

Assessing determinants of Performance of Students' Towards Applied Mathematics I in the Case of Mettu University, Oromia, Ethiopia

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Abstract: The study was conducted in Mettu University. For this study data were collected by using questionnaires. So, the researcher was used primary data collection method. In this study, the researcher applied simple random sampling and stratified sampling technique which is used to select samples from the target population and the sample size used in the study was 2800 observations. The researcher is primarily used based on quantitative research, which constructed multiple regression model to identify and measure the predictors of performance of students towards Applied Mathematics I in the study area. A total of 533 students were included. Of these 139(26.1%) were females and 394(73.9%) were male. The correlation analysis of performance of students indicate that, there is statistically and significantly positive correlation between age, marital status, grade level, economic status and classroom instruction with average score of student's results. This means that as these variables increase average score results of students also will increase and vice versa. Age, EHEECE mark, Applied mathematics have statistically significant effects on the students' performance (CGPA).

Keyword: Mathematics, Applied Mathematics I, performance of student

1 INTRODUCTION

Now a days education has been an important aspect of human life throughout the understanding of what is going on. Education is one most fundamental and important instrument to drive an individuals as well as the community civilization and development. Globalization, technological revolution and education is considered as a first step for every human activity. It plays a vital role in the development of human capital and is linked with an individual's well-being and opportunities for better living [1]. It ensures the acquisition of knowledge and skills that enable individuals to increase their productivity and improve their quality of life. This increase in productivity also leads towards new sources of earning which enhances the economic growth of a country [2].

Mathematics is the science of reasoning and computations. It is the science or study of numbers, quantities or shapes. [3], [4] defined mathematics as the language that helps us to describe ideas and relationships drawn from the environment. Mathematics enables one to make the invisible to be visible, thereby solving problems that would be impossible otherwise.

Beside these, Ethiopia had formulated education and training policy about two decades ago in which all citizens participate equally with a considerable affirmative action given for the formerly marginalized groups, especially women. Supporting this idea the ministry of education of the country mentioned that, though this much effort is made to foster science and technology for the wellbeing of the country as well as the individuals, educational sector is being challenged by limited achievement of female students' in mathematics and sciences at different educational levels [5].

Mathematics is believed to be a core subject in all disciplines and in the area of natural sciences in particular and it is clear that mathematical knowledge matters the knowledge of other fields of studies such as Science, Technology, Engineering and Mathematics (STEM). Promoting this idea, [6] stated that mathematics is the bedrock of all sciences. Applied mathematics I has been one of the compulsory course that are given at all universities pre engineering students and for some other fields. Even though the course is accredited this much, more students usually score below the desired average rather than other pre engineering courses.

Therefore, this study focuses on forecasting the performance of students' towards applied Mathematics I course. The main reasons that inspire the researchers to focus the study on the performance towards applied mathematics I is most of first year pre-engineering students in Mettu University, they can't achieved the expected goal in applied mathematics at different times. During their stay in this University, the researchers observed that, first year Mettu University students are expected to solve different mathematical problems that need various steps from the simplest to complex, for most of the students these activities were difficult tasks and they have not achieved the expected outcomes at that level. Therefore, these reasons initiated the researchers to assess factors in relation to achievement in applied mathematics of students and come up with possible solutions.

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2 METHODOLOGY

2.1 Study population and sampling techniques

The data for this study was collected from several sections of pre engineering in the fall semester of 2010 and 2011 batch of Mettu University. For this study simple random sampling were applied and there were 533 students were enrolled in the course, taught by fourteen different instructors. Each section had approximately 50 students initially enrolled.

2.2 method of data analysis

2.2.1 Descriptive Statistics

Descriptive statistics utilizes numerical and graphical methods to look for patterns in the data set to summarize the information which reveled in the data set and to present the information in convenient form. The main purpose of descriptive statistics to provide an over view information which collected. In most cases, descriptive statistics used to examine or explore one variable at a time. Always analysis of statistical data begun by describing the raw data; in order to achieve this, descriptive statistics plays an important role. Descriptive statistics describes the data collect through numerical measurement, chart, and frequency distribution and so on.

