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Ordinal Logistic Regression Model in Identifying Hot Spot Factors That Affect Academic Performance of Students; The Case of College of Social Science and Humanities at Ambo University, Ethiopia by Habte Tadesse Likassa and Gudeta Aga Hirko, Ambo University, Ethiopia

Abstract

Education is the process by which people acquire knowledge, skill, habits, values and attitude. (Cynthia George (2006)).The main goal of the study is Ordinal Logistic Regression Model in Identifying Hot Spot Factors That Affect Academic Performance of Students; The Case of College of Social Science and Humanities, Ambo University, Ethiopia. The total population for the study is 189 with the sample size of 72. So as to meet the requirement self administrated questionnaire is designed. A stratified random sampling is employed in the departments. Appropriate methods descriptive and inferential statistics (chi square test and ordinal logistic regression model). Result of descriptive statistics showed that majority of the students failed in medium achievement as compared to low achievers, most female students 73.7% are low achiever than male 26.3%. The result of ordinal logistic regression model revealed that sex; times spent for study, average monthly income, preference choice towards department, availability of reference book are statistically significant linked with the academic status of students in the study area. The university should give attention to alter or improve performance of students those felt in low academic achievement.

Keywords: Academic performance, Ordinal, Time, Income and Chi Square

Background of the study

Education is the process of learning and acquiring information. It is also the process by which people acquire knowledge, skill, habits and values or attitude. Moreover it can be defined as the process through which human being express their findings and value accumulated over time in high struggle for survival from generation to generation. To say education is an important means of economic, social and cultural development of any country is not exaggeration which is means without education, no country can show observable change in its economy, culture, sociological interaction and political circumstances. Clear identification of hot spot factors associated with educational areas is important and keen. Promotion and clear determination of education enables people to become more productive member of the society. It is obvious that a world is rapid developing and dynamic change due to education. Even though education is the core medium by which growth and development of a given country is facilitated, it is undeniable that there are many observable problems and driving factors is the in quality of education activities (knhlenberg; 1999).

Education can be divided into two main type's formal teaching and learning system in school and self taught learning or what is often termed life experience. Education gives the people the

specialized training they may need for a job or career. It is important since it help to increase their knowledge and understanding of the world. The cognitive area of education aims at increasing person's knowledge and intellectual skill. It also deals with the ability to think and reason effectively. Generally education aim at producing intelligent, responsible, well informed citizen who take an active interest in the world around them. The focus being given to education by the Government of the country is extremely encouraging. It is part of the global resurgence of interest in education. The country seems to have realized that education is the gateway to future economic prosperity in country and the chosen instrument for combating unemployment. It is very well accentuated in many of the recent educational documents of the country that education is the sole driving force behind scientific and technological advance and an essential prerequisite for cultural vitality spearheading all forms of social progress and equality. Many of these stated values of education, especially, of higher education, have been very well articulated in the overall capacity building programs and policy documents of the country .Since the issuance of the Education and Training Policy (ETP) in 1994, accompanied with educational sector development programs, efforts have been made to improve higher education in quality and *accessibility*.

Statement of the Problem

Education is the most important tool in the development of all country in the world including Ethiopia. But most of the students do not learn in a manner that is preferable and not scoring a good result due to obvious hot spot factors and facilities required for education. Wudu Tefera 2000 revealed that the academic achievement of students at higher public institution was felt in low academic achievement. Research conducted by Daba Meshesha et al (2014) also revealed that the academic achievement of students at higher public institutions is low.

Moreover, the problem is also observed at different higher public institution including Ethiopia; therefore, so as to examine the academic achievement of students at the College of Social Science and Humanity and identify the student's academic status the following research questions are addressed in the study:

- ✓ What is the magnitude level of academic performance of the students?
- ✓ What are the hot spot factors that influence the academic performance of the students?

General & Specific Objectives of the study

The main objective of the study is an Ordinal Logistic Regression Model in Identifying Hot Spot Factors That Affect Academic Performance of Students; The Case of College of Social Science and Humanities, Ambo University, Ethiopia.

