

# Binary Logistic Regression Analysis in Assessment and Identifying Factors That Influence Students' Academic Achievement: The Case of College of Natural and Computational Science, Wolaita Sodo University, Ethiopia

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**ABSTRACT:** Education in higher institution can be influenced by some many factors these variables are inside and outside school that affect students' quality of academic achievement or academic performance. These factors may be termed as student factors, family factors, school factors and peer factors. In our case we tried to assess and identify students' academic achievement in their university stay. The main objective of this study is to assess and identify the major factors which influence the academic achievement of students at College of Natural and Computational Science of Wolaita Sodo University (WSU). Out of 1,497 students a sample of 316 students of was taken from nine departments of College of Natural and Computational Science of Wolaita Sodo University using stratified random sampling with proportional allocation to size of department. Both secondary a well as primary sources of data were used through student filled questionnaire. The result of the binary logistic regression analysis revealed that study time, good life later on, arranging study outside class, father's education level, peer influence, amount of money received from family and securing student first choice of department have a significant relation with student academic achievement at 5% level of significance. It can be concluded that to increase and improve students' academic achievement of students some step for securing student first choice of department and counseling as well as guiding about peer influence in university stay should be taken into consideration. It can be recommended that the stalk holders should set programs to strength self-concept to make them confident on their potential.

**Key words:** academic achievement, binary logistic regression analysis, good life later on, peer influence, securing first choice of department, Wolaita Sodo University

## INTRODUCTION

Education is one of the most important factors in producing human resource that is necessary for economic development of a country. Education, in a broad sense, is any act or experience that has a formative effect on mind, character or physical ability of an individual. The role of education plays and contributes to intellectual growth and development of society which becomes the common concern in both developed and developing countries (Hanushek, 2006). The quality of educational system of any country may reflect the development attempts to be made in social, economic and political aspects. Furthermore, in this era of globalization and technological revolution, education is considered as a first step for every human activity. It plays a vital role in the development of human capital and is linked with an individual's well-being and opportunities for better living (Battle & Lewis, 2002).

Schools, colleges and universities have no worth without students. Students are most essential asset for any educational institute. The social and economic development of a country is directly linked with student academic performance. Student academic performance measurement has received considerable attention in previous research, it is challenging aspects of academic literature, and science student performance are affected due to social, psychological, economic, environmental and personal factors. These factors strongly influence on the student performance, but these factors vary from person to person and country to country. Indeed, academic performance can be influenced by some many factors these variables are inside and outside school that affect

students' quality of academic achievement. These factors may be termed as student factors, family factors, school factors and peer factors (Crosnoe, Johnson & Elder, 2004).

It is assumed that the number of determinants or factors other than university entrance result may significantly affect the academic performance of students in universities. The factors might be the type and location of secondary school attended, type of admission, quality of teaching, life in university, study habit, economic and educational background of parents, references and textbook availability in a university, students placement by their first choice etc. In our study, we take GPA of students can measure student academic performance. This idea supported by (Hijaz & Naqvi, 2006) stated that GPA in university is commonly used indicator of student academic performance.

Therefore, academic performance of students in universities can be measured by using CGPA (Cumulative Grade Point Average) or GPA (Grade Point Average) which is influenced by the above stated factors. Thus, the main objective of the current study was to assess and identify the major factors that influence student academic performance.

## METHODOLOGY

### Description of study area and period

The study was carried out in Wolaita Sodo University in the academic year of 2012/2013. Wolaita Sodo University is one of the higher institutes of education in Ethiopia. It was established on October 2007(1999 E.C) by the government of Ethiopia. It is found in temperate region of South Nationalities and Peoples (SNNP) regional state in Wolaita zone capital town of Sodo. Sodo town is located (54<sup>0</sup>N latitude and 38<sup>0</sup> S longitude) and 396km south of Addis Ababa and 130km from regional town Hawassa. Now the University is operating 3 campuses, 9 colleges and schools and more than 40 departments or programs.

