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AN INVESTIGATION OF FACTORS AFFECTING STUDENTS' ACADEMIC ACHIEVEMENT IN THE LIGHT OF THE MULTINOMIAL LOGISTIC MODEL – A CASE STUDY OF THE FACULTY OF SCIENCE AND HUMANITIES AT THADIQ, SHAQRAA UNIVERSITY, KSA

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ABSTRACT

This paper aimed at studying the factors that affect the academic achievement of students at the Faculty of Sciences and Humanities, Thadiq, Shaqraa University-KSA. Multinomial Logistic Regression (M. Lo.R.) was used to analyze the data. A significant relationship was found between academic achievement and the studied factors. The variables father's educational status, mother's educational status, existence of desire in the specialization (EDS), existence of somebody helps in the study, the average number of hours of revision per day has an effect on the students' academic achievement. Nearly 56 % of student academic achievement depends upon all the fifteen studied variables. Nearly 50 % of student academic achievement depends upon the five variables that mentioned above. The results of the present study can be made use of in planning for the enhancement of a student's academic achievement. Similar studies in other faculties are needed to support the results reached in the present study.

KEYWORDS: Academic achievement, Multinomial logistic regression-Shaqraa university, KSA.

INTRODUCTION

This paper deals with the factors that affect student academic achievement at the Faculty of Sciences and Humanities at Thadiq, Shaqraa University, KSA. Multinomial Logistic Regression (M.Lo.R.) was used to analyze the data because (1) the sample size was large, and (2) there were two levels of the independent variables and seven levels of the dependent variable.

The problem of the study is that there are only two previous studies about factors that affect Students' Academic achievement at Shaqraa University, and they did not use M.Lo.R. Therefore the effect of these factors on the multinomial dependent variable needed further research.

There are 16 variables in this study. The dependent variable is students' academic achievement which takes seven levels and is denoted by Yi as in appendix 1. The other fifteen variables are independent variables. These variables are configured in appendix 1 and denoted by X1, X2,…, X15.

In this paper this hypothesis will be tested:

$$H_0: \ \beta_i = 0 \quad against \quad H_1: \ \beta_i \neq 0$$

$$where: \quad i = 0,1,2,3,.......,15$$

The importance of this paper is that it will determine important factors that may affect student academic achievement.

This paper aims at testing the significance of the factors that may affect the academic level of the students through the logistic model.

There are many studies that have used the Logistic Model analysis (Lo.M). Verhulst was the first researcher used the logistic function (1838) that he named growth function. The term logistic function was used by Pearl and Read (1920). Berkson (1944) made a comparison between the Logistic Model (LO.M) and a Normal Distribution Model (NDM) and reached to the result that the LO.M was better than the NDM. Also the LO.M and NDM were used by Cox (1970) for data consisting of three dose levels of the drug and found that the LO.M has a better fit than the NDM. According to Berkson (1951), if the data have binomial distribution, LO.M is better than NDM in fitting the data, and the estimates of LO.M are better than those of NDM because Lo.M estimates are sufficient and efficient. In 1972 Ashton wrote a book where he explained how to transform LO.M to Linear Model (Li.M). In 1983 McCullagh and Nelder used Chi-Square (CST) and Deviance (D) tests for fitting Lo.M and found that the two tests approached to CST. McCullagh and Nelder used the Weighted Least Square Method (WLSM) because there was heterogeneity of variance. In 1987 Richard and Little found that Lo.M was the best for binary data (Richard and Little; 1987). In 1989 Lemeston and Hosmer used equation 1 to test the suitable partial group of Lo.M

$$C(q) = \frac{SSE(q)}{SSE(p)/(n-p-1)} + 2(q+1) - n \rightarrow (1)$$

SSE(q) = Sum of Squares due to Error of the suitable model that contains "q" variables.
SSE(p) = Sum of Squares due to Error that belongs to the Linear Regression of the model which contains "p" variables.
If C(q) is small enough, the model of "q" variables is the best.
In 1995 Minard authored a book entitled "Applied Logistic Regression Analysis", which contains important applications in social sciences. In 1999 Sequeiria and Taylor transformed the binary Lo.M to study treatment effect by using binary variable "I" for the treatment, with "γ" factor and continuous variable X; such that:

$$Ln(\frac{P}{q}) = \alpha + BX^{(2)} + \gamma I \rightarrow (2)$$

Where: $\alpha, \beta, and\ \gamma$ are parameters, p is the probability of success, "q" is equal to one minus "p" which is the probability of failure. Finally $Ln(\frac{P}{q})$ is the linear transformation of the proportion of the response in the Lo.M. In 2000 the second edition of the book "Applied Logistic Regression" that was written by David and Stanley appeared. This book contains applications of Lo.M in the field of Biostatistics, social science, education, and health. In 2002 Pingchao, Kuklida and Gray did a research entitled "An Introduction to Logistic Regression Analysis and Reporting", which deals with educational data. This research is available on the internet. Also in 2006 Sansh and Gozde published a research entitled "Logistic Regression Analysis to Determine the Factors that Affect (Green Card) Usage for Health Services".

The Lo.M is used to represent the relationship between explanatory proportional variable with binomial distribution and dummy dependent variable. The dependent variable takes the values 1 if there is response and 0 otherwise, (Seber & Wild; 1989).

Arabi and Husain (2014) published a paper entitled "Trends of Secondary Schools Students in Forming Their Choice of Future Specialization where the Academic in Two Branches Art and Science". They have used logistic regression and found that the students' marks, the way parents look at them, fathers' job, the way the society looks at them, and future job affected the choice of the future specialization.

Aromolaran et al (2013) published a paper entitled "Binary Logistic Regression of Students Academic Performance in Tertiary Institution in Nigeria by Socio-Demographic and Economic Factors". The researchers used four factors. The factors fitted into predictive binary logistic regression model for the log-odds in favor of poor performance as $\mathrm{Log}\{\frac{\pi}{1-\pi}\} = 0.122 - 0.092X1 + 0.479X2 - 0.383X3 - 0.411X4$. A number of recommendations like rendering financial support to students in need of such family planning orientation while in school and studying the effect of demographic and socioeconomic factors on student academic performance should be regularly emphasized to students.

