

**Determinants of Students Performance in Kenya Certificate of
Secondary Education Using Ordinal Logistic Regression in
Kiambu County**

By

Samuel Gitonga Kinyua

I56/79761/2012

A Dissertation submitted to the School of Mathematics,
Department of Statistics in the Partial Fulfillment of the Requirement for the
Degree of Masters of Science in Social Statistics at the
University of Nairobi

NOVEMBER 2014



DECLARATION

I declare that this is my original work and has not been presented in any other learning institution for academic award.

Signature:

Date:

Samuel Kinyua

This work has been presented with my approval as the university supervisor:

Signature:

Date:

Prof. J.A.M. Ottieno

Signature:

Date:

Dr. John Nderitu

DEDICATION

I dedicate this project to my wife Eunice, my daughters: Betty, Kathryn, and Loise and to my church members for their endless support.

ACKNOWLEDGEMENTS

My gratitude to the almighty God for the wisdom and chance he has provided me with to pursue my Masters Degree.

I am grateful to the University of Nairobi, particularly to my supervisors Prof. J.A.M Ottieno and Dr. J. Nderitu for guiding me through my project work and to the mathematics department for the knowledge I acquired during my two years study period at the university of Nairobi. Furthermore, I pass my regards to my classmates for their tireless support and encouragement to carry on to the end of our MSC degree.

CONTENTS

DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGEMENTS	iv
LIST OF FIGURES	vii
LIST OF TABLES	viii
ACRONYMS	ix
LIST OF SYMBOLS	x
ABSTRACT	xi
CHAPTER ONE - INTRODUCTION	1
1.1 Background	1
1.2 Purpose of the study	2
1.3 Study Objectives	2
1.3.1 Main Objective	2
1.3.2 Specific objectives	3
1.4 Study Justification	3
CHAPTER TWO - LITERATURE REVIEW	5
2.0 Introduction	5
2.1 The Demand for Education	5
2.2 Financing of Education	5
2.3 Secondary School Education	6
2.4 Graduate Examiners	7
2.5 Selection Process into Secondary Schools	7
2.6 Student's Gender	8
2.7 Student's Age	9

2.8 KCPE Marks Predictability to Student’s Performance in KCSE.....	10
2.9 Public Primary Schools versus Private Primary School.....	10
CHAPTER THREE – METHODOLOGY	13
3.1 Introduction	13
3.2 Data Source	13
3.3 Study Variables definition.....	13
3.4 Assumptions of the Ordinal Logistic Regression Model	15
3.5 Ordinal Logistic Regression Model	16
3.6 The Likelihood Function.....	18
3.7 Ordinal Logistic Regression Parameter Estimator.....	19
3.8 The Odds Ratio in Ordinal Logistic Regression.....	20
3.9 Goodness of Fit.....	22
CHAPTER FOUR - RESULTS AND DISCUSSION.....	23
4.1 Data Analysis, Results and interpretation	23
CHAPTER FIVE -CONCLUSION AND RECOMMENDATION	38
5.1 Conclusion.....	38
5.2 Recommendation	39
APPENDIX.....	42

LIST OF FIGURES

Figure 1: Frequencies for the Sampled Student's Age	25
Figure 2: KCSE Performance in 2013 within the Sampled Secondary Schools in Kiambu County Based On Gender	26
Figure 3: Frequencies on the Sampled Students KCSE Performance Based on their Primary School Type: Private or Public Primary School	30
Figure 4: Frequencies on the Sampled Students KCSE Performance Based on their Secondary School Type: Private or Public Secondary School	32

LIST OF TABLES

Table 1: Conceptual Framework on the Study Variables Impact on the Overall Student's Performance	12
Table 2: Definition of Variables Used In the Study	14
Table 3: Frequencies of the Study Variables	23
Table 4: A Cross tabulation Table on the Transition Trends of Primary School Graduates to Secondary Schools Based on the School Type	27
Table 5: The Students Gender Based on the Primary School they attended	28
Table 6: The Students Gender Based on the secondary School they attended.....	29
Table 7: Test of Parallel Lines	33
Table 8: Study Variable Maximum Likelihood Parameter Estimates	34
Table 9: Pseudo R-Squared.....	35
Table 10: Goodness of Fit of the Model	36
Table 11: Model-Fitting Information	36

ACRONYMS

KCPE	Kenya Certificate of Primary Education
KCSE	Kenya Certificate of Secondary Education
OLR	Ordinal Logistics Regression Model
MDG	Millennium Development Goal
FPE	Free Primary Education
MoE	Ministry of Education