2.2.2 Inferential Statistics

Inferential statistics describes the data with making any inferences by generalization and by summarizing sources of numeric data in to meaningful form. In this study regression will be used to identify potential risk factor that affects performance of students.

2.2.2.1 The regression Analysis

The method of data analysis to measure the functional relationship between the dependent variable and one or more independent variables is a regression analysis. A linear regression equation of the dependent variables Y on K independent variables $x_1, x_2, x_3, \dots, x_k$ is given by

$$Y = B_0 + B_1x_1 + B_2x_2 + \dots + B_kx_n + \epsilon$$

$B_1, B_2, B_3, \dots, B_k$ are the slopes(the change in Y for the unit change in the explanatory variable x_1).

Multiple Linear regressions

If more than one independent variables are estimated with a dependent variables, than such a regression model is called regression model

$$Y = B_0 + B_1x_1 + \dots + B_kx_k + \epsilon$$

4. RESULTS AND DISCUSSION

The preceding chapter presents the empirical results based on the multiple regressions to test these outcomes of the analysis data and provides the results from the analysis of data and its interpretation for Performance of students towards applied mathematics in Mettu University. The investigation is with regard to the relationship between Performance of students(measured by CGPA) towards applied mathematics as dependent variable and Sex, age, EHEECE mark, math's enjoyment, self confidence, motivation, foundation, Applied mathematics Grade as independent variables.

Therefore, this chapter deals with the results of the study which include descriptive statistics of variables, correlation results for dependent and independents variables, diagnosis test for the regression models, and regression analysis for Performance of students towards applied mathematics measures and eventually the summary of the chapter is presented in the last section.

4.1 Descriptive results of independents variables

All tables and figures will be processed as images. You need to embed the images in the paper itself. Please don't send the images as separate files. This section reports the descriptive results of factors affecting performance of students towards applied mathematics in Mettu University. The data for this study contains 533 randomly selected students of which 139(26.1%) were females and the remaining 394(73.9%) were male.

The summary statistics of data is given in table 4. 2. As shown in the table 4.1 the average cumulative average grade point is 2.43.

Table 4.1 Descriptive statistics

Descriptive Statistics					
Variables	N	Minimum	Maximum	Mean	Std. Deviation
CGPA	533	.45	4.00	2.4296	.62515
Age	533	18	24	19.94	1.198
Applied mathematics Grade	533	20	85	47.21	16.844
EHEECE Mark	533	19	80	48.66	13.257

Table 4.2 Summary results between dependent variable performance of students towards applied mathematics and independ-

ent variables.

Variables		Frequency	Percentage
Sex	Female	139	26.1
	Male	394	73.9
Mathematics En-joyment	Yes	39	7.3
	No	494	92.7
Self confidence	Yes	13	2.4
	No	520	97.6
Motivation	Low	490	91.9
	Medium	36	6.8
	High	7	1.3
Foundation	Yes	499	93.6
	No	34	6.4

Summary descriptive results were presented in table 4.2 above. In this study a sample 533 sample students was considered.. Of these 139(26.1%) were females and 394(73.9%) were males. Out of the entire subject integrated in this study; the frequency and percentage of students who enjoy with mathematics problem and not enjoy with such problem were 39(7.3%), and 494(92.7%) respectively.

Out of the total students who has a self-confidence while doing mathematics problem(self-confidence) included in this study 13(2.4%) and 520(97.6%) were self-confidence, and had no self confidence respectively.

As shown in figure 1 above out of the 533 sample of students who participated in the study area 91.93 % (490) were has low motivation towards mathematics problem, 36(6.75%) are medium motivation and 7(1.31%) were highly motivated related to applied mathematics during the study period.

4.2 Inferential Results for the Outcome Variable

In this section, the correlation matrix, co linearity information of independent variables and multiple linear regression results and checking the assumptions of multiple linear regression analysis are presented.

