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Multilevel Analysis on Determinants of Academic Achievement of Second Year Regular Students: The Case of Addis Ababa University School of Commerce

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Abstract : *The aim of this study is to identify factors affecting academic achievement of second year regular students of Addis Ababa University, School of Commerce. Data were obtained from primary and secondary sources. A cross-sectional survey was conducted on a total of 79 students from six different departments using multistage stratified sampling techniques. A designed questionnaire was used to obtain data on background information, student level, department level and school level. The secondary data were obtained from the registrar office of School of Commerce, Addis Ababa University. Multiple linear regression and multilevel linear regression were used to analyze the data. From the study, it was found out that multilevel regression model is much better than the classical regression model in fitting the data and in explaining the variations of the academic achievement at different levels. The results of this study showed that the mean academic achievements of commerce second year regular students were 2.54 with standard deviation of 0.432. The result revealed that the factors: study hours, mothers' educational level, teachers' commitment, standard of lectures and presentations, assessment and marking criteria, and course interest have positive effects on the achievement of students. On the otherhand, department preference and absent from school have negative effects on academic achievement of students. There was a high degree of variation of academic achievement of students among departments while there was similarity within departments.*

Keywords: *Academic Achievement, Linear Regression Analysis, Multilevel Analysis, School of Commerce*

I. Introduction

1.1 Background of the Study

The students are admitted into the University, with different admission points, from different socio-economic backgrounds and are from various school backgrounds, when they get into the University system. The management of the University transforms them through the process of teaching and learning and the students output is seen through their academic achievement (Koontz and Weihrich[1]). Schools, Colleges and Universities have no worth without students. Students are most essential assets for any educational institute. The students' academic achievement plays an important role in producing the best quality graduates who will become great leaders and manpower for a country thus responsible for the country's economic and social development (Ali et.al.[2]). Most of the researchers around the word used the GPA to measure the students' academic achievement (Galiher[1]; Diaz[3]; Barkley[4]; Kirnan[5]. The researchers used GPA to measure students' academic achievement in a particular semester; some other researchers, measure students' academic achievement through the result of a particular subject or the previous years' result (Harbet. Al.[6]; Roberts et.al.[7] and Hijazi et.al[8]).

It is suggested in the literature that student performance, learning facilities and socio-economic background are thought to be proximate determinants of academic performance of students, see for example, Kirmani et.al.[5]; Ali, et. al.[2]; Raychauduri et al.[10]; Robertset.al[7].; Kernan et.al.[5].Past studies on academic performance analysis were mainly descriptive in nature and limited to the study of associations between academic performances with certain academic performance-related variables. Few studies have been done on academic performance in students using linear regression model, and most of these studies are based on small-scale survey data. The present study is based on the academic achievements of second year undergraduate students of Addis Ababa University, School of Commerce. Commerce second year undergraduate Students are taken as population and focuses the students' average academic achievement for the three consecutive semesters. The main objective of this study is to identify the determinants on academic achievement of Commerce second year undergraduate regular students. Furthermore, the study assesses to check students' academic achievement variations across departments using multilevel linear regression analysis.

1.2 Statement of the problem

Many scholars do believe and recommend the need to conduct in-depth studies on the academic achievement of students based on students, teachers and schools characteristics (Howie[11]). Many researchers has been discussed the different factors that affect the students' academic achievement in their research works like students competency, class schedules, course text books, learning facilities, home works, assignments, complexity of the course material, teachers' role in the class and technology used in the class.The researchers share the idea and the main reason behind the need to study on the student level and department level factors and identification of the determinants of academic achievement of students. Therefore, this study attempt to address the following questions:

- What are the factors that affect the academic achievement at students'level within each department?
- How much of the variation of the academic achievement is accounted for department level and student level factors?

1.3 Significance of the study

The study may be helpful for policy makers, the concerned community and the school administration to design and implement the policies to improve the students' academic achievement and the quality of education by changing the attitude of students towards learning, motivating students towards their goal they have set to achieve and improving the teaching procedures. It may also create awareness among students about their rights and responsibilities to achieve quality of education. Furthermore, the study is expected to initiate researchers and used as a stepping stone for further studies on students' academic achievement issue and contribute some information on the application of multilevel analysis on educational data.