LIST OF SYMBOLS

β	Model coefficient
p	Number of parameters
n	Sample size
$l(\beta)$	Log-likelihood function of the Ordinal logistic regression model
$L(\beta ; X)$	Likelihood function of the logistic regression model
π_{ij}	Unique probability for the j^{th} response given the i^{th} observation based on some reference category of j

ABSTRACT

In this project, I have modeled the determinants of students' performance in the Kenya Certificate of Secondary Education examination within Kiambu County. The selection and allocation process to secondary school for primary schools graduates has posed a great conflict to the interested stakeholders and parents within the education sector. The project's aim was to find out the effects of private and public primary schooling on a student's secondary school academic and overall performance. Six secondary schools in Kiambu County were sampled for the study based on their categories and the data on 2009 form – one-cohort students' performance in their 2013 final examination. Data analysis conducted through exploratory and confirmatory analysis – Ordinal Logistic Regression model using SPSS version 20. The main determinants of a learner's performance in their secondary school graduate examination were age, primary school type, secondary school type and their marks in Kenya Certificate of Primary Education examination and points. The learners' Kenya Certificate of Primary Education Examination points, gender, and secondary school category had a significant impact on the learners' Kenya Certificate of Secondary Education performance, with significance values of 0.000, 0.002, and 0.001 respectively.

CHAPTER ONE - INTRODUCTION

1.1 Background

In the year 2008, 695,777 students sat for Kenya Certificate Primary School, where 367, 125 were male and 328,652 females, while in the year 2009, 381,600 were male and 345,454 female from a total of 727,054 students. Students' performance in the Kenya Certificate of Primary Education (KCPE) is examined at standard eight and this determines the transition into different types of secondary schools in Kiambu County and also nationally. Kiambu County has 8 national schools, 10 extra-county schools, 19 county schools, 199 district schools, and 83 private schools, which total to 319 secondary schools, of which 47 are boys' schools, 63 girls' schools and 209 mixed secondary schools.

The current 8-4-4 education system in Kenya was launched in 1985. The system is designed to provide eight years of primary education, four years of secondary education, and four years of University education. At each level, the students are assessed and their performances determine the type of school they are admitted to. The primary schools graduate exams and the type of school, (private or public), have a great impact on the secondary school they transit to. Since the introduction of free primary school in the country in 2003, public primary schools performance level has gone down leaving their counterparts from the private schools to dominated the top positions.

Private schools' performance in the present day, earn their students enrollment in top performing secondary schools at the National and county levels. On the contrary, less than 30% students graduating from public school gain access to the same schools .Due to the limited places available in top performing public secondary schools, the competition at this level is very stiff.

1.2 Purpose of the study

The study seeks to establish how performance of students in Kenya Certificate of Primary Education (KCPE) exams, based on whether it is a public or private school, determines their performance in Kenya Certificate of Secondary Education (KCSE) depending also, on whether the secondary school is a public or private school.

The current conflict over Kenya Certificate of Primary Education graduate admission to secondary schools of different ranking, poses a great challenge to the stakeholders within the education sector and to the learners within this cohort. The mode of school allocation has been challenged, since it tends to favor learners from private schools. Bright students from public schools have missed opportunities to join top national schools while their counterparts from the private schools do so. An Ordinal logistic regression model gives the determinants in order of their significant based on the different school category transition. This makes it necessary to study the trends of students' performance based on the school type (private-public, private-private, public-private, and public-public) in order to provide an insight into the determinants of performance difference in public and private schools.

1.3 Study Objectives

The objectives of the study are:

1.3.1 Main Objective

To find out the effects of private and public primary schooling on a student's secondary school academic and overall performance.

1.3.2 Specific objectives

- i. To identify the determinants of students' performance and achievement based on transition from: public-to-public, public to private, private-to-private and private to public from primary school level to the secondary school level.
- ii. To establish the impact of a learner's age on their performance in the graduate secondary school examination
- iii. To establish the impact of a learner's gender on their performance in the final secondary school examination

Hypotheses

The following hypotheses were used for the study on school type effect on secondary school students' performance:

1. There is no significant difference in the academic performance of students from both private and public primary schools in KCSE.
2. There is no significant difference in the academic performance of students based on their age.
3. There is no significant difference in the academic performance of students based on their gender from either public or private secondary schools.

