, number of rooms in house, mothers' education and income are insignificant variables in determining the students' academic performance. Since the values of VIF (variance inflation factors) are too low, there is no problem of multicollinearity in our data.

Thus, based on stepwise regression analysis, the study presents the following model;

$$CGPA = 2.20 + 0.01IQ + 0.19AC - 0.17Gender - 0.01Geographic Location + 0.01Self Study Hour + 0.21 Fridge \quad (3.1)$$

The results of the final selected model show that the students' IQ positively affects their CGPA at university. The student's CGPA increases by 0.1 when the student's IQ increases by 1. Ownership of AC also positively affects the students' CGPA. The students' CGPA increases by 0.19 points if there is AC in their household. The students' gender of also affects their academic performance. Being male negatively affects CGPA by 0.17. Location of the students' household was also found to affect the students' academic performance. As distance of the household increases by one kilometer to the nearest market, CGPA reduces by 0.01. The students' CGPA was also found to be positively affected by how much time they devote to their self-study at home. A one-hour increase of self-study a week caused CGPA to increase by 0.01. Ownership of fridge, another measure of household wealth, was found to positively affect the students' CGPA. The students from the households owning a fridge have a higher CGPA by 0.21.

4. Conclusion and Policy Suggestions

The presented study was intended to suggest the best model to predict students' academic performance at the tertiary level of education. CGPA was used as the indicator of students' academic performance. A pool of variables, related to family socioeconomic status, the students' personality traits and demographic characteristics, was created, which was most frequently used in previous studies. Then stepwise regression was used to find the best model for predicting the students' academic performance. It was found that the students' IQ, ownership of household

assets (AC and fridge), and self-study hours positively affected the students' CGPA at university, while being male and distance to nearest market negatively affect the students' CGPA.

Ownership of household assets was found to positively affect the students' academic performance. Therefore, it is suggested that policies which encourage assets accumulation by households be adopted. These will be beneficial for students' academic performance in the long run. Students should be encouraged to devote more hours to self-study.

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