The following notes are properties of logistic regression:

- When we have a dichotomous variable as the dependent variable, OLS regression won't work. The Linear Probability Model can be fitted, but The relationship is non-linear because the probabilities are bound between 0 and 1.
- The error terms are heteroscedasticity because the dependent variable is produced by a binomial process where the variance depends upon the underlying value.
- As we have learned we can correct these problems with a generalized linear model.
- We know that the error distribution is given by a binomial distribution. So, we only need to choose a link function. We know the identity link won't work because we have the non-linearity problem.
- There are several possible link functions, but the best one (or at least the easiest to interpret) is the logit function.
- The logit is the log of the odds:

$$\log it(p) = \log(\frac{p}{1-p})$$

- This function spreads the probabilities over the entire number range.
- So, our logistic regression model looks like:

$$\log(\frac{\hat{p}}{1-\hat{p}}) = \beta_0 + \beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_p x_{ip}$$

- How do we interpret the B's? Well, first, let's relate this equation back to odds rather than the log-odds by taking antilogarithm of both sides to have:

$$(\frac{\hat{p}}{1-\hat{p}}) = e^{\beta_0} e^{\beta_1 x_{i1}} e^{\beta_2 x_{i2}} \ldots e^{\beta_p x_{ip}}$$

- How does a one-unit change in Xi1 affects the predicted odds?
- It increases the odds by a multiplicative factor of e^{B1}.

By exponentiating the B's we get odds ratios - how much the odds increase multiplicatively with a one-unit change in the independent variable. For categorical variables, these can be interpreted directly as odds ratios between groups. For continuous variables they are the odds ratios between individuals who are identical on the other variables but, differ by one unit on the variable of interest.

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MATERIAL AND METHODS

The study was carried out in the Faculty of Sciences and Humanities at Shaqraa University, KSA in February 2015. The sample size was determined by proportion formula 3 and using 96% confidence interval with marginal error 5%.

$$n = \frac{(Z_{\frac{\alpha}{2}})^2 pq}{d^2} \rightarrow (3)$$

Where,

P = Probability of student success = 0.5
q = Probability of student failure = 0.5
d = Maximum estimate of the marginal error = 0.05
$Z_{\frac{\alpha}{2}} =$ Standard normal value = 2

Based upon the above values and formula3, n was equal to 400.

To obtain a sample size for proportional allocation, a population of size "N" is divided into "L" strata of sizes N1, N2,…, NL, and select samples of sizes n1, n2,…, nL respectively, from the "L" strata, the allocation is proportional if $n_i = (\frac{N_i}{N})n$ for all i=1,2,3,..,L, (Walpole: 1982).

Since the population encompassed males and females, it was divided into two strata. A simple random sample of size 200 was selected from each stratum by using equal allocation because the number of male and female students was nearly equal.

The variables used in the study were shown in the questionnaire in the appendix 1.

If Xi represents the explanatory (independent) variable, ni is the sample size of the stratum "i", ri is the sample size of the positive response of the stratum "i", and (ni - ri) is the sample size of the negative response of the stratum "i", then the probability of success is given by equation (3) as follows:

$$p_i = pr(y=1/x) = \frac{r_i}{n_i} \rightarrow (3)$$

and the probability of failure is given by equation 4 as follows:

$$q = 1 - p_i = pr(y=0/x) = \frac{n_i - r_i}{n_i} \rightarrow (4)$$

Since "p" and "1-p" are functions in "X" we can write them according to the Lo.M as in equations 5 and 6.

$$p = \frac{\exp(\beta_0 + \beta_1 X_i)}{1 + \exp(\beta_0 + \beta_1 X_i)} \rightarrow (5)$$

$$1 - p = \frac{1}{1 + \exp(\beta_0 + \beta_1 X_i)} \rightarrow (6)$$

The Lo.M is intrinsically a linear model, so it can be transformed to L.M and obtains Best Linear Unbiased Estimators "BLUE" (Draper & Smith, 1981) and (Rat & David, 1983). In 1944 Berkson transformed the Lo.M to L.M according to equation 7 by dividing equation 5 by equation 6 and taking the logarithm (Berkson, 1944).

$$Ln(\frac{p}{1-p}) = Z_i = \beta_0 + \beta_1 X_i \rightarrow (7)$$

From equation 7, "p" is a function of "Z" and "Z" is a function of X, therefore:

$$\frac{\partial p}{\partial X} = \beta_1 p(p-1) \rightarrow (8)$$

$$\frac{\partial Z}{\partial X} = \beta_1 \rightarrow (9)$$

The mean and variance of "Z" are given by equations 10 and 11 as follow:

$$E(Z) = \beta_0 + \beta_1 X_i \rightarrow (10)$$

$$V(Z) = \frac{1}{n_i p_i (1 - p_i)} = \delta_i^2 \rightarrow (11)$$

The Weighted Least Square Method (WLSM) should be used because the mean of "Z" is a function of $\beta_1 \;\; and \;\; X_i$, and its variance is a function of its mean, therefore the variance of "Z" is heteroscedasticity, i.e. $V(e_i / X_i) \neq \delta_i^2$.

According to (Kendall & Stuart; 1968) the weight "wi" in equation 12 was used to have homogeneity of variance.

$$w_i = \frac{1}{\delta_i^2} = n_i p_i (1 - p_i) \rightarrow (12)$$

To estimate ß0 and ß1 the WLSM and partial derivative of ß0 and ß1 were used in equation 13

$$SSe_i = \sum_{j=1}^{n_i} w_i (Z_i - \hat{Z}_i)^2 = \sum_{j=1}^{n_i} w_i (Z_i - \beta_0 - \beta_1 X_i)^2 \rightarrow (13)$$

First equation 13 was differentiated with respect to ß0 and the result was then equated by zero and second the same equation was differentiated with respect to ß1 and the result was equated by zero. Finally by solving the two previous equations obtained by the differentiation we have equation 14 as follows:

$$\underset{\sim}{\hat{\beta}} = (X'WX)^{-1} X'WZ \rightarrow (14)$$

Where: $\underset{\sim}{\hat{\beta}} = \begin{bmatrix} \hat{\beta}_0 \\ \hat{\beta}_1 \end{bmatrix}$, $X = \begin{bmatrix} 1 & X_{11} \\ 1 & X_{21} \\ 1 & X_{31} \\ . & . \\ . & . \\ 1 & X_{n1} \end{bmatrix}$, $Z = \begin{bmatrix} \ln(\frac{p_1}{q_1}) \\ \ln(\frac{p_2}{q_2}) \\ . \\ . \\ \ln(\frac{p_n}{q_n}) \end{bmatrix}$