1.4 Study Justification

The study is an analysis of the trends in students' performance and achievement based on transition from: public-to-public, public to private, private-to-private and private to public at the primary and secondary school level of schooling. This provides basis for choice of schools by parents to avoid the current primary school graduate selection procedure to secondary schools, and provide essential information for the education sector, parents, and the learners. This would be in form of planning for: resources, learning and teaching

facilities, school allocation of teachers and even students, private schools establishment approval, allocation of KCPE graduates to secondary schools, and financial allocation. Furthermore, such an analysis advised the current trends, which are then used to predict future intakes, and absorption levels for individual cohort at a particular time/year to either public or private secondary schools without conflicts.

1.5 Summary

The subsequent sections of this thesis are organized as follows: chapter two, literature review on factors that affect students' performance at their secondary school final exam level, chapter three describes the study methodology, chapter four provides the results and data analysis and discussion while chapter five is on the study conclusion and recommendations for policy developments and further studies.

CHAPTER TWO - LITERATURE REVIEW

2.0 Introduction

This chapter describes the factors that affect students' performance at the secondary school level as studied by different researchers based on various determinants. It gives an overview of the other researchers' findings in relation to the determinants of secondary school students' performance within the recent past.

2.1 The Demand for Education

To achieve the Millennium Development Goal 2 (MDG): having universal education for all, almost all countries in the world are currently on the move to ensure provision of Free Primary Education (FPE). This is an essential tool in the policy setting for the poor, since it ensures provision of basic education to millions of the world's child population.

The demand for education especially in public schools has generally gone up in Kenya since the introduction of free primary education in 2003 and subsidized secondary school education in 2008 by former president Honorable Mwai Kibaki. This has resulted to a constraint of limited learning and teaching facilities within public schools, due to the tremendous enrollment rates, ultimately affecting students' performance in public schools compared to private schools.

2.2 Financing of Education

Public schools are part of a larger school system, which function as a part of the government and must follow the rules and regulations set by the government's Ministry of Education. Public schools funding is from the government and at times well-wishers. In contrast, private schools generate their own funding, which typically comes from a variety of

sources such as: tuition; private grants; and fundraising from parents, alumni, and other community members.

2.3 Secondary School Education

Secondary education is the second stage in learner education development; it takes a middle position between primary and tertiary level. It therefore holds a functional role in enabling learners to access higher education, preparing them for lifelong education, and work. It is an investment as well as an instrument that can be used to achieve rapid economic, social, political, technological, scientific, and cultural development of the country (Nelson Jagero, 2013).

Education, especially Secondary education, plays a significant role in the economic development of a nation. Secondary education is the foundation of the scientific and technological advancement that Africa needs as a continent, to develop to the level of industrialized economies. Moreover, secondary education is the gateway to higher education and to an individual's employment. Thus, the demand for secondary education, which is the pivot of an individual's academic learning process, is higher in the present generation than before.

Secondary schools in Kenya are categorized into national, county, extra-county, district, and private schools. The categories are based on performance, facilities, availability of resources, school location, and nationwide enrolment of students. The national schools are government schools and are the most prestigious secondary schools in the country. They are also among the oldest schools, often modeled on British public schools, but with government funding.

2.4 Graduate Examiners

In Kenya, national examination scores at primary and secondary school levels, act as proof of completion, and qualification for further education and later justification for entry into the labor market. KCPE score is used to select form one students to various cadres of secondary schools on the premise that their performance in KCPE will affect their performance in KCSE that comes at the end of secondary education (Nelson Jagero, 2013). Therefore, Nelson (2013) places a significant value for the secondary school graduate exams which, being public and nationally done, serve to: Specify goals and standards of education nationally in order to control the disparate elements of the education system and provide evidence that certifies the achievement of students, needed in the job market for placement. Moreover, they allocate students into further education courses in an objective, unbiased way since the available spaces keep diminishing with the rise in the education level. They facilitate international mobility, legitimize membership in international global society, and evaluate the quality of education and its relevance. Furthermore, they help in diagnosing the education systems' weaknesses and motivate policy reforms at different levels.

2.5 Selection Process into Secondary Schools

The Ministry of Education, using a computerized system, conducts admissions to secondary schools, centrally. The allocation to secondary school is based on an individual students' KCPE performance. During KCPE registration, students list their preferred secondary schools based on the available categories. Each student has to choose two national schools of their preference, two county schools, two extra-county schools, and three district schools. At selection, national schools have a set of county quotas, from which they choose a given number of students from each county, based on their KCPE performance. The secondary school admissions algorithm ranks students within each district and gender by descending KCPE score and so the process of admitting students is carried separately for both genders.