## STUDY DESIGN

The research design was qualitative as well as quantitative research design can be employed.

### Source of population

All college of Natural and Computational Science of Wolaita Sodo University students admitted in the academic year of 2013 were considered as population. The Study Subjects were 316 students those who are randomly selected from the source population were the study subjects of this study.

### Sample Size Determination

The sample size can be determined by employing the following formula with margin of error 5% to obtain a sample size. It is given by:

$$n = \frac{N}{1 + Ne^2}$$

where:

N is total population to be 1,497

n is sample size determined

e is margin of error with 0.05

Based on the above formula, *n* can be calculated as follow:

$$n = \frac{N}{1 + Ne^2} = 316$$

Sampling procedure was a simple random sampling technique was employed to select the departments which is five departments out of nine departments were randomly selected by using lottery method. In order to select the students from the selected departments, stratification on the base of academic years was done and appropriate probability sampling technique were used in all academic year of the department selected on basis of proportional to size as:

$$\frac{N_h}{N} = \frac{n_h}{n} = w_h \text{ (PPS)} \dots \dots \text{proportional to size allocation}$$

where:  $N_h$  is population size in stratum h

$n_h$  is sample size in stratum h

Table 1. Shows Colleges, selected department and number of sampled students

No	College	Department	Population Size	Sample Size
	College of Natural & Comp.Sci	Biology	533	113
		Chemistry	348	73
		Statistics	138	29
		Environ'tal Sci.	200	42
		IT & Comp Sci.	278	59
			= 1,497	= 316

Source: Wolaita Sodo University Registrar 2012/13.

Table 2. Results of Descriptive statistics

Factors		Status		
		Not ok	Ok	Total
Sex	Male	49(16.2%)	128(72.3%)	177(56.1%)
	Female	34(11.5%)	92(30.5%)	126(39.8%)
Place of High school	Urban	60(19.9%)	178(59.1%)	238(79.1%)
	Rural	21(7.0%)	40(13.3%)	61(20.3%)
Age	18-23 years	83(27.8%)	187(62.5%)	270(90.3%)
	≥ 24 years	0(0%)	29(9.7%)	29(9.7%)
Father's edu. Level	Illiterate	20(6.7%)	43(14.3%)	63(21.0%)
	Primary	31(10.3%)	86(28.7%)	117(39.0%)
	Secondary	14(2.7%)	27 (10.3%)	41(13.7%)
	Certificate & above	18(3.0%)	58(10.3%)	76(25.3%)
Mother's edu. Level	Illiterate	25(8.3%)	79(26.2%)	104(34.6%)
	Primary	41(13.6%)	75(24.9%)	116(38.5%)
	Secondary	9(3%)	30(10.0%)	39(13.0%)
	Certificate& above	9(3.0%)	31(10.3%)	40(13.3%)
Good life	Strongly Agree	46(15.2%)	121(39.9%)	167(55.1%)
	Agree	25(8.3%)	75(24.8%)	100(33.1%)
	Neutral	4(1.3%)	13(4.3%)	17(5.6%)
	Disagree	5(1.7%)	5(1.7%)	10(3.3%)
	Strongly disagree	3(1.0%)	4(1.3%)	7(2.3%)
Peer influence	Strongly Agree	19(6.4%)	45(15.2%)	64(21.5%)
	Agree	29(6.4%)	88(29.6%)	117(39.4%)
	Neutral	20(6.7%)	37(12.5%)	57(19.2%)
	Disagree	6(2.0%)	26(8.8%)	32(10.8%)
	Strongly disagree	7(2.4%)	12(4.0%)	19(6.4%)
Study outside class	< 48hrs	81(26.7%)	123(40.6%)	204(67.3%)
	≥ 48hrs	2(0.7%)	97(32.0%)	99(32.7%)
Money received	<1500birr	83(28.3%)	106(36.2%)	189(64.5%)
	≥ 1500birr	0(0%)	104(35.5%)	104(35.5%)
Frustration	Yes	18(6.0%)	53(17.5%)	71(23.5%)
	No	61(20.2%)	163(74.2%)	224(74.2%)
Counseling & guidance	Yes	44(14.5%)	112(37.0%)	156(51.5%)
	No	39(12.9%)	106(35.0%)	145(47.9%)
1 <sup>st</sup> choice dept	Yes	56(18.5%)	152(50.3%)	208(68.9%)
	No	26(8.6%)	63(20.9%)	89(29.5%)