$W = \begin{bmatrix} W_1 & 0 & ..... & 0 \\ 0 & W_2 & ..... & 0 \\ . & . & . & ... \\ . & . & . & \\ 0 & 0 & .... & W_n \end{bmatrix}$, $X'WZ = \begin{bmatrix} \sum W_i Z_i \\ \sum W_i X_i Z_i \end{bmatrix}$ $X'WX = \begin{bmatrix} \sum W_i & \sum W_i X_i \\ \sum W_i X_i & \sum W_i X_i^2 \end{bmatrix}$

From the previous equations the vector β can be written as in equation 15:

$$\underset{\sim}{\hat{\beta}} = \begin{bmatrix} \hat{\beta}_0 \\ \hat{\beta}_1 \end{bmatrix} = \begin{bmatrix} \frac{\operatorname{cov}(X,Z)}{v(X)} \\ \bar{Z} - \hat{\beta}_1 \bar{X} \end{bmatrix} \rightarrow (15)$$

The estimated value of "Z" can be written as in equation 16:

$$\hat{Z}_i = \hat{\beta}_0 + \hat{\beta}_1 X_i \rightarrow (16)$$

The Sum of Squares due to Regression (SSR) can be written as in equation 17:

$$SSR = S_{\hat{Z}\hat{Z}} = \hat{\beta}_1 \operatorname{cov}(X,Z) = \hat{\beta}_1^2 S_{XX} \rightarrow (17)$$

The Sum of Squares due to Error term (SSE) can be written as in equation 18:

$$SSE = S_{ZZ} - S_{\hat{Z}\hat{Z}} = S_{ZZ} - \hat{\beta}_1^2 S_{XX} \rightarrow (18)$$

$$SST_0 = S_{ZZ} = \sum W_i Z_i^2 - \frac{(\sum W_i Z_i)^2}{\sum W_i} \rightarrow (19)$$

The means of $\hat{\beta}_0$ and $\hat{\beta}_1$ are given by $E(\hat{\beta}_0) = \beta_0$, $E(\hat{\beta}_1) = \beta_1$ and their variances are given by $S^2_{\hat{\beta}_0} = MSE(C_{00})$ and $S^2_{\hat{\beta}_1} = MSE(C_{11})$, where C00 and C11 are the diagonal elements of the matrix

$$\begin{bmatrix} \sum W_i & \sum W_i X_i \\ \sum W_i X_i & \sum W_i X_i^{\,2} \end{bmatrix}^{-1}.$$

Since $MSE = \hat{\delta}^2 = 1$, therefore

$$S^2_{\hat{\beta}_0} = C_{00} = \frac{1}{\sum W_i} + \bar{X}^2 S^2_{\hat{\beta}_1}$$ and $$S^2_{\hat{\beta}_1} = C_{11} = \frac{1}{S_{XX}}.$$

The hypothesis should be tested is:

$H_0 : \beta_i = 0$ against $H_1 : \beta_i \neq 0 \;\; \forall i = 0,1$

To test the above hypothesis the statistic "t" that in equation (20) was used.

$$t_c = \frac{\hat{\beta}_i - \beta_i}{s_{\hat{\beta}_i}} = \frac{\hat{\beta}_i}{s_{\hat{\beta}_i}} \rightarrow (20)$$

Where under H0 we have $\beta_i = 0$.

Since the sample size used in the research was very large, the calculated "t" value is near to Z, therefore it will be compared with the tabulated value "1.96", (because 95% confidence limits were used). If the absolute value of the calculated value in equation 21 is greater than 1.96, H0 is rejected, otherwise it is accepted.

The coefficient of determination given by equation (21) was used to determine the dependency percentage of the dependent variable "Z" upon the independent variable "X" in the linear regression. The value $\hat{p}_i$ is given by equation (22).

$$R^2 = \frac{S_{\hat{Z}\hat{Z}}}{S_{ZZ}} \rightarrow (21)$$

$$\hat{p}_i = \frac{e^{\hat{Z}_i}}{1 + e^{\hat{Z}_i}} \rightarrow (22)$$

If we have more than one independent variable, the quantity $\ln(\frac{p}{q})$ can be written as in equation 23.

$$\ln(\frac{p}{q}) = \hat{\beta}_0 + \sum_{j=1}^{p} \hat{\beta}_j X_{ij} \rightarrow (23)$$

$i = 1,2,3\ldots,n$

$\ln(\frac{p}{q}) =$ Logit transformation

$(\frac{p}{q}) =$ Odds of success

The value of p is given by equation (24):

$$p = \frac{1}{1 + \exp[-(\hat{\beta}_0 + \sum_{j=1}^{p} \hat{\beta}_{ij} X_{ij})]} \rightarrow (24)$$

Likelihood Function for Logistic Regression (LFLR):

Since Logistic Regression predicts probabilities rather than just classes, we can fit it using likelihood. For each training data-point, we have a vector of features, xi, and an observed class, yi. The probability of that class was either p, if yi = 1, or 1-p, if yi = 0. The likelihood is then given by equation 25 (Cox; 1966).

$$L(\beta_0,\beta)=\prod_{i=1}^{n}(p(X_i))^{Y_i}.(1-p(X_i))^{1-y_i}\rightarrow(25)$$

The log-likelihood turns products into sums as follow:

$$l(\beta_0,\beta)=\sum_{i=1}^{n}y_i\ln(p(X_i))+\sum_{i=1}^{n}(1-y_i)\ln(1-p(X_i))\rightarrow(26)\qquad l(\beta_0,\beta)=\sum_{i=1}^{n}\ln(1-p(X_i))+\sum_{i=1}^{n}y_i\ln\frac{p(X_i)}{(1-p(X_i))}\rightarrow(27)$$

$$l(\beta_0,\beta)=\sum_{i=1}^{n}\ln(1-p(X_i))+\sum_{i=1}^{n}y_i(\beta_0+X_i\beta)\rightarrow(28)$$

$$=\sum_{i=1}^{n}-\ln(1+e^{\beta_0+X_i\beta})+\sum_{i=1}^{n}y_i(\beta_0+X_i\beta)\rightarrow(29)$$

Typically, to find the maximum likelihood estimates, we differentiate the log likelihood with respect to the parameters, set the derivatives equal to zero, and solve. To start that, take the derivative with respect to one component of β, say β_j

$$\frac{\partial l}{\beta_j}=\sum_{i=1}^{n}\frac{e^{\beta_0+X_i\beta}}{(1+e^{\beta_0+X_i\beta})}+\sum_{i=1}^{n}x_i.y_i\rightarrow(30)$$

$$=\sum_{i=1}^{n}[y_i-p(x_i;\beta_0,\beta)]x_i\rightarrow(31)$$

Equations 29 and 30 are transcendental, and there is no closed form solution. Therefore, they can be approximately solved numerically.