In this section, the correlations matrix was used to measure the degree of linear association between two variables. In our case, we have to correlate the relation between Independents and outcome variables (CGPA of students).

Variance Inflation Factors (VIF) greater than 10 are generally seen as indicative of severe multi-collinearity. The 1/VIF column is the tolerance and it ranges from 0 to 1, with 1 being the absence of multi-collinearity. In our case all of the VIFs are below 10 and all of the tolerances are close to one indicating that there is no problem of multi-collinearity in our data.

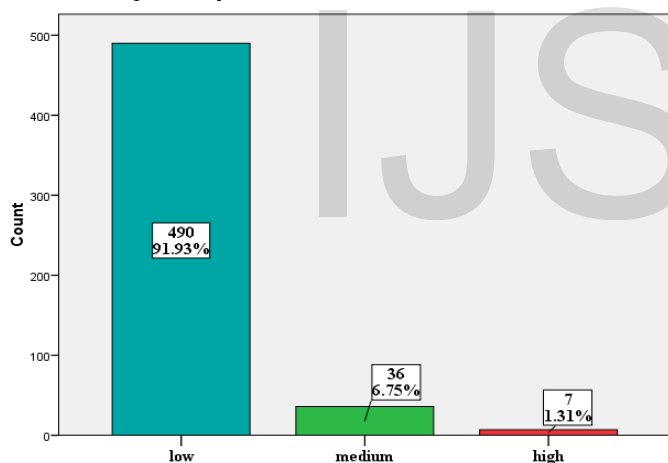


figure 1 students motivation related to performance of students towards applied mathematics

Table 4.3 Correlation Matrix of dependent and independent Variables.

Variables	CGPA	Sex	Age	EHEECE mark	Mathematics enjoyment	Self confidence	Motivation
CGPA	1.0000						
Sex	0.1389	1.0000					
Age	-0.0268	0.0594	1.0000				
EHEECE Mark	0.1386	-0.0228	0.0097	1.0000			
Mathematics enjoyment	0.3683	0.1013	-0.0340	0.1921	1.0000		
Self confidence	0.2342	0.0662	-0.0225	0.1519	0.2825	1.0000	
Motivation	0.4032	0.0517	-0.0094	0.1477	0.3097	0.5754	1.0000
Foundation	0.2349	0.0723	0.0061	0.0050	0.0733	0.0413	0.0734
Applied grade	0.7830	0.0794	-0.0185	0.1172	0.3676	0.2466	0.3942

Table 4.3 shows us correlations between CGPA of students and independent variables. Performance of students (CGPA) is negatively correlated with age of students. The coefficient estimate of correlation is -0.0268. The result suggests that age of students are independent of performance of students towards applied mathematics. Likewise, sex of students, EHEECE mark, mathematics enjoyment, self confidence, motivation, applied mathematics grade and foundation were positively correlated with CGPA of students. The significance effect of this result is indicated in the multiple linear regression model result. This means that as these variables increase CGPA of students also will increase and vice versa.

The correlation matrix is presented in Table 4.3, to check whether these correlations create the so called multicollinearity problem, a formal assessment is done using variance inflation factors and condition number criteria.

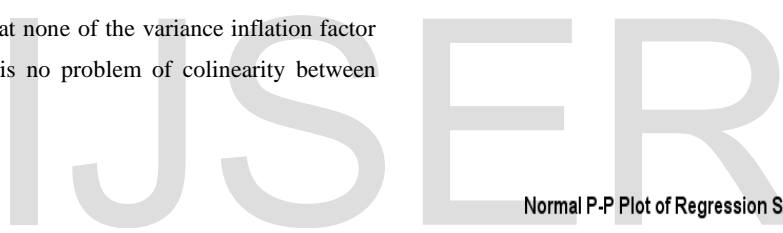
In this assessment, first VIF is applied to detect multicollinearity in the model. It has been noted that if any of the VIF is greater than 10, those variables are highly related to the other repressors. But in all cases as shown in Table 4.4, it is found that none of the variance inflation factor is greater than 10. Hence there is no problem of colinearity between independent variables.