**Variables Identification****Dependent variable**

The dependent variable of this study is "academic performance". For our study purpose the response variable "academic performance" which has two binary outcomes coded 0 if a student is not ok status ( $CGPA < 2.00$ ) and 1 if student ok status ( $CGPA \geq 2.00$ ).

**The Explanatory Variables**

The predictor variables considered in this analysis include age of student, parents' educational background, securing first choice of department, availability of textbooks and references, environmental factor, study habit, place of residence before joining university and others.

**Data Collection Methods**

Both primary as well as secondary data were used the structured questionnaire was prepared for quantitative method, while semi-structured questionnaire was designed for the qualitative method.

**Data Entry and Analysis**

Data entry and cleaning were carried out using statistical software package SPSS version 22.0 for the analysis. Descriptive statistics analysis was used to show the frequency distribution and its results were presented by tables. In order to identify the effect of explanatory variables on the response variable binary logistic regression model (odd ratio) was used.

**RESULTS AND DISCUSSIONS**

From table 1 the median age of students interviewed was 19 years, ranging from age 18 to 23 years. Age group of 18-23 years was the predominant 270(90.3%) study subjects, followed by  $\geq 24$ (9.7%). Regarding their sex, 177(56.1%) of them were males and only 126(39.8%) of them were females during the study period. Regarding place of high school were student came account 238(79.1%) was urban and 61(20.3%) was rural, respectively. Based on table 1, student mother's education level which assumed to be influence on student academic performance account for illiterate 104(34.6%), primary 116(38.5%), secondary 39(13.0%) and followed certificate and above 40(13.3%), respectively. On the same manner, student father's education level assumed to be influence on student academic performance based on the fact that illiterate 63(21.0%), primary 117(39.0%), secondary 41(13.7%) and certificate and above 76(25.3%), respectively.

In this section it is discussed as the model summary, in order to identify factors associated with student academic achievement binary logistic regression model was used. Moreover, the joint impact of all explanatory variables on the response variables will also determine by using the concept of Nagelkerke  $R^2$  which is explained in the model, summary.

Table 3. Model summary

Step	-2 likelihood	Log Cox & Snell R Square	Nagelkerke R Square
1	111.00 <sup>a</sup>	0.261	0.1560

The most common assessment of overall model fit in logistic regression is the likelihood ratio test, which is simply the chi-square difference between the null model (i.e., with the constant only) and the model containing the predictors. Under Model Summary we see that the -2 Log Likelihood statistics is 111.00. This statistic measures how poorly the model predicts the student academic performance in ok status, the smaller the statistic the better the model. The value of Cox & Snell  $R^2$  and Nagelkerke  $R^2$  are good enough. Cox and Snell or Nagelkerke  $R^2$  is an analogous statistic in logistic regression to the coefficient of determination  $R^2$  in linear regression, but not close analogy. The model summary provides some approximation of  $R^2$  statistic in logistic regression. Cox and Snell's  $R^2$  attempts to imitate multiple  $R^2$  based on likelihood. The result of Cox and Snell  $R^2$  indicates that 26.10% of the variation in the dependent variable is explained by the explanatory variables. Nagelkerke  $R^2$  in model summary table above is 0.1560, which indicates that 15.60% of the variability in the dependent variable student academic performance was explained the explanatory variables (Table 3).

Table 4. Goodness of fit (Model Diagnostic)  
Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	45.000	7	0.980

As it is observed from the table above since P-value is 0.980 is greater than the level of significance at 5%. We can conclude that the data fits the model well. Since the p-value is 0.980 which is insignificant therefore our fitted logistic regression model is good fit (Table 4).