1.4 Limitation of the study

There are certain limitations of this study.

- The study was being carried out without including teachers and administrative staff.
- The study was conducted only on second year undergraduate students
- Including more other related factors that affect the students' academic achievement could have improved the results.

II. Statistical Data And Methodology

2.1 Description of the Study Area

This study is conducted in School of Commerce, Addis Ababa University. The School is found separately from the main campus. School of Commerce consists of six departments called Accounting, Administrative Service Management (ASM), Business Administration and Information System (BAIS), Finance and Development Economics (FNDE), Marketing Management (MM), and Logistic and Supplies Chain Management (LSCM). The School designs a program for each department in order to produce undergraduates and postgraduate (BA and MBA) who have broad knowledge in their fields of study, who are capable of formulating research projects and independently conducting research.

The **target population** considered in this study is the total number of second year undergraduate regular students of School of Commerce.

2.2 Sampling Design and Techniques

The study used cross-sectional survey with two-stage stratified sampling design method. The main purpose of stratification is to reduce sampling error due to heterogeneity and taking into account the existence of variability among the departments. Stratified sampling increases efficiency (Cochran[12]). At first and second stage, sample of second year students and the six departments of Addis Ababa University in School of Commerce were considered, respectively. Sample of students was taken from the sampled departments by probability proportional to academic achievement of Commerce second year students. The list of the ID Number and CGPA of second year undergraduate students from each department was collected from the registrar office of School of Commerce.

2.3 Sample Size Determination

In conducting researches that require taking a sample, we always have the stage of deciding the sample size. The decision is important because taking too large sample implies waste of resources while too small sample reduces the usefulness of the results. There are different ways of estimating the population variance for sample size determination. These are taking the variance from pilot survey, previous research work and by guesswork (Cochran[12]).Accordingly, since we cannot find the population parameters (μ, σ), then we can

determine the sample size from their estimators by conducting pilot survey. Using pilot survey, 35 students were selected randomly from six departments and sample size was decided.

Let $Y_i$be the CGPA of students with $\bar{y} = \frac{\sum_{i=1}^{n} Y_i}{n}$ and$s^2 = \sum_{i=1}^{n}(y_i - \bar{y})^2/n - 1$, so the sample size will be determined by the following formula:

$$n = \begin{cases} n_0 & \text{if } \frac{n_0}{N} < 5\% \\ \frac{n_0}{1 + \frac{n_0}{N}} & \text{if } \frac{n_0}{N} \geq 5\% \end{cases}$$

where, $n_0 = \frac{z_{\alpha/2}^2 S^2}{d^2}$

s^2 =variance of CGPA of sample students

z= theoretical value corresponding to the 5% level of significance, set as$z_{\alpha/2}$=1.96

d= marginal error determined by the investigator, set as 0.07

n= the required sample size,

N= population size

The selected pilot question is: what is your CGPA of the first three consecutive semesters?

Response	No. of students	Average	SD
CGPA	35	2.331	0.356

As we observed from the table, 35 students were selected for pilot survey. So the pilot sample size and target population were 35 and 268, respectively.

In the study, we have taken d=0.07, $= 0.05$, $z_{\alpha/2}$ =1.96

$n_0 = \frac{Z_{\alpha/2}^2 S^2}{d^2} = \frac{(1.96)^2(0.356)^2}{(0.07)^2}$=99.32

$\frac{n_0}{N} = \frac{99.32}{268}$ =0.37>5%

$n = \frac{n_0}{1+\frac{n_0}{N}} = \frac{99.32}{1+99.32/268}$ =72.46≈ 73.

From the above calculation the minimum sample size required to get the maximum precision is to be 73 students. But for this study we considered a sample of 79 students.