Applied mathematics Grade	.766	1.306
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4.5 Multiple Linear Regression Results

4.5.1 Model Specification

Before we fit the multiple linear regression model, first we check for linear functional form based on graphical displays of the dependent variable with each of the independent variables. The plots displayed in Figure 2 indicate that the relationship between the dependent and independent variables is linear.



Normal P-P Plot of Regression Standardized Residual

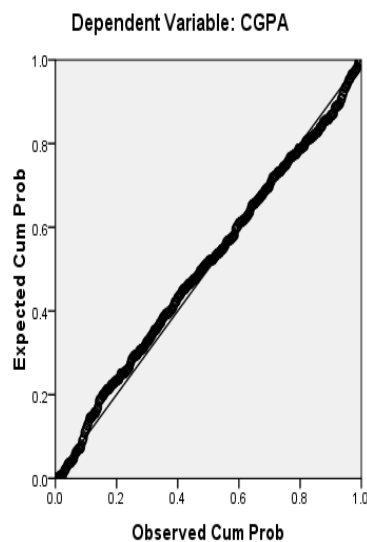
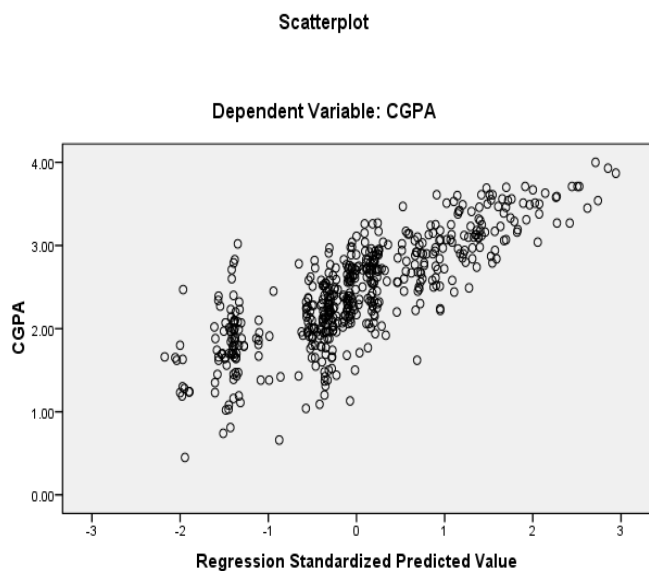


Table 4.4 Variance inflation factor (VIF)

Variables	Collinearity Statistics	
	Tolerance	VIF
Sex	.977	1.024
Age	.994	1.006
EHEECE mark	.947	1.056
Math enjoyment	.798	1.254
Self confidence	.653	1.531
Motivation	.595	1.682
Foundation	.974	1.026



The fitted multiple linear regression models are given by:

$$Y(CGPA) = \beta_0 + \beta_1SEX + \beta_2AGE + \beta_3EHEECE + \beta_4MATHS + \beta_5Self\ confidence + \beta_6motivation + \beta_7foundation + \beta_8applied\ math + \epsilon_i$$

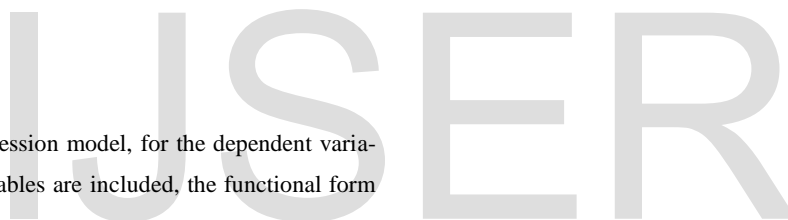
equation(4.1)

Where β_0 is a constant which gives the value of Y, when X=0. It is called the Y intercept. $\beta_1, \beta_2, \dots, \beta_8$ is indicating the slope of the regression line, and it gives a measure of the change in Y for a unit change in X_1, X_2, \dots, X_{14} . It is also regression coefficient of Y on X_i .