Specific Objectives of the Study

- ✓ To assess the academic performance of students
- ✓ To determine factors that affects academic performance of the students

Significance of the Study

According to this study, it is very important to know the impact of factors given from the university on the academic performance of students.

- ✓ Assessing the academic performance of the students is very important for the concerned body so as to give attention in promoting the low achievers.
- ✓ In other case, since there exists a lot of factors that hindered students' success, having to identify those factors may play a great role to improve students' performance in the college aforementioned.
- ✓ Identification of factors associated with the performance of the students is very useful for the top management of the University and concerned body to put their attention so as to reduce the problems.
- ✓ Finally, it is known to be that there is discrimination between sex groups in Ethiopia. Having the identified sex group those affected by the factors that affect their performance is important for the concerned body to find out the solution for those sex groups.

Data and Methodology

Descriptive of Study Area and Period

Currently there are about 33 Universities and other different private institutions in our country. Of these Ambo University is one of the well known institutions in conducting scientific research, providing quality of education and giving a community based services. It is located in the central part of Oromia National Regional State of Ethiopia and it is launched and located in Western Shoa Zone. It is about 114 KM from Addis Ababa. Now days, it has about three branches, mainly Awaro, Walliso and Gudar campus including the main campus. It is extended widely to reach horizon of excellence. Its target is so as to promote quality of education for its customers and stakeholders, more than ten different colleges and institutions are available in the main campus of which college of social sciences and humanities is also the most well recognized college in the campus.

Study of population

The target population of the study is all third year students at College of social science and Humanity in 2007 E.C. There are about 189 Third Year Students of Social Science and Humanities in Ambo University, Ethiopia. There are about four different departments in the College namely Afan Oromo, English, Civics and Ethical and Sociology.

Method of Data Collection

For this study both primary and secondary source of data are used. For primary source of data a well designed questionnaires filled by the respondents. Secondary data is used so as to get the number of students from each department selected from the College of Social Science and Humanities in Ambo University.

Sampling Design and Sampling Techniques

In this study an appropriate sampling technique mainly stratified random sampling is used. In stratified random sampling a population is first divided in to sub population of N_1, N_2….N_L units respectively. When the strata have been determined a sample is drawn from each stratum. Sample size within strata is denoted by n1, n2 …n_L respectively.

Sample Size Determination

In this study, stratified random sampling was applied to determine the sample size of the students from the whole population. The total number of samples 'n' was calculated as follows, (Cochran, 1997)

$$\mathbf{n} = \frac{\sum_{i=1}^{n} \mathbf{WhQhPh}}{\mathbf{V}+\frac{\mathbf{1}}{\mathbf{N}}\sum_{i=1}^{n} \mathbf{WhQhPh}} = \frac{\sum \frac{\mathbf{W_h P_h Q_h}}{\mathbf{V}}}{\mathbf{1}+\frac{\mathbf{1}}{\mathbf{NV}}\sum \mathbf{W_h P_h Q_h}}$$

To determine sample size first we have to know the population proportion by using some technique. In this study will use from the previous research for the purpose of determining the sample size of students to be select (Getu T; 2011).

N_1 = 45 Number of students in Afaan Oromo

N_2 = 32 Number of students in English
N_3 = 53 Number of students in civics& Ethical education and
N_4 = 59 Number of students in sociology
$N=N_1+N_3+N_4$ = 45+32+53+59 = 189
$V=d^2/ (Z_{0.025})^2$ = $(0.08)^2/ (1.96)^2$ = 0.0025/3.8416 = 0.001666.

W_h, is the stratum weight, given by $W_h = \frac{N_h}{N}$

W_1= 0.238 W_3= 0.280
W_2=0.169 W_4= 0.312

Applying the formula, $n = 72$

Where, n=total number of samples, α=the significance level=0.05.
d = margin of error =0.08 and = $Z_{0.025}$=1.96.
Where n_h is sample size of the h^{th} stratum (Department)

Sample size of h^{th} Stratum(n_h)	Values
n_1	17
n_2	12
n_3	20
n_4	23
Total	72

Identification of Variable in Study

Dependent Variable: is the academic status of students (Low, Medium and High)

Performance	Code Value
Low	0
Medium	1
High	2

The independent Variables:

The explanatory variables included in the study are sex, income, age, preference choice of department, time spent for study, weather condition, place of study, place of residence, class attended, efficiently enough reference book and educational background of family.