For the testing goodness of fit, the log likelihood ratio, distributed as chi – square is used as in equation 32.

X2 = 2[ln L0 – ln L1]……(32)

L1 = Likelihood function that contains "i" variables.

L0 = Likelihood function that contains "i-1" variables.

To test the significance between observed "hik" and expected " h^ik " frequencies, the null hypothesis H0 is tested according to the equation 33.

H0: h^ik = hik against H1: h^ik ≠ hik

H-Statistics = ΣΣ (hik - h^ik)2 / h^ik …………..(33)

Where H is distributed as chi-square with (m-2) degrees of freedom, where "m" is the number of iterations.

According to Hosmer et al (1988), after coding data by using SPSS. From toolbar, choose analysis: regression, and Binary logistic. Put the dependent variable in the dialogue box "dependent" and the independent variables in (Covariates). From option, choose 1st classification plots, 2nd Hosmer-Lemeshow goodness of fit, 3rd case wise listing of residual, 4th correlation of estimates, 5th iteration history, 6th CL for exp (ß), 7th Display: (At each step), and Removal: (0.10), 8th Include constant in the model.

The data collected by the questionnaire contain variables of the study and their values and symbols, (see appendix 1). Appendix 2 contains summary of the data. The summary includes variables of the study, their stratified samples and their marginal process. 10% of the students, their academic rate (AR) was less than 2.0. 10% of the students, their academic rate was between 2.0 and 2.5. 20% of the students, their academic rate was between 2.5 and 3.0. 17.5% of the students, their academic rate was between 3.0 and 3.5. 20% of the students, their academic rate was between 3.5 and 4.0. 10% of the students, their academic rate was between 4.0 and 4.5. 12.5% of the students, their academic rate was between 4.5 and 5.0. 51% of the students, their Fathers' Educational Status (FES) were less than higher secondary (LHS). 50.5% of the students, their Mother's Educational Status (MES) were less than higher secondary. 49.3% of the students, have no desire in the specialization. 50% of the students, have no somebody helps in the study. 45.8% of the students, revise with colleagues in groups. 55.3% of the students, take on average Less than 3 hours per day in revision. 50.5%% of the students, have distance from their residences to the college is greater than 50 km. 50.3%% of the students can understand the lecturers that who teach courses. 49.5% of the students, feel that the classrooms are equipped for teaching. 49.3% of the students feel that the expense is not adequate. 50.8% of the students, claim that the studied courses are not available. 49.2% of the students obtain advantage of academic advising. 47.5% of the students, contribute to sports activities of the college. 47.5% of the students, are participating in the cultural activities of the college.

From Appendix 3: There are some variables have p-vales greater than 0.05, so we will delete the variables that have p – value greater than 0.05 beginning from the variable with the biggest p-value to get adjusted model.

The adjusted model:

In appendix 4 column B contains the estimated multinomial logistic regression coefficients for the models. An important feature of the multinomial logit model is that it estimates (k-1=14) models, where k is the number of levels of the outcome variable. In this instance, SPSS is treating the student's academic rate (4.5-5.0) as the referent group and therefore estimated a model for the rates: "(Less than 2),(2.0-2.5),…and (4.0-4.5)" relative to the rate (4.5-5.0). Therefore, since the parameter estimates are relative to the referent group, the standard interpretation of the multinomial logit is that for a unit change in the predictor variable, the logit of outcome relative to the referent group is expected to change by its respective parameter estimate (which is in log-odds units) given the variables in the model are held constant.

Intercept of (Less than 2) rate relative to (4.5-5.0) rate:- This is the multinomial logit estimate for (less than 2) rate relative to (4.5-5.0) rate when the predictor variables in the model are evaluated at zero. For FES (the variable MHS evaluated at zero), the logit for increasing (less than 2) rate relative to (4.5-5.0) rate is -19.773. Note that evaluating the other variables at zero is out of the range of plausible scores, and if the scores were mean-centered, the intercept would have a natural interpretation: log odds of changing (less than 2) rate relative to (4.5-5.0) rate for a FES with the average of the other variables scores.

The following equation obtained from appendix 4, it is used to estimate the rate of change of the student's academic rate from less than 2.0 points to (4.5-5.0) points.

$$Y = e^{-19.773+8.001X_2+1.972X_3+2.637X_4-6.692X_5+16.991X_7}$$

Father's Educational Status (FES):- This is the multinomial logit estimate for a one unit increase in FES score for (less than 2) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student's FES was to change from Less Than Higher Secondary School (LTHSS) to aHigher Secondary School and Above (HSSA), the multinomial log-odds of increasing (less than 2) rate to (4.5-5.0) would be expected to increase by 8 units while holding all other variables in the model constant.

Mather's Educational Status (MES):- This is the multinomial logit estimate for a one unit increase in FES score for (less than 2) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student's MES was to change from Less Than Higher Secondary School (LTHSS) to a Higher Secondary School and Above (HSSA), the multinomial log-odds of increasing (less than 2) rate to (4.5-5.0) would be expected to increase by 1.972 units while holding all other variables in the model constant.

Existence of Desire in the Specialization (EDS):- This is the multinomial logit estimate for a one unit increase in EDS score for (less than 2) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student transfers from no EDS to EDS, the multinomial log-odds of increasing (less than 2) rate to (4.5-5.0) would be expected to increase by 2.637 units while holding all other variables in the model constant.

Existence of Somebody Helps in the Study (ESHS):-This is the multinomial logit estimate for a one unit increase in ESHS score from (less than 2) points rate relative to (4.5-5.0) points, given the other variables in the model are held constant. If the student transfers from no ESHS to ESHS, the multinomial log-odds of increasing (less than 2) points to (4.5-5.0) points, would be expected to decrease by 6.692 units while holding all other variables in the model constant.

Average Number of Hours of Revision per Day (ANHRD) - This is the multinomial logit estimate for a one unit increase in ANHRD score for (less than 2) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student was to transfer from less than three ANHRD to equal / more than three ANHRD, the multinomial log-odds of increasing (less than 2) rate to (4.5-5.0) would be expected to increase by 16.991units while holding all other variables in the model constant. Similarly, we can explain the remaining variables.