The best students in the county, based on gender are allocated to their first preference national school, followed by the second best students and the rest in that order. Once the students' first choices are filled and yet some have not been allocated any secondary school, the algorithm considers their second secondary school choices for selection. The process is organized in a manner that ensures that each student is only admitted to one school at a time.

2.6 Student's Gender

Gender parity in the present day is the foundation for education equity in the country. School enrolment patterns in secondary education portray gender parity as a feasible target (Mwangi and Nyagah, 2011). In the previous years, female's performance in KCSE was better than males in the arts and humanities. To the contrary, Boys excelled in the sciences, which are critical to scientific and technological development, this determines the type of occupational course one enrolls in and later, the nature of employment they take up in life.

The school type is further classified based on gender as either: Girls, boys or mixed schools. In a single sex education setting, all learners are either girls or boys while in mixed schools, they are both girls and boys learning within the same classrooms. According to Mburu P.D. (2013), in gender separate classrooms, students have higher motivation and higher confidence levels, which offer them, better educational opportunities. Girls in particular, feel better about their bodies, the body development, and their body image, which ultimately has a positive impact on their academic abilities. To the contrary, within well-managed mixed gender educational environment, boys and girls learn to respect and value each other's ideas. The two respective genders learn to listen and communicate with each other. Hence, Isolating boys and girls in single-sex schools is a barrier to effective development in their interpersonal skills in order to later, function as grown-ups in their society.

Single-sex schools have a higher percentage of graduates who attend four-year colleges and a lower percentage of graduates who attend two-year junior colleges than coeducational schools (Mburu P.D., 2013). Students in single sex schools performed better compared to those in mixed schools. Furthermore, Boys in mixed schools also performed better compared to their counterpart female learners in all the grades or class. Hence, the type of school that one attends is an important factor in determining one's performance in KCSE examinations. To the contrary, a study on the relationship of primary and secondary school performance by Nelson Jagero (2013); indicated that girls performed better compared to boys in KCSE, despite the fact that they were admitted with lower marks in KCPE. Nelson's KCPE results further indicate that for the boys, their performance in KCPE had only 28.9% effect on their performance in KCSE, compared to the girls 41.8%.

2.7 Student's Age

The age of a learner at a particular level of education has an impact on their performance. Most of the students who join pre-school classes later than the recommended five years, age do not perform as expected, because they miss learning experiences at a time when they are most receptive to learning basic skills and establishing secure foundations for cognitive development (Wasanga et al, 2011). Hence, when these learners sit for their subsequent final primary and secondary school level exams, they always indicate a lower performance level compared to their counterparts who attended school within the right age bracket. Yet a study by Fertig et al. (2005) shows that the school entry age in Germany and its effect on education attainment is very controversial; some enter school late but perform well while some join early and do not perform well.

Adult student performance in primary and secondary school setting, is in most cases poor. When older learners are taught in classes with younger children, there may be psychosocial issues of self-esteem, bullying, and gender harassment. This further results to problems of

matching learning to cognitive capabilities since the curriculum used is the same and the learners are taught the same content despite their age difference (Wasanga et al., 2011).

2.8 KCPE Marks Predictability to Student's Performance in KCSE

Other than examination certification, KCPE and KCSE are exams used for selection into the next level of education; KCPE determines KCSE level while KCSE determines university or tertiary colleges levels. Performance in KCPE has a major effect on student's performance in KCSE achievement. However, Data obtained in a study by Mbugua et al., (2012) on students who scored between 200 and 400 points out of a maximum of 500, indicated that their entry marks into secondary schools, could not be the cause of poor performance at Kenya Certificate of Secondary Education level in their final exams.