Statistical Methods of Data Analysis

In this study, we have used both descriptive and inferential statistics by incorporate the relevant statistical software SPSS version 21 packages. From the descriptive statistics (frequency, graph and percentage) and inferential statistics mainly chi square test of association and ordinal logistic regression model were used.

Results and Discussions

Descriptive Statistics

The data obtained as quantitative and qualitative form are described, summarized and distributed in different ways. As cogently observed in table below majority academic performance of students range in the medium class (51.39 %), and while 26.39% are in the range of low class, with only 22.22% of them are in the high class (Figure 1).

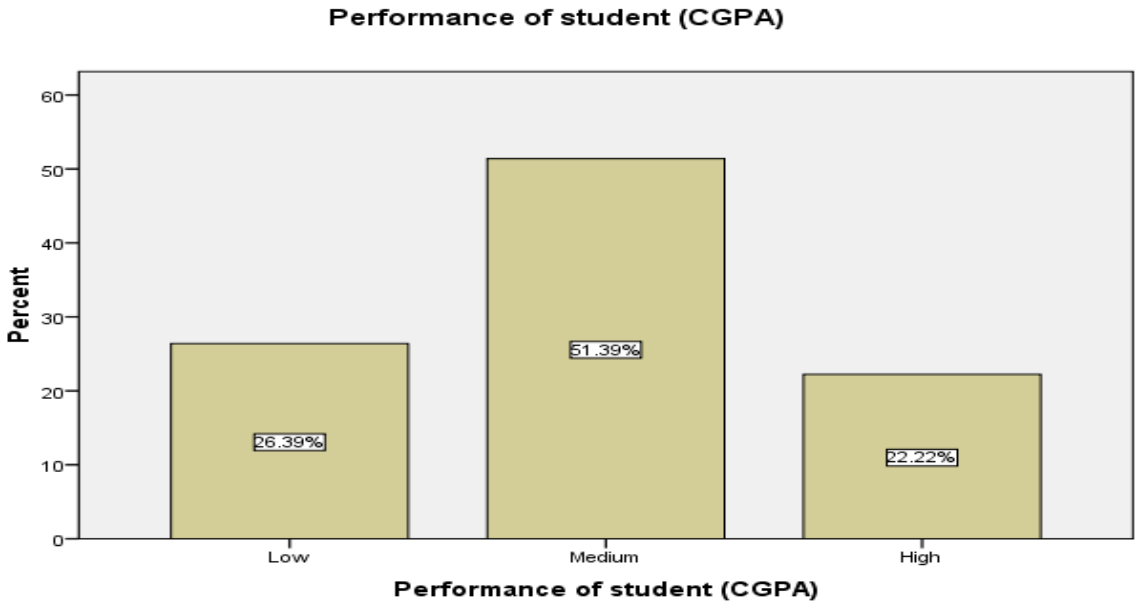

Figure 1: Figure of performance of students (CGPA) in Social Science College, Ambo University, Ethiopia

Table 3: The Descriptive Statistics on Socio demographic Variables and Academic Status of Students, College of Social Sciences and Humanities, Ambo University, Ethiopia