To select the study population from the target population, stratified random sampling technique is used. Therefore, the population is stratified in to six stratums (Stratum1= second year regular students of Accounting department, Stratum2= second year regular students of ASM department, Stratum3 = second year regular students of BAIS department, Stratum4= second year regular students of FNDE department, Stratum5= second year regular students of MM department and Stratum6= second year regular students of LSCM department). When the size of the sample from a given stratum is proportional to the size of the stratum, proportional allocation will be used. That is in proportional allocation; a small sample will be taken from a small stratum and large sample will be taken from a large stratum and the sample size in each stratum will then be added. (Cochran[12]).

$$\frac{n_h}{N_h} = \frac{n}{N} \Rightarrow n_h = \frac{n}{N} N_h$$

where, $N = \sum N_h$ -------- total number of second year regular Commerce students

$n_h =$ Sample size drown from stratum Nh

$N_h =$ Population size in h stratum (in hth department)

$n =$ Total sample size required = $n_1 + n_2 + n_3 + n_4 + n_5 + n_6$

Population in each department (N_h) and sample drawn from each department (n_h) are given below:

Population	Sample size drawn
N_1=115	n_1=31.32≈ 32
N_2=62	n_2=16.88≈ 17
N_3=23	n_3=6.26≈7
N_4=43	n_4=11.73≈ 12
N_5=20	n_5=5.45≈ 6
N_6=5	n_6=5

2.4 Data Collection Method

Both primary and secondary data were used for the study. For the randomly selected students, secondary data (CGPA of second year undergraduate regular students) were collected from the registrar office of school of Commerce. Primary data were collected using a designed questionnaire from the students whose secondary data were taken.

2.5 Study Variables

The response variable is the academic achievement of second year undergraduate regular students of School of Commerce and it is measured by the cumulative grade point average (CGPA) of three consecutive semesters.

Independent Variables:

- **Background characteristics**: sex, age, religion, family income, father's educational level and mother's educational level
- **Student Level characteristics:** department preference, study hours, absent from school, mother's educational level
- **Teacher related characteristics**: teaching method fit with subject curriculum, teaching preparation, course coverage, teachers interest towards their profession
- **Department level characteristics**: teachers' commitment to their job, standard of lectures and presentations, assessment and marking criteria and teachers' interest towards the course they have been teaching
- **School level characteristics**: accessibility and quality of library resources, ICT (internet connection), and course materials.

2.6 Methods of Data Analysis

The first step in the analysis was to produce descriptive statistics for the department and student-level factors. Thereafter a correlation matrix was made to identify the variables which had some association with students' academic achievements. The multilevel modeling was used to identify factors affecting students' academic achievement and to distinguish the variation in achievement across departments. All the computations were done using SPSS and MLwin software. SPSS was used for the descriptive and linear regression analysis part, and the MLwin was used for the multilevel analysis part.

i. Classical Linear Regression Analysis

Multiple linear regression analysis is a statistical technique which had been designed to assess the extent of relationship between a continuous dependent variable and explanatory variables.
A linear model relating the response variabley_i to several predictors has the form

$$y_i = \beta_0 + \sum_{p=1}^{k} \beta_p x_{pi} + \varepsilon_i.$$

The parameters $\beta_0, \beta_1, \ldots, \beta_k$ are called regression coefficients, $\varepsilon_i$is the residual term which provides for random variation in y_i not explained by the x variables. This random variation may be due partly to other variables that affect y_i but are not known or not observed.

2.6.1 Multilevel Linear Regression Model

Multilevel linear regression model is applied in educational research since many problems in education are multilevel characteristics. Thus, it is used as a standard approach to handle such nested structure of educational data (Goldstein[13]).

Model Specification: A multilevel linear regression model is a statistical expression enabling the study of simultaneous effects of factors from students, level-one, and departments, level-two, on academic achievement of students.

The **Random Coefficients Model**: used to assess whether the slope of any of the explanatory variables has a significant variance component between the groups. The random coefficient model is given as follows:

$$Y_{ij} = \underbrace{\beta_o}_{\substack{overall \\ mean}} + \underbrace{\beta_1 X_{1ij} + \ldots + \beta_m X_{mij} + \varepsilon_{ij}}_{student\text{level}} + \underbrace{\beta_{m+1} X_{(m+1)j} + \ldots + \beta_n X_{nj} + U_j}_{department\text{level}}$$

where

$y_{ij}$is achievement of students,
$\varepsilon_{ij}$is level one variance,

$U_j$level two variance, m student-level explanatory variables and n − m department-level explanatory variables.