2.9 Public Primary Schools versus Private Primary School

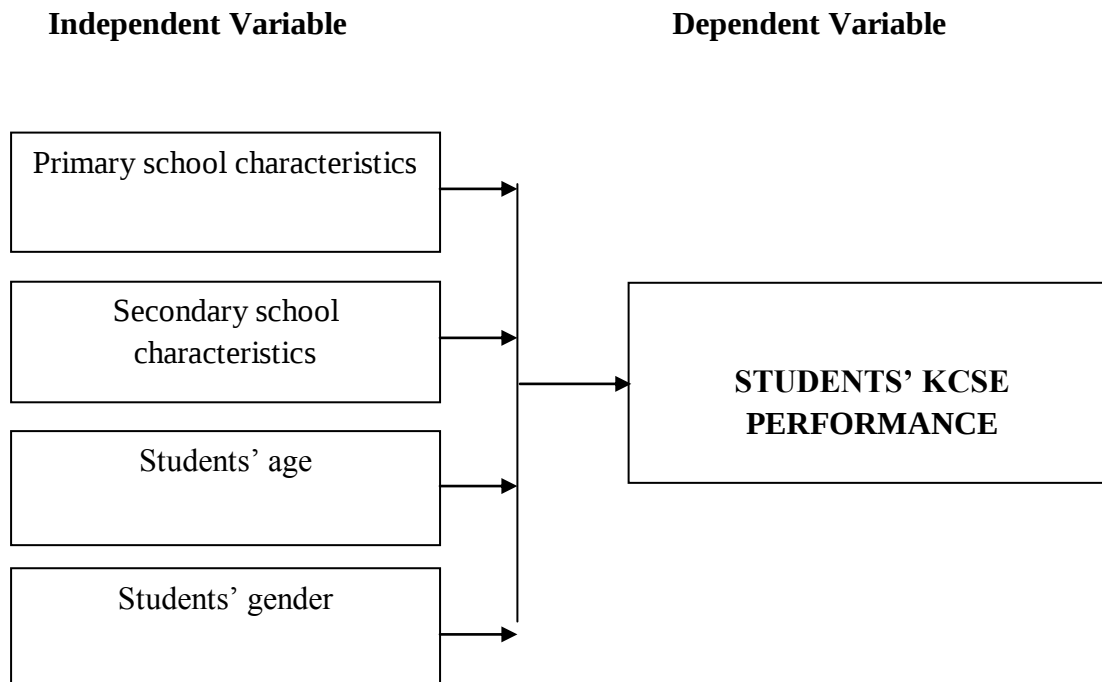
National examinations performance is low for most students at the public primary level of education compared to their counterparts from the private primary schools. This creates a discriminatory disadvantage to KCPE graduates from public primary schools, particularly when considering that primary examination is a measure of a learner's ability and a margin on which selection and placement to better secondary schools is based. While elite primary schools in Kenya are largely private, many best secondary schools are public. Almost all the national and county schools in the country are public and under government ownership.

Factors affecting learner's performance

The students' home is the primary agent of their performance in school. This depends on the family type; monogamous, polygamous or single parent. Many children are hindered from reaching their optimum level in academic pursuit due to some negative factors arising from their background (Akomolafe and Olorunfemi-Olabisi, 2011). The family type influences the

student's interest and motivation towards their education and overall academic performance. The level of motivation is determined by the nature of parental involvement in their children's performance by providing conducive learning environment, financial support, moral and encouragement towards their education. The family type is a significant factor, influencing student's academic performance (Akomolafe and Olorunfemi-Olabisi, 2011); Students from monogamous families usually enjoy parent involvement in their education better than their counterparts from other family types. Moreover, the students' performance in academic and school related activities and functions, significantly depend on their family type and level of parental involvement in their studies.

**Table 1: Conceptual Framework on the Study Variables Impact on the Overall
Student's Performance**



Source: Researcher's Own Model (2014)

The conceptual framework provides the four basic categories of the factors that influence a learners performance in KCSE based on the type of primary school they attended. The primary school characteristics include many features, which this study has considered, such as the type of school (private or public) and the marks scored in their Kenya Certificate of Primary education. Among the numerous factors within the secondary school characteristics, the researcher picked on, the category and the type of secondary school the student attended. Secondary schools are categorized into; national schools, county schools, extra-county school, district and private schools. The student are categorized by gender (male or female) and age, which is based on the recommended age, and common trend, which ranges from, 16 to 20 years for a secondary school student's age, although higher age bracket 21 to 30 is sometimes experienced.

CHAPTER THREE – METHODOLOGY

3.1 Introduction

This section presents the study methodology used in an attempt to achieve the objectives of the study. The chapter provides the data source and collection procedure, description of the target population and the statistical model used for the analysis development process.

3.2 Data Source

Secondary data on the sampled secondary school academic performance was used in the study. Secondary data consists of existent information, collected by researchers for different purposes, from external sources such as documentation, archival records, magazines, and internet. An advantage of using secondary data in-place of primary data is its ability to save on time, cost, and labour and furthermore it gives a general idea on how to conduct the research and the best method to be used since the researcher employs existing information.