Variables	Category	Academic Performance of Students			
		Low	Medium	High	Total

Sex	Female	73.7	40.5	31.25	47.22
	Male	26.3	59.5	68.75	52.78
Age	Less Than 23	68.42	64.9	50	62.5
	More than 23	31.58	35.1	50	37.5
Place of coming	Rural	47.4	56.8	68.75	56.94
	Urban	52.6	43.2	31.25	43.06
Family educational background	illiterate	47.4	56.8	31.3	48.61
	literate	52.6	43.2	68.8	51.39
Time spent for study	Less than 4 Hr	73.69	59.5	37.5	58.33
	More than 4 Hr	26.32	40.5	62.5	41.67
Preference choice of dep't	No	68.42	24.3	31.25	37.27
	Yes	31.58	75.7	68.75	62.5
Income of student	Less than 400	68.42	54.1	31.3	52.78
	More than 400	31.58	45.9	68.8	47.22
Sufficient reference book	No	73.68	64.9	62.5	66.67
	Yes	26.32	35.1	37.5	33.33
Place of study	Dorm	42.11	29.7	31.25	33.33
	Library	31.6	40.5	37.5	37.5
	Space	26.32	29.7	31.25	29.17
Attending class	No	52.60	21.62	37.5	33.33
	Yes	47.40	78.38	62.5	66.67
Weather condition	No	31.60	54.1	68.8	51.39
	Yes	68.40	45.9	31.3	48.61

From above Table shows of all 72 respondents included in the study area 34 (47.22%) of them are females and 38(52.78%) of them are males and the percentages of female students are Low achiever (73.7%) when compared to male students (26.3%). The students who got choice towards department, their interest were kept by the college is 62.5 %(45) and 37.5 % (27) of them are got by chance Also the students which get <400 income 52.78 % (38) per-month and those of who get>=400 are 47.22 % (34).

Result of Inferential Statistics

Prior using to identify major factors that affect the academic performance of the students filtering the significance of factors by using chi-square test of association is much deals the associations/relationships among two variables and test hypotheses about relationships between two or more ordinal level variables.

Table 4: The result of Test of Association by Chi-Square Test Statistics

Variables	Pearson Chi-Square	DF	Sig.
Sex	9.151	2	0.010*
Age	4.686	2	0.096
Place of coming	2.806	2	0.246

Family educational background	2.925	2	0.232
Time of spent on study	15.012	2	0.001*
Preference choice of department	24.695	2	0.000*
Income of student	12.688	2	0.002*
Sufficient reference book	12.688	2	0.002*
Place of study	23.168	4	0.000*
Attending class	21.352	2	0.000*
Weather condition	5.021	2	0.081

*sig at 5% level of significance

From the table above it is clearly observed that sex of the respondents, time spent for the study, preference of students towards department, Income of students, sufficient of reference of book, place of the study and attending the class are significantly associated with the academic performance status of the students in the study area at 5% level of significance (Table 4).

Ordinal Logistic Regression Analysis

Ordinal logistic regression was a type of logistic regression analysis that when the response variable is categorized more than two with having natural order or rank. That is, we can rank the values, but the real distance between categories is unknown. Under Ordinal Logistic Regression Analysis we can deal Model Fitting Information, Goodness-of-Fit, Pseudo R-Square, Parameter Estimates and Test of parallel lines. In this model there are five types of link functions i.e. logit, probit, Complementary log-log, Negative log-log and Cauchy (inverse Cauchy). From this logit link function is used in the analysis because it is evenly distributed categories and is reasonable choices when the changes in the cumulative probabilities are gradual and log it involves all levels of the response and dichotomizes the response scale. If there are abrupt changes, other link functions should be used.

Result of Model checking (Model Diagnostic)

Table 5: Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	DF	Sig.
Intercept Only	148.020			
Final	60.248	87.773	12	.000

The -2 log likelihood can be used in comparisons of nested models. From the table above since the p-value is significantly less than 5% it indicates as there is evidence that the model gives better predictions than if we just guessed based on the marginal probabilities for the outcome categories (Table 5).

Table 6: Goodness-of-Fit Statistics

	Chi-Square	Df	Sig.
Pearson	75.197	126	0.78
Deviance	60.248	126	0.869

We start from the null hypothesis that the fit is *good.* From the result of goodness of the fit indicated above, it is possible to say that the model fits the data well since the p value is larger 5% level of significance. *This means* we fail to reject null hypotheses is depending on the

Table 7: Results of Model Summary

Cox and Snell	0.704
Negelkerke	0.808
McFadden	0.593

Pseudo R squares are additional measures of goodness of fit for ordinal logistic regression. The above shows that the values of the three pseudo R square measures; Cox and Snell, Nagelkerke and McFadden as 0.704, .0.808 and .0.593 respectively for final model. The results support the conclusion that the final model fit the data well. The pseudo R^2 values (Nagelkerke = 80.8%) indicates that the explanatory variables explains a relatively high proportion of the variation between students in their academic performance.