The following equation obtained from appendix 4, it is used to estimate the rate of change the student's academic rate from (2.0-2.5) to (4.5-5.0).

$$Y = e^{-19.459+4.569X_2+0.146X_3+2.198X_4-2.692X_5+18.343X_7}$$

Father's Educational Status (FES):- This is the multinomial logit estimate for a one unit increase in FES score, for (2.0-2.5) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student's FES was to change from Less Than Higher Secondary School (LTHSS) to a Higher Secondary School and Above (HSSA), the multinomial log-odds of increasing from (2.0-2.5) points to (4.5-5.0) points, would be expected to increase by 4.569 units while holding all other variables in the model constant.

Mather's Educational Status (MES):- This is the multinomial logit estimate for a one unit increase in MES score for (2.0-2.5) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student's MES was to change from Less Than Higher Secondary School (LTHSS) to a Higher Secondary School and Above (HSSA), the multinomial log-odds of increasing the (2.0-2.5) rate to (4.5-5.0) would be expected to increase by 0.146 units while holding all other variables in the model constant.

Existence of Desire in the Specialization (EDS):- This is the multinomial logit estimate for a one unit increase in EDS score for (2.0-2.5) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student transfers from no EDS to EDS, the multinomial log-odds of increasing of (2.0-2.5) rate to (4.5-5.0), would be expected to increase by 2.198 units while holding all other variables in the model constant.

Existence of Somebody Helps in the Study (ESHS):-This is the multinomial logit estimate for a one unit increase in ESHS score for (2.0-2.5) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student transfers from no ESHS to ESHS, the multinomial log-odds of increasing (2.0-2.5) rate to (4.5-5.0) would be expected to decrease by 2.692 units while holding all other variables in the model constant.

Average Number of Hours of Revision per Day (ANHRD) - This is the multinomial logit estimate for a one unit increase in ANHRD score for (2.0-2.5) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student was to transfer from less than three ANHRD to equal / more than three ANHRD, the multinomial log-odds of increasing (2.0-2.5) rate to (4.5-5.0) would be expected to increase by 18.343 units while holding all other variables in the model constant. Similarly, we can explain the remaining variables.

The following equation obtained from appendix 4, it is used to estimate the rate of change the student's academic rate from (2.5-3.0) to (4.5-5.0).

$$Y = e^{-1.603+7.279X_2+0.342X_3+2.505X_4-5.599X_5+0.662X_7}$$

Father's Educational Status (FES):- This is the multinomial logit estimate for a one unit increase in FES score for (2.5-3.0) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student's FES was to change from Less Than Higher Secondary School (LTHSS) to a Higher Secondary School and Above (HSSA), the multinomial log-odds of increasing (2.5-3.0) rate to (4.5-5.0) would be expected to increase by 7.279 units while holding all other variables in the model constant.

Mather's Educational Status (MES):- This is the multinomial logit estimate for a one unit increase in FES score for (2.5-3.0) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student's MES was to change from Less Than Higher Secondary School (LTHSS) to a Higher Secondary School and Above (HSSA), the multinomial log-odds of increasing the (2.5-3.0) rate to (4.5-5.0) would be expected to increase by 0.342 units while holding all other variables in the model constant.

Existence of Desire in the Specialization (EDS):- This is the multinomial logit estimate for a one unit increase in EDS score for (2.5-3.0) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student transfers from no EDS to EDS, the multinomial log-odds of increasing (2.5-3.0) rate to (4.5-5.0) would be expected to increase by 2.505 units while holding all other variables in the model constant.

Existence of Somebody Helps in the Study (ESHS):-This is the multinomial logit estimate for a one unit increase in ESHS score for (2.5-3.0) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student transfers from no ESHS to ESHS, the multinomial log-odds of increasing (2.5-3.0) rate to (4.5-5.0) would be expected to decrease by 5.599 units while holding all other variables in the model constant.

Average Number of Hours of Revision per Day (ANHRD) - This is the multinomial logit estimate for a one unit increase in ANHRD score for (2.5-3.0) rate relative to (4.5-5.0) given the other variables in the model are held constant. If the student was to transfer from less than three ANHRD to equal / more than three ANHRD, the multinomial log-odds of increasing (2.5-3.0) rate to (4.5-5.0) would be expected to increase by 0.662 units while holding all other variables in the model constant. Similarly we can explain the remaining variables. Because there is only one significant variable, we cannot obtain an equation to estimate the rate of change of the student's academic rate from (3.5-4.0) to (4.5-5.0) and from (4.0-4.5) to (4.5-5.0) for all variables.

Also in appendix 4 we have: Std. Error:- These are the standard errors of the individual regression coefficients for the fourteenth respective models estimated.

Wald:- This is the Wald chi-square test that tests the null hypothesis that the estimate equals 0.

df:- This column lists the degrees of freedom for each of the variables included in the model. For each of these variables, the degree of freedom is 1.

Sig:- These are the p-values of the coefficients or the probability that, within a given model, the null hypothesis that a particular predictor's regression coefficient is zero given that the rest of the predictors are in the model. They are based on the Wald test statistics of the predictors, which can be calculated by dividing the square of the predictor's estimate by the square of its standard error. The probability that a particular Wald test statistic is as more extreme as or more so, than what has been observed under the null hypothesis is defined by the p-value and presented here. In multinomial logistic regression, the interpretation of a parameter estimate's significance is limited to the model in which the parameter estimate was calculated. For example, the significance of a parameter estimate in the rate(less than 2) relative to (4.5-5.0) model cannot be assumed to hold in the other rates relative to (4.5-5.0) model. For the rate(less than 2) relative to (4.5-5.0), the Wald test statistic for the predictor FES which was denoted by X2 is 10.950 with an associated p-value of 0.001. If we set our alpha level to 0.05, we would fail to accept the null hypothesis and conclude that for the rate (less than 2) relative to (4.5-5.0), the regression coefficient for FES has been found to be statistically different from zero, given the other rates are in the model.

For the rate (less than 2) relative to (4.5-5.0), the Wald test statistic for the MES which was denoted by X3 is 1.329 with an associated p-value of 0.249. If we set our alpha level to 0.05, we wouldn't reject the null hypothesis and conclude that for the rate (less than 2) relative to (4.5-5.0), the regression coefficient for MES has not been found to be statistically different from zero given the other rates are in the model.