The proportions of variance explained by the final model at student level and department level, respectively are: $\frac{\sigma^2_{\varepsilon(null)} - \sigma^2_{\varepsilon(final)}}{\sigma^2_{\varepsilon(final)}}$, and $\frac{\sigma^2_{u(null)} - \sigma^2_{u(final)}}{\sigma^2_{u(final)}}$, where $\sigma^2_{(null)}$ and $\sigma^2_{(final)}$ are variances of null and final models, respectively.

The **null model**: a model in which all explanatory variables are fixed. $Y_{ij} = \beta_0 + U_{oj} + \varepsilon_{oij}$, the index i indicating student, j indicating department, U_{oj} is level two error, ε_{0ij} is level one error, β_0 is interpreted as the overall average of academic achievement and Y_{ij} is academic achievement of i[th] student in j[th] department.

The null model is used for different purpose such as to decompose the total variance, to estimate the interclass correlation and to measure how much of the variation is explained by the model with no predicators included. The total variance is decomposed as the sum of the department-level and student-level variances: $\text{var}(Y_{ij}) = \text{var}(U_{oj}) + \text{var}(\varepsilon_{oij}) = \sigma^2_{\varepsilon} + \sigma^2_{u}$. The variances σ^2_{ε} and σ^2_{u} estimate the variation among departments and among students, respectively. It is, therefore, possible to decompose the variance at two levels to assess how much of the variation is due to students themselves and how much is due to department.

III. Data Analysis

3.7 Determinants of Academic Achievement: A Multiple Linear Regression Analysis

The most important explanatory variables of academic achievement of students were identified using stepwise selection method in multiple linear regressions. In this model, department preference (0=based on their first choice; 1=not based on their first choice), study hours, absent from school (0=yes; 1=no), mother educational level (0=illiterate; 1=literate), teachers' commitment (0=dissatisfied; 1=satisfied), standard of lectures and presentations (0=dissatisfied; 1=satisfied), assessment and marking criteria (0=dissatisfied; 1=satisfied), and interest towards the course attended (0=dissatisfied; 1=satisfied) were found to be determinants of academic achievement of commerce second year students at 5% level significant. The study indicated that absent from school and department preference had negative impacts on academic achievement of students. The variables like study hours, mother educational level, teachers' commitment, standard of lectures and presentations, assessment and marking criteria and course interest had positive effects on the achievement of students.

Table 1: Identified variables using multiple linear regression models

Variables	B	Std. Error	t	Sig.
Student level				
Constant	1.348	.482	2.795	.007*
Department preference	-.278	.087	-3.191	.000*
Study hours	.245	.058	4.227	.000*
Absent from school	-.080	.016	-4.928	.000*
Cheat on exam	.266	.082	3.244	.000*
Mother educational level	.044	.015	3.000	.003*
Department level				
Teachers' commitment	.135	.060	2.250	.018*
Standard of lectures and presentations	1.031	.203	5.072	.000*
Assessment and marking criteria	.161	.044	3.659	.000*
Interest towards the course attended	.228	.051	4.475	.000*

*Significant ($p<0.05$)

3.8 ANOVA to Test Mean Difference among Department

In the multilevel analysis, a two-level structure is used with departments as the second-level unit and students as the first-level units. This is basically with the expectation that there would be a difference in the academic achievement of students among the departments. In this part, we test if there are differences in the mean achievement of students among departments before proceeding to multilevel model analysis. We can carry out a mean test for school mean differences, i.e. a test of the null hypothesis ($H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = 0$ (no differences among departments)). The alternative hypothesis (H_A: At least there is difference between two departments)). The F-test was used to test for differences between the departments means. The F-test statistic gives Fcal=2.634, df (5, 72), P.value=0.030<0.05. Thus, there is evidence for heterogeneity among the department with respect to academic performance of students. We conclude that there are real differences

(variation) between departments in the mean academic achievement students. The results presented in the subsequent sections are carried out using the MLwin software.

3.9 Multilevel Linear Regression Model without Explanatory Variables

The results of fitting multilevel linear regression model without explanatory variables are presented in Table 2. It is observed that the level oneandleveltwo variance were significant indicating that student and department difference contributed for the variation in academic achievement of students.