The result of OLS (Ordinary least square estimation) estimates for the multiple linear regression model given in equation (4.1) are shown in Table 4.6

Figure 2 Normal P-P plot of regression standardized residual for CGPA of students

Next we fit a multiple linear regression model, for the dependent variable when all the explanatory variables are included, the functional form is:



Coefficients							
Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B	
	B	Std. Error	Beta			Lower Bound	Upper Bound
(Constant)	.922	.286		3.230	.001	.361	1.483
Sex	.095	.037	.067	2.548	.011	.022	.168
Age	-.009	.014	-.016	-.630	.529	-.035	.018
EHEECE mark	.002	.001	.034	1.292	.197	.000	.004
Math enjoyment	.156	.070	.065	2.238	.026	.019	.292
Self confidence	-.141	.130	-.035	-1.086	.278	-.396	.114
Motivation	.208	.063	.111	3.304	.001	.084	.331
Foundation	.298	.067	.117	4.443	.000	.166	.430
Applied mathematics Grade	.026	.001	.697	23.555	.000	.024	.028

a. Dependent Variable: CGPA

From table 4.6 above multiple linear regression analysis results indicate that sex of students, mathematics enjoyment, motivation, foundation and applied mathematics grade were significantly affect the performance of students (since p-value (0.011, 0.026, 0.001, 0.000 and 0.000 is less than

$$Y(CGPA) = 0.922 + 0.095SEX - 0.009AGE + 0.002EHEECE + 0.156MATHS - 0.141self\ confidence + 0.208motivation + 0.298foundation + 0.026applied\ math + \epsilon$$

From the fitted MLRM (Multiple linear regression model) there is also positive relationship between sex of students, EHEECE marks of students, Math's enjoyments, motivation, foundation and applied mathematics grade with CGPA of students.

Based on the results given in this table 4.6, two of the eight explanatory variables considered in this study were found statistically negatively associated with CGPA of students. They are age of students and self confidence.

4.6 Appropriateness of the regression model

Table 4.7 Model summary for regression model

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.805 ^a	.648	.643	.37350

5%) whereas age of students, EHEECE mark of students, and self confidence were not significantly affects the performance of students (since p-value is larger than 0.05) in Mettu University during the study period.

From equation 4.1 above the fitted regression line from table 4.6 results is given by:

Table 4.8 ANOVA table for the overall significance of the parameter

ANOVA						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	134.813	8	16.852	120.799	0.000
	Residual	73.099	524	.140		
	Total	207.912	532			

From the above table 4.7 coefficient of determination (R²=64.8%) the goodness of the fitted model approximately good model.

From table 4.8 indicate that the overall significance of the regression parameter is statistically significant since p-value (0.000) is less than 5%.

5.1 Conclusion

This study analyzes the effect of age, sex of students, students grade in applied mathematics I, EHEECE mark, CGPA, students motivation towards mathematics, students enjoyment with mathematical problem, self-confidence of students towards math problems.

As illustrated in the correlation analysis of performance of students indicate that, there is statistically and significantly positive correlation between sex, CGPA, EHEECE, mathematics enjoyment with math problem, students self-confidence towards math problem, motivation towards math problems. This means that as these variables increase average score results of students also will increase and vice versa.

In this study, the researcher applied multiple linear regression analysis to these factors that are expected to measure students performance. The results of multiple linear regression analysis, showed that age, EHEECE mark, Applied mathematics have statistically significant effects on the students' performance(CGPA).

5.2 Recommendation

From the result obtained and conclusions made the author would like to forward the following recommendations:

- The researcher recommends that ministry of education should give a focus on the quality and efficiency of higher education entrance exam.
- It is also recommended for applied mathematics I instructors to make an ongoing evaluation and give continuous feedback for inappropriate behaviors developed by the students so that appropriate measure will be taken on time. In this case, the class size should get in to consideration and it should be reduced to an optimum number of students as far the teacher manages.
- It is recommended to applied mathematics curriculum designers to regularly evaluate, revise and design by identifying the problems in connection with horizontal relationship with other fresh man courses.

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