Table 8: Parameter Estimates of Ordinal Logistic Regression

Variables		B	S E	Wald	DF	Sig.	95% CI	
							Lower	Upper
Threshold	Performance (0)	-4.960	2.308	10.891	1	0.001*	-11.485	-3.436
	Performance(1)	-0.055	1.551	0.001	1	0.000*	-3.096	-2.985
Location	Sex (0)	-0.093	0.844	1.205	1	0.027*	-2.580	-0.727
	Age(0)	-2.237	0.988	5.124	1	0.273	-4.175	-0.300
	Place of coming (0)	0.040	0.74	0.003	1	0.956	-1.411	1.491
	Family educational background (0)	-0.788	0.754	1.093	1	0.296	-2.266	0.689
	Time spent (0)	-2.332	0.840	7.702	1	0.006*	-3.979	-0.685
	Sufficient reference book (0)	-1.184	0.916	4.040	1	0.001*	-1.980	-1.612
	Income (0)	-2.254	0.885	6.481	1	0.011*	-3.989	-0.519
	Preference of choice of dep't (0)	-3.237	1.039	9.708	1	0.002*	-5.273	-1.201
	Place of study(0)	-0.183	1.212	0.23	1	0.88	-2.557	2.192
	Place of study (1)	3.285	1.230	7.136	1	0.008*	0.875	5.695
	Attending class(0)	-3.123	1.424	4.806	1	0.028*	-5.915	-0.331
	Weather condition(0)	1.553	0.720	4.650	1	0.031*	0.141	2.964

Result of Interpretation of parameter estimation by using Ordinal Logistic Regression Model

The threshold represents the response variable in the ordered logistic regression. The threshold estimate for [performance = 0] is the cut off value between low and middle performance and the threshold estimate for [performance = 1] is the cutoff value between middle and high performance.

From this table we have the variables that affect Academic performance of student like, sex, time spent on study, income, sufficient reference book, preference choice of department, place of

study , class attending and weather condition were statistically significant with p-values of 0.027,0.006, 0.011, 0.001, 0.002, 0.008,0.028 .and 0.031respectively.

This test is based on descriptive measures of the log-likelihood function at the maximum likelihood estimate of the parameters of the model .This statistic has a chi-squared distribution with one degree of freedom.

The significance of the Wald statistic in the column with heading sig (< 0.05) indicates the importance of the predictor variables in the model (we reject the Null hypothesis Ho: $\beta_j = 0$ and a high value of the Wald statistic shows that the corresponding predictor variable is significant.

The Wald test statistic for the predictor female is 1.205 with an associated p-value of 0.027. If we set our alpha level to 0.05, we reject the null hypothesis and conclude that the regression coefficient for female has been found to be statistically different from zero in estimating academic performance given other independent variables are in the model.

The Wald test statistic for the predictor Age is 5.124 with an associated p-value of 0.273. Since our alpha level is 0.05, we would fail to reject the null hypothesis and conclude that the regression coefficient for age has not been found to be statistically different from zero in estimating academic performance given those left independent variables in the model.

Conclusion, the findings indicate that Academic performance of a student is associated with sex, age, place of coming, family educational background, income, time of study, reference book, preference choice of department, attending class and weather condition. From these the independent variables low income, less reading, unavailability of sufficient reference book, unconsidered preference choice of department and not attending class, are the factors that have effects on academic performance of student, are found to be statistically significant with Academic performance of students.

For instance from Table 4.6 the value of the odd ratio for females, the odds of high achieve versus the combined medium and low achiever are 0.911 times lower than for males, given the other variables are held constant. Likewise, the odds of the combined categories of high and medium versus low achiever is 0.911 times lower for females compared to males, given the other variables are held constant in the model.