Table 2. Results for Multilevel Linear Regression Model without explanatory variables

Parameters of null model	estimate	S.E.	Z-value	P-value
Fixed Part				
Intercept (β_0)	0.2578	0.0366	7.04	0.000*
Random Part: Variance Component				
Level-two variance				
$\sigma_u^2 = \text{var}(u_{0j})$	1.06	0.305	3.46	0.000*
Level-one variance				
$\sigma_\varepsilon^2 = \text{var}(\varepsilon_{0ij})$	0.157	0.015	10.47	0.000*
ρ (ICC)	0.87			
Overall fit -2*log(likelihood) Chi- squared based statistics, 2 df			1076.392	0.000*

* Significant ($p<0.05$)

The variances σ_ε^2 and σ_u^2 estimate the variation among students and among departments, respectively. It is, therefore, possible to decompose the variance into student level and department level variance to assess how much of the variation is due to students themselves and how much is due to departments. The sources of variation in the model are students and departments. From the result given above most of the variation in student achievement was accounted for by department differences while small amount of variation associated with individual student differences. Also, the empty model provides an estimate for the intra-class correlation. It is calculated as department-level variances divided by the total variance of student achievement defined as:

$$ICC = \rho = \frac{\sigma_u^2}{\sigma_\varepsilon^2 + \sigma_u^2} = \frac{1.06}{0.157 + 1.06} = 0.87$$

Since the value of ρ is large which indicated that achievement within each department is more homogeneous but there is large difference or variation between departments i.e. between department variations is higher than within department variation. From this value, it is also important to note the appropriateness of multilevel model for the analysis of given data because of clustering or nesting effect of students in departments. The result indicated that 87% of the variance on academic achievement can be explained at department level and the remaining 13% of the variance in the overall achievement was accounted for the individual student difference.

3.10Determinants of Academic Achievement: Random Intercept Model and Fixed Explanatory Variables

As can be seen from Table 3, the analysis of multilevel linear regression revealed that academic achievement of students varied among departments. To identify the effect of explanatory variables a multilevel regression model with random intercept and fixed explanatory variables were estimated using MLwin software. The deviance based chi-square test for significance of the overall goodness fit model(X^2 =- 2log(likelihood of null model) - (-2log(likelihood of final model))=1076.392-599.402=477.99, df = 44, P<0.05)indicates that the random intercept model with the fixed explanatory variables is found to be a better fit as compared to the empty model.In addition, department preference, study hours, absent from school, mother educational level from student level variables and teachers' commitment, standard of lectures and presentations, assessment and marking criteria and course interest from department level were also found to be significant determinants of variation in achievement of students. From the random part the level-one and level-two variances of the random intercept model $\sigma_{\varepsilon(\text{final})}^2 = \text{var}(\varepsilon_{0ij})$ and $\sigma_{\varepsilon(\text{final})}^2 = \text{var}(\varepsilon_{0ij})$ was found to be significant, which implies that individual students and department difference contributing for the variation of academic achievement of students from the random slope and fixed explanatory model.

Table3. Results in Fixed and Random Intercept Linear Regression Model

Variable	Estimate	S.E.	Z-value	P-value
Intercept (β_{0j})	1.358	0.291	4.67	0.000*
Fixed Part				
Student level				
Department preference	-0.082	0.032	-2.68	0.004*
Study hours	0.034	0.014	2.43	0.007*
Absent from school	-0.042	0.018	-2.33	0.009*
Cheat on exam	0.071	0.016	4.06	0.000*
Mother educational level	0.371	0.024	14.95	0.000*
Department level variables				
Teachers' commitment	0.027	0.014	1.92	0.054
Standard of lectures and presentations	0.057	0.018	3	0.013*
Assessment and marking criteria	0.042	0.018	2.6	0.008*
Course interest	0.043	0.014	3.285	0.000*
Academic counseling	0.031	0.015	2.133	0.032*
Random Effect				
Department level $\sigma^2_{u(final)} = \text{var}(u_{0j})$	0.112	0.003	3.36	0.00*
Student level $\sigma^2_{\varepsilon(\text{final})} = \text{var}(\varepsilon_{0ij})$	0.134	0.008	16.5	0.000*
-2*log(likelihood) Chi-squared based statistics, at 44 df598.402				0.000*

IV. Conclusions and Recommendations

This study was designed to identify the factors affecting the academic achievement of students based on primary and secondary data. Multiple linear regression and multilevel linear regression models were used. The results showed the importance of using student-level and department-level factors simultaneously in order to understand the variation in students' academic achievement. The results showed that the academic achievement of undergraduate regular students was affected by the student level variables like study hours, absent from school, mother's educational level, department preference and department level variables like teachers' commitment to their job, standard of lectures and presentations, assessment and marking criteria and teachers' interest towards the courses they had been teaching.