Table 5. Results of binary logistic regression model

								Lower	Upper
Step 1 <sup>a</sup>	Study time (> 48 hours= ref.)	3.968	1.215	10.671	1	.001*	5.853	4.890	571.318
	Amount of money received from family (>1500 birr ref.)	31.247	4.126E3	26.79	1	.009*	3.720	.678	3.880
	Peer influence (Yes=ref.)	-2.356	1.157	4.146	1	.042*	.095	.010	.916
	No	.765	1.347	.323	1	.570	2.149	.153	30.089
	Securing 1 <sup>st</sup> choice of department (Yes=ref.)	2.44	1.888	1.290	1	.034*	11.473	.010	.916
	No	.965	1.447	.667	1	.570	2.149	.153	30.089
	Father Education			5.734	4	.022*	2.512		
	Illiterate (ref.)	1.838	4.019E4	.000	1	1.000	6.281	.000	.
	Primary	-.626	1.092	.328	1	.0467*	2.535	.063	4.547
	Secondary	.790	.893	.783	1	.376	2.204	.383	12.695
	Certificate and above	-.485	1.053	.212	1	.645	.616	.078	4.853
	Good life later on			6.938	4	.001*			
	Strongly agree	3.226	1.785	3.266	1	.071	25.182	.761	833.018
	Agree	4.063	1.839	4.882	1	.027*	58.135	1.582	2.136E3
	Neutral	5.358	2.332	5.278	1	.022*	212.330	2.196	2.053E4
	Disagree	2.976	2.111	1.986	1	.159	19.599	.313	1.229E3
	Strongly disagree			6.209	5	.286			
	Arranging study time outside class (strongly agree=ref.)	0.997	3.343	4.381	1	.036*	2.001	.000	.641
	Agree	-5.246	3.179	2.724	1	.099	.005	.000	2.675
	Neutral	-6.835	3.553	3.701	1	.044*	.001	.000	1.137
	Disagree	-3.361	4.119	.666	1	.414	.035	.000	111.239
	Constant	15.708	5.699E4	.000	1	1.000	6.639E6		

From the table above it is observed that the estimated odds ratio 5.853 indicates those students who study more than 48 hours are 5.853 times more likely to perform better in academic performance compared to those student study less than 48 hours controlling for other variables in the model. On the same fashion, the estimated odds ratio 11.473 indicates that student securing first choice of department are 11.473 more likely to perform better in academic performance compared to those student who have not secured first choice of department controlling for other variables in the model. Similarly, the estimated odds ratio 0.095 indicates that student who are not influenced by peer are 9.5% more likely to perform better as compared to those student influenced by peer controlling for other variables in the model. Based on the above table, the estimated odds ratio 3.720 indicates that those students who receive more than 1500 birr money from their family are 3.720 times more likely to perform better compared to those who receive less than 1500 birr money from their family controlling for other variables in the model. Arranging study outside class also one of the determine factor for academic performance from the above result revealed that the estimated odds ratio 2.001 indicates that those student who arrange study outside class are 2.001 times more likely to perform better compared to their counterparts controlling for other variables in the model. Regarding father's education level the estimated odds ratio 2.512 indicates that those student whose father's level of education in certificate and above level are 2.512 more likely to perform better compared to those counterparts controlling for other variables in the model.

## CONCLUSIONS

From the logistic regression analysis it was also concluded that the odds of securing first choice of department, peer influence, father's education level, study time, arranging study outside class and amount of

money received from family are significant predictor variables seems to indicate better academic achievement of students in ok status as compared to their counterparts in College of Natural and Computational Science of Wolaita Sodo University situation.

### RECOMMENDATIONS

A lot should be done towards developing the academic achievement of students by counseling and guiding about peer influence at university level.

It can be also recommended that the university should set programs to strength self-concept or motivation to make them confident on their potential.

The stalk holders should secure student first choice of department.

Further study with additional predictor variables have to be made so as to address the issues raised in this study.

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