For the rate (less than 2) relative to (4.5-5.0), the Wald test statistic for the predictor "Existence of Desire in Specialty" (EDS) which was denoted by X4 is 3.435 with an associated p-value of 0.064. If we set our alpha level to 0.05, we would not reject the null hypothesis and conclude that for the rate (less than 2) relative to (4.5-5.0), the regression coefficient for EDS has not been found to be statistically different from zero given the other rates are in the model.

For the rate (less than 2) relative to (4.5-5.0), the Wald test statistic for the predictor "Existence of Someone Helps in study" (ESHS) which was denoted by X5 is 7.490 with an associated p-value of 0.006. If we set our alpha level to 0.05, we would reject the null hypothesis and conclude that for the rate (less than 2) relative to (4.5-5.0), the regression coefficient for ESHS has been found to be statistically different from zero given the other rates are in the model.

Similarly the remaining results can be explained as mentioned above.

Exp(B): These are the odds ratios for the predictors. They are the exponentiation of the coefficients. There is no odds ratio for the variable student's rate (as a variable with 6 degrees of freedom) was not entered into the logistic regression equation. The odds ratio of a coefficient indicates how the risk of the outcome falling in the comparison group compared to the risk of the outcome falling in the referent group changes with the variable in questionnaire. An odds ratio > 1 indicates that the risk of the outcome falling in the comparison group relative to the risk of the outcome falling in the referent group increases as the variable increases. In other words, the comparison outcome is more likely. An odds ratio < 1 indicates that the risk of the outcome falling in the comparison group relative to the risk of the outcome falling in the referent group decreases as the variable increases. In general, if the odds ratio < 1, the outcome is more likely to be in the reference group.

At the rate (less than 2) relative to (4.5-5.0) we have:-Exp(B) for FES - This is the odds or "relative risk" ratio for a one unit increase in FES score for "less than two" rate relative to (4.5-5.0) rate level given that the other variables in the model are held constant. If the variable (FES) was to increase score by one unit, the relative risk of changing (less than two rate) to (4.5-5.0) rate would be expected to increase by a factor of 2984.509 given the other variables in the model are held constant. So, given a one unit increase in FES, the relative risk of being in the (less than two rate) group would be 2984.509 times more likely when the other variables in the model are held constant.

Exp(B) for MES - This is the odds or "relative risk" ratio for a one unit increase in MES score for "less than two" rate relative to (4.5-5.0) rate level given that the other variables in the model are held constant. If the variable (MES) was to increase score by one unit, the relative risk of changing (less than two rate) to (4.5-5.0) rate would be expected to increase by a factor of 7.184 given the other variables in the model are held constant. So, given a one unit increase in MES, the relative risk of being in the (less than two rate) group would be 7.184 times more likely when the other variables in the model are held constant.

Exp(B) for "Existence of Somebody Helps in Study":- This is the odds or "relative changing" ratio for a one unit increase in ESHS score for "less than two" rate relative to (4.5-5.0) level given that the other variables in the model are held constant. If the variable ESHS was to increase score by one unit, the relative of changing (less than two rate) to (4.5-5.0) rate would be expected to increase by a factor of 13.974 given the other variables in the model are held constant. So, given a one unit increase in ESHS, the relative of being in the (4.5-5.0) group would be 13.974 times more likely when the other variables in the model are held constant. More generally, we can say that if the variable was to increase ESHS score, we would expect the student to be more likely to change (less than two) rate over (4.5-5.0) rate. Similarly the remaining results can be explained as mentioned above.

95% Confidence Interval for Exp(B):- This is the Confidence Interval (CI) for an individual multinomial odds ratio given the other predictors are in the model for outcome 5 relative to the referent group. For a given predictor with a level of 95% confidence, we'd say that we are 95% confident that the "true" population multinomial odds ratio lies between the lower and upper limit of the interval for outcome 5 relative to the referent group. It is calculated as the $\text{Exp}(B \pm (z\alpha/2)^*(\text{Std.Error}))$, where $Z\alpha/2=1.96$ is a critical value on the standard normal distribution. This CI is equivalent to the z test statistic: if the CI includes one, we'd fail to reject the null hypothesis that a particular regression coefficient is zero given the other predictors are in the model. An advantage of a CI is that it is illustrative; it provides a range where the "true" odds ratio may lie.

From table 1, chi-square is 327.525 and highly significant, because sig. or p-value is less than 0.001, the fitted model is significant. In this table we have:

2(Log Likelihood):- This is the product of -2 and the log likelihoods of the null model and fitted "final" model. The likelihood of the model is used to test of whether all predictors' regression coefficients in the model are simultaneously zero and in tests of nested models.

Chi-Square:- This is the Likelihood Ratio (LR) Chi-Square test that at least one of the predictors' regression coefficient is not equal to zero in the model. The LR Chi-Square statistic can be calculated by -2*L(null model) - (-2*L(fitted model)) = 604.341- 276.816 = 327.525, where L(null model), is from the log likelihood with just the response variable in the model (Intercept Only) and L(fitted model) is the log likelihood from the final iteration (assuming the model converged) with all the parameters.

df:- This indicates the degrees of freedom of the chi-square distribution used to test the LR Chi-Square statistic and is defined by the number of predictors in the model (fifteen predictors in fourteen models).

Sig:- This is the probability getting a LR test statistic being as extreme as, or more so, than the observed statistic under the null hypothesis; the null hypothesis is that all of the regression coefficients in the model are equal to zero. In other words, this is the probability of obtaining this chi-square statistic (327.525), or one more extreme, if there is in fact no effect of the predictor variables. This p-value is compared to a specified alpha level, our willingness to accept a type I error, which is typically set at 0.05 or 0.01. The small p-value of the Lo.R test, < 0.00001, would lead us to conclude that at least one of the regression coefficients in the model is not equal to zero. The parameter of the chi-square distribution used to test the null hypothesis is defined by the degrees of freedom in the prior column.

Table (1): Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	604.341			
Final	276.816	327.525	90	.000

Also from table 2, we have chi-square is 410.662 which, is highly significant, because p-value is less than 0.001, so the fitted model is significant.

Table (2): Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	410.662	210	.000
Deviance	156.456	210	.998

Table 3 shows that nearly 56 % of the changes of the students' academic achievement depend on the change of the fifteen independent studied variables.

Table (3): Pseudo R-Square

Cox and Snell	.559
Nagelkerke	.572
McFadden	.216

From table 4, there are only variables x2, x3, x4, x5, x7 have a significant effect on y.