The odd ratio for average monthly income who get less than 400, the odds of high achieve versus the combined medium and low achiever are 0.105 times lower than for who more than 400, given the other variables are held constant.

Likewise, the odds of the combined categories of high and medium versus low achiever is 0.105 times lower for average monthly income who get less than 400 compared to who get more than 400, given the other variables are held constant in the model.

Also the odd ratio for time spent for study less than 4 Hr, the odds of high achieve versus the combined medium and low achiever are 0.097 times lower than for those who study more than 4 Hr, given the other variables are held constant. Likewise, the odds of the combined categories of high and medium versus low achiever is 0.097 times lower for time spent for study less than 4 Hr compared to those who study more than 4 Hr, given the other variables are held constant in the model and

Similarly, the odd ratio for in the library , the odds of high achieve versus the combined medium and low achiever are 26.71 times higher than for those who study space, given the other variables are held constant.

Table 9: Test of parallel lines

Model	-2 Log Likelihood	Chi-Square	DF	Sig.
Null Hypothesis	60.248			
General	43.303	16.945	12	0.202

One of the assumptions underlying ordinal logistic regression is that the relationship between each pair of outcome groups is the same. This is commonly referred to as the test of parallel lines because the null hypothesis states that the slope coefficients in the model are the same across response categories (and lines of the same slope are parallel). The table shows parallel line test for final model with chi square value 16.945 and p-value=0.202 which is greater than the 5% level of significance. Therefore, there is no enough evidence to reject the null hypothesis for final model. Thus, the proportional odds assumption appears to have held for final model.

In this study we have looked at regression models that can be applied when our outcome is represented by an ordinal variable. In contrast ordinal regression models take advantage of the ordinarily in the outcome by summarizing the relationships between explanatory variables and the outcome in a simplest explanation model. The study indicates that students which getting lower income per-month are affected by achievement status and more female students are low performed when compared to male students with their academic performance. The study also shows that the factors that affect academic performance of students in College of Social science and Humanities of Ambo University were: sex, low income, less reading, unavailability of sufficient reference book, study place, unconsidered preference choice of department, not attending class, and weather condition are found to be more significantly associated with performance of students. With both studies use the same variables for instance the total amount of time spent on studying correlates with the amount and degree of learning. The amount of time engaged in academic activities predicts achievement level (Getu T; (2011)) of Addis Ababa University says that students should study regularly throughout the school year. But the difference in this study the factor variable was from the total ten factor variables eight variables were significantly have an effect on students Result and for our study we have got seven Factor statistically significant affect students performance was sex, time spent for study, reference book, students choice towards department, Students Income per monthly, attending class and place of study.

Conclusion

The result of the study shows that student's Academic performance is affected by some hot spot factors during their life in the campus. From the result of the study it is revealed that sex of the respondents, time spent for the study, preference of students towards department, Income of students, sufficient of reference of book, place of the study and attending the class are significantly associated with the academic performance status of the students in the study area at 5% level of significance.

Furthermore the findings indicate that Academic performance of a student is associated with sex, income, time spent on study, sufficient reference book, preference choice of department, place of study , class attending and weather condition.

The Academic performance of a student is strongly associated with sex, income, time spent on study, sufficient reference book, preference choice of department, place of study , class attending and weather condition .

In conclusion sex, low income, less reading, unavailability of sufficient reference book, unconsidered preference choice of department and not attending class are found to be more significantly associated with academic performance of students in Ambo University in case of College Social Science and Humanities Students.

Recommendation

Based on the results of this study, we offer the following recommendations drawn:

- ✓ It is highly advisable if the females get high encouragement and affirmative action should be recommended.
- ✓ It is highly advisable if the university fulfill all the required materials related to books, and any relevant materials that assist them in promoting their performance.
- ✓ The university should give attention to alter or improve performance of students those felt in low academic achievement.
- ✓ The Ambo University should give attention and support, the students who have no economic support and getting low income.
- ✓ The Dean of CSSH should give attention to the problems and report for the concerned body to solve those problems that influence the academic performance of students.

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