The study also indicated that absent from school and department preference had negative impact on academic achievement of students. The variables like study hours, mother's educational level, teachers' commitment towards their job, standard of lectures and presentations, assessment and marking criteria and interest of teachers towards the course they had been teaching were found to be positively related with the academic achievement of students. It can be concluded that the variation of academic achievement of Commerce second year undergraduate regular students was higher among departments while there was similarity within departments. It was found out that multilevel modeling is much better than the classical regression model in fitting the data and in explaining the variations of the students' academic achievement across departments.

From the results and the discussion we made the following recommendation:

- The government and the concerned bodies: students, teachers, school administration and policy makers need to work together to improve the academic achievement of students.
- Accessibility and quality of leaning facilities to the students (library, ICT (internet connection), course materials) need to be provided by the school in order to increase the academic achievement of students.
- The school administration and stakeholders should maximize teachers' interest and commitment to their job in some departments whose relative performance of students was found to be low.

References

[1]. Koontz, H and Weihrich, H. (1988). Management. McGraw- Hill, INC. New York

[2]. Ali, Norhidayah, Jus off, Kamaruzaman, Ali, Syukriah, Mokhtar, Najah and Salamt, Azni Syafena Andin. (2009). 'The Factors Influencing Students' Performance at Universiti Teknologi MARA Kedah, Malaysia'. Canadian Research & Development Center of Sciences and Cultures: Vol.3 No.4.

[3]. Diaz, Antonia Lozano. Personal, Family Academic Factors Affecting Low Achievement In Secondary School. Electronic Journal of Research in Educational Psychology and Psychopedagogy, 1(1), 43-66. ISSN: 1696-2095

[4]. Barkley, Andrew. (2006). 'The Determinants of College Student Performance: The Role of Assessment Method'. WAEA annual meetings.

[5]. Kernan, Willium, Bogart, Jane and Wheat, Mary E. (2011). Health related Barriers to learning among graduate student, Health Education, vol. 11, No. 5, pp.425-455.
[6]. Harb, Nasri and El-Shaarwi, Ahmed. (2006).'Factors Affecting Students' Performance'. MPRA Paper No. 1362.
[7]. Roberts, Kerry L. & Sampson, Paulinen M.(2011).School board member professional development and effect on student achievement. International Journal of Educational Management, vol.25, No.7, pp.701-713.
[8]. Hijazi, Syed Tahir and Naqvi, S.M.M. Raza. (2006). 'Factors Affecting Students' Performance: A Case of Private Colleges'. Bangladesh e-Journal of Sociology: Volume 3, No. 1.
[9]. Kirmani, Neghat Sana &Siddiquah, Aishah (2008). Identification and Analysis of Factors Affecting Students Achievement in Higher Education.2nd International Conference on assessing quality in higher education.
[10]. Raychaudhuri, Amitava, Debnath, Manojit, Sen, Seswata & Majundra, braja Gopal. (2010). Factors affecting Student's academic performance: A case study in agartala municipal concial area. Bangladesh e-journal of sociology, vol.7, No. 2.
[11]. Howie, S.J. (2003). English Language Proficiency and Contextual Factors Influencing Mathematics Achievement of Secondary School Pupils in South Africa. Enscheda: Doctoral dissertation, University of Twente.
[12]. Cochran, W. (1977). Sampling Techniques. Third Edition. John Wiley and Sons (ASIA) PteLtd
[13]. Goldstein, H., Rasbash, J. and Yang, M. (1998). A Multi-level Analysis of School Examination Results.Oxford Review of Education, 19 (4), 425-433.

Appendix