Table (4): Likelihood Ratio Tests

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	167.445a	.000	0	.
x2	199.854	32.409	6	.000
x3	183.644	16.199	6	.013
x4	184.778	17.333	6	.008
x5	183.112	15.667	6	.016

x7	196.413	28.968	6	.000
The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.				
a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.				

Variables with higher importance sequentially are X2 with p-value less than 0.0001 and 32.409 as chi-square, X7 with p-value less than 0.0001 and 28.968 as chi-square, X4 with p-value 0.008 and 17.333 as chi-square, X3 with p-value 0.013 and 16.199 as chi-square and X5 with p-value 0.016 and 15.667 as chi-square.

From table 5, chi-square is 277.162 and highly significant, because p-value is less than 0.001, so the fitted model is significant. In this table we have:

Table (5): Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	444.607			
Final	167.445	277.162	30	.000

Also from table 6, we have chi-square is 531.083 and highly significant, because p-value is less than 0.001, so the fitted model is significant.

Table (6): Goodness-of-Fit

	Chi-Square	df	Sig.
Pearson	531.083	72	.000
Deviance	81.650	72	.204

Table 7 shows that nearly 50 % of the changes of the students' academic achievement depend on the change of the five independent studied variables.

Table (7): Pseudo R-Square

Cox and Snell	.500
Nagelkerke	.511
McFadden	.182

RESULTS

A relationship exists between student academic achievement and the studied variable. Nearly 56 % of student academic achievement depending upon all the fifteen studied variables. Nearly 50 % of student academic achievement depends upon five variables, these variables are father's educational status, mother's educational status, existence of desire in the specialty, existence of someone helps in education and average number of hours of revision per a day.

DISCUSSIONS

Based on the above mentioned results, the following recommendations are offered:

- The student should maintain the variables that appeared with positive effect.
- The student should take benefit of the variables that appeared with negative effect.
- Conducting similar studies on variables rather than the ones included in the studied model.
- Making use of the results of the present study in planning for the enhancement of student academic achievement.
- To study why Existence of Somebody Helps in Study (ESHS), appears with a negative sign in the studied model.
- To study why there are some of the studied variables have no significant effect on the student's academic achievement.

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APPENDICES:-

Appendix (1): Questionnaire

No.	Variable	Symbol	Classification
1-	Students' Academic Rate (Dependent Variable)	Y	Less than 2 ( )
			2.0-2.5 ( )
			2.5-3.0 ( )
			3.0-3.5 ( )
			3.5-4.0 ( )
			4.0-4.5 ( )
			4.5-5.0 ( )
2-	Sex	X1	Female ( )
			Male ( )
3-	Father's Educational Status (FES)	X2	Less than Higher Secondary School ( )
			Higher Secondary School and above ( )
4-	Mother's Educational Status (MES)	X3	Less than Higher Secondary School ( )
			Higher Secondary School and above ( )
5-	Existence of desire in the specialization (EDS)	X4	No ( )
			Yes ( )
6-	Existence of Somebody Helps in Study (ESHS)	X5	No ( )
			Yes ( )
7-	Revision with colleagues in groups (RCG)	X6	No ( )
			Yes ( )
8-	Average number of hours of revision per day(AHR)	X7	Less than 3 hours ( )
			3 hours and above ( )
9-	The distance of college from your residence(DCR).	X8	Less than 50 km ( )
			More than 50 km ( )
10-	Can the majority of the students understand the Professors or Lecturers who teach courses(MSUP)?	X9	No ( )
			Yes ( )
11-	Are the classrooms equipped for teaching(CET)?	X10	No ( )
			Yes ( )
12-	Adequacy of the expenses(AE)	X11	Not Enough ( )
			Enough ( )
13-	Availability of courses (AC)	X12	No ( )
			Yes ( )
14	Taking advantage of Academic Advising(TAAA)	X13	No ( )
			Yes ( )
15-	participation in sports activities at the college (PSA)	X14	No ( )
			Yes ( )
16-	Participation in cultural activities at the college(PCA)	X15	No ( )
			Yes ( )

Appendix (2): Summary of Case Processing Data.

		N	Marginal Percentage
Students' Academic Rate	less than 2	40	10.0%
	2.0-2.5	40	10.0%
	2.5-3.0	80	20.0%
	3.0-3.5	70	17.5%
	3.5-4.0	80	20.0%
	4.0-4.5	40	10.0%
	4.5-5.0	50	12.5%
Sex (X1)	Female	200	50.0%
	Male	200	50.0%
Father's Educational Status (X2)	Less than heigher secondary (LHS)	204	51.0%
	Heigher secondary and above (HSA)	196	49.0%
Mather's Educational Status (X3)	Less than heigher secondary (LHS)	202	50.5%
	Heigher secondary and above (HSA)	198	49.5%
Existence of desire in the specialty (X4)	No	197	49.3%
	Yes	203	50.8%
Existence of somebody helps in study (X5)	No	200	50.0%
	Yes	200	50.0%
Revision with colleagues in groups (X6)	Less than 3 hours per day	217	54.3%
	3 hours and above per day	183	45.8%
Average number of hours of revision per day (X7)	No	221	55.3%
	Yes	179	44.8%
Far of college from your residence. (X8)	No	198	49.5%
	Yes	202	50.5%
Can you understand the majority of the Professors or Lecturers who teach courses? (X9)	No	199	49.8%
	Yes	201	50.3%
Does the classrooms equipped for teaching. (X10)	No	202	50.5%
	Yes	198	49.5%
Adequacy of the expenses (X11)	Not Enough	203	50.8%
	Enough	197	49.3%
Availability of courses (X12)	No	203	50.8%
	Yes	197	49.3%
Taking advantage of Academic Advising (X13)	Less than 3 hours	203	50.8%
	3 hours and above	197	49.3%
Contribution to sports activities of the college (X14)	No	210	52.5%
	Yes	190	47.5%
Participation to cultural activities of the college (X15)	No	210	52.5%
	Yes	190	47.5%
Valid		400	100.0%
Missing		0	
Total		400	
Subpopulation		51a	

a. The dependent variable has only one value observed in 28 (54.9%) subpopulations.

Appendix (3): Likelihood Ratio Tests

	Model Fitting Criteria			Likelihood Ratio Tests		
Effect	AIC of Reduced Model	BIC of Reduced Model	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	468.816	851.996	276.816a	.000	0	.
x1	457.917	817.148	277.917b	1.101	6	.982
x2	481.129	840.360	301.129b	24.313	6	.000
x3	472.142	831.373	292.142b	15.326	6	.018
x4	465.079	824.311	285.079b	8.263	6	.219
x5	464.381	823.613	284.381b	7.565	6	.272
x6	464.802	824.034	284.802b	7.987	6	.239
x7	488.945	848.177	308.945b	32.129	6	.000
x8	466.856	826.088	286.856b	10.040	6	.123
x9	462.874	822.106	282.874b	6.058	6	.417
x10	462.711	821.943	282.711b	5.895	6	.435
x11	456.817	816.049	276.817b	.001	6	1.000
x12	459.893	819.125	279.893b	3.077	6	.799
x13	459.893	819.125	279.893b	3.077	6	.799
x14	459.987	819.219	279.987b	3.171	6	.787
x15	459.987	819.219	279.987b	3.171	6	.787

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

b. Unexpected singularities in the Hessian matrix are encountered. This indicates that either some predictor variables should be excluded or some categories should be merged.

Appendix (4): Parameter Estimates

Students' Academic Ratea		B	Std. Error	Wald		Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Less than 2	Intercept	-19.773-	1.433	190.511	1	.000			
	[x2=0.00]	8.001	2.418	10.950	1	.001	2984.509	26.105	341213.340
	[x2=1.00]	0b	.	.	0	.	.	.	.
	[x3=0.00]	1.972	1.710	1.329	1	.249	7.184	.251	205.224
	[x3=1.00]	0b	.	.	0	.	.	.	.
	[x4=0.00]	2.637	1.423	3.435	1	.064	13.974	.859	227.276
	[x4=1.00]	0b	.	.	0	.	.	.	.
	[x5=0.00]	-6.692-	2.445	7.490	1	.006	.001	1.030E-5	.150
	[x5=1.00]	0b	.	.	0	.	.	.	.
	[x7=0.00]	16.991	.000	.	1	.	23943345.382	23943345.38	23943345.382
	[x7=1.00]	0b	.	.	0	.	.	.	.

2.0-2.5	Intercept	-19.459-	.819	564.393	1	.000			
	[x2=0.00]	4.569	2.760	2.742	1	.098	96.474	.432	21545.096
	[x2=1.00]	0b	.	.	0	.	.	.	.
	[x3=0.00]	.146	1.434	.010	1	.919	1.158	.070	19.247
	[x3=1.00]	0b	.	.	0	.	.	.	.
	[x4=0.00]	2.198	1.222	3.236	1	.072	9.007	.821	98.750
	[x4=1.00]	0b	.	.	0	.	.	.	.
	[x5=0.00]	-2.692-	2.850	.892	1	.345	.068	.000	18.067
	[x5=1.00]	0b	.	.	0	.	.	.	.
	[x7=0.00]	18.343	.000	.	1	.	92522592.986	92522592.99	92522592.986
	[x7=1.00]	0b	.	.	0	.	.	.	.
2.5-3.0	Intercept	-1.603-	.363	19.455	1	.000			
	[x2=0.00]	7.279	1.828	15.854	1	.000	1450.255	40.297	52193.648
	[x2=1.00]	0b	.	.	0	.	.	.	.
	[x3=0.00]	.342	1.244	.076	1	.783	1.408	.123	16.139
	[x3=1.00]	0b	.	.	0	.	.	.	.
	[x4=0.00]	2.505	.954	6.890	1	.009	12.248	1.886	79.525
	[x4=1.00]	0b	.	.	0	.	.	.	.
	[x5=0.00]	-5.599-	1.843	9.229	1	.002	.004	9.982E-5	.137
	[x5=1.00]	0b	.	.	0	.	.	.	.
	[x7=0.00]	.662	.804	.678	1	.410	1.939	.401	9.378
	[x7=1.00]	0b	.	.	0	.	.	.	.
3.0-3.5	Intercept	-.283-	.240	1.383	1	.240			
	[x2=0.00]	3.384	1.753	3.728	1	.054	29.492	.950	915.286
	[x2=1.00]	0b	.	.	0	.	.	.	.
	[x3=0.00]	1.352	1.143	1.399	1	.237	3.864	.412	36.285
	[x3=1.00]	0b	.	.	0	.	.	.	.
	[x4=0.00]	1.039	.910	1.302	1	.254	2.826	.474	16.828
	[x4=1.00]	0b	.	.	0	.	.	.	.
	[x5=0.00]	-2.849-	1.755	2.635	1	.105	.058	.002	1.806
	[x5=1.00]	0b	.	.	0	.	.	.	.
	[x7=0.00]	.167	.675	.061	1	.804	1.182	.315	4.442
	[x7=1.00]	0b	.	.	0	.	.	.	.
3.5-4.0	Intercept	.296	.210	1.985	1	.159			
	[x2=0.00]	3.064	1.712	3.205	1	.073	21.419	.748	613.484
	[x2=1.00]	0b	.	.	0	.	.	.	.
	[x3=0.00]	3.794	1.541	6.065	1	.014	44.421	2.169	909.632
	[x3=1.00]	0b	.	.	0	.	.	.	.
	[x4=0.00]	.423	.915	.214	1	.644	1.526	.254	9.175
	[x4=1.00]	0b	.	.	0	.	.	.	.
	[x5=0.00]	-2.716-	1.701	2.550	1	.110	.066	.002	1.854
	[x5=1.00]	0b	.	.	0	.	.	.	.
	[x7=0.00]	-2.526-	1.272	3.946	1	.047	.080	.007	.967
	[x7=1.00]	0b	.	.	0	.	.	.	.
4.0-4.5	Intercept	-.236-	.240	.963	1	.326			
	[x2=0.00]	2.573	2.265	1.290	1	.256	13.103	.155	1110.172
	[x2=1.00]	0b	.	.	0	.	.	.	.
	[x3=0.00]	3.955	1.679	5.546	1	.019	52.187	1.941	1402.788
	[x3=1.00]	0b	.	.	0	.	.	.	.
	[x4=0.00]	-.351-	1.077	.106	1	.744	.704	.085	5.813
	[x4=1.00]	0b	.	.	0	.	.	.	.

	[x5=0.00]	-2.771-	2.277	1.482	1	.224	.063	.001	5.425
	[x5=1.00]	0b	.	.	0	.	.	.	.
	[x7=0.00]	-2.297-	1.429	2.584	1	.108	.101	.006	1.654
	[x7=1.00]	0b	.	.	0	.	.	.	.

a. The reference category is: 4.5-5.0.

b. This parameter is set to zero because it is redundant.