Stratified sampling method was used to select the schools to be involved in the research within Kiambu County. The strata were grouped based on the category of the secondary school type as either: national, extra- County, county, district, or private schools. A stratum would later on be regrouped into either boys, girls or mixed schools. The target population for this particular study was all secondary school students within Kiambu County who were in the 2009-form one entry and graduated from secondary school in 2013, giving the 2009 secondary school cohort. Out of the 319 secondary schools in Kiambu County, a sample of six was selected based on a stratified sampling technique on the secondary school category strata.

3.3 Study Variables definition

Table 1 presents definitions of both dependent and independent variables of the study.

Table 2: Definition of Variables Used In the Study

Dependent Variable	Definitions
Secondary students KCSE performance	3 = A (excellent) 2 = B (Good) 1= C (Fair) 0 = D (Poor)
Explanatory variables	
Primary school Characteristics	
Type of primary school	Public = 0 Private = 1
KCPE marks out of 500 marks	Refers to the marks a student score at the primary school final examination level
Secondary School Characteristics	
Type of secondary school	Public = 0 Private = 1
Category of secondary school	National school = 0 Extra county school = 1 County school = 2

	District school = 3 Private school = 4
Students characteristics	
Students age at the time they sit for their KCSE examination	Refers to the age of a student when they sit for their KCSE examination
Students' gender	Female = 0 Male = 1

3.4 Assumptions of the Ordinal Logistic Regression Model

The Ordinal logistic regression model has the following assumptions:

- i. The dependent variable assumes its distribution is within the range of the exponential family of distribution.
- ii. Proportional odds assumption or the parallel regression assumption: the relationship between each pair of outcome groups is the same since the coefficients that describe the relationship between the lowest versus all higher categories of the response variable, are the same as those that describe the relationship between the next lowest category and all higher categories (Ombui et al., 2011).
- iii. Logistic regression does not assume a linear relationship between the dependent and the independent variable but a linear relationship between the logit of the response and explanatory variables and further, does not require the independent variable to be in an interval or unbounded.

- iv. The model assumes that the error terms are independent and that all the variables are included in the regression model. There is no assumption of a normal distribution over the error term.

3.5 Ordinal Logistic Regression Model

Ordinal logistic regression is used to model ordered categorical response variables and only applies to data that meet the proportional odds assumption. The model fits multiple logistic regressions on a multi-category ordered response variable that has been dummy coded. The response variable Y is categorical response variable with $K + 1$ categories: $Y \in (0, 1 \dots K)$

$$Y = \begin{cases} 0, & \text{poor} \\ 1, & \text{fair} \\ 2, & \text{good} \\ 3, & \text{excellent} \end{cases}$$

The proportional odds assumption states that the number added to each of the set logarithms to get the next is the same in every case to form an arithmetic sequence the reference category is 3 = *reference group* and so non-reference K categories have a linear regression function with the regression parameters given as

$$\beta_j = (\beta_{1j}, \beta_{2j}, \dots, \beta_{pj}) \text{ where } j = 0, 1, \dots, K$$

And a set of predictor variable vector with p predictor variables

$$\hat{X}_i = (X_{1p}, X_{2p}, \dots, X_{ip}) \text{ where } i = 1, 2, 3, \dots, n$$

The link function is a transformation of the probabilities that allows for estimation of the model, in ordinal logistic regression the link function is the logit; the link defines what goes to the left side of the equation linking the random component on the left side of the equation and the systematic component on the right. (Adejumo and Adetunji 2013, Ombui et al., 2011). The logit equations of the Ordinal logistic regression model (OLR) form a comparison

the log odds of each of the non-reference K response variables to the categorical variable of choice, logit equations shown as:

$$\log \left[\frac{\pi_1 + \pi_2 + \pi_3}{\pi_{j+1} + \pi_{j+2} + \dots + \pi_j} \right] = \log \left(\frac{P(Y=j/X_i)}{P(Y=0/X_i)} \right) = \hat{X}_i \beta, \quad (3.1)$$

The response probability are then uniquely determined and thus their summation is equal to one.

$$P(Y = 0/X_i), P(Y = 1/X_i), \dots, P(Y = j/X_i)$$

$$\text{where } j = 0, 1, 2, 3 \text{ and where } i = 1, 2, 3, \dots, n$$

$$\sum_{j=1}^K P(Y = j/X_i) = 1$$

$$\pi_{ij} = \frac{e^{\sum_{k=1}^j X_i \beta_k}}{1 + e^{\sum_{k=1}^j X_i \beta_k}} \quad (3.2)$$

$$\pi_{1j} = \frac{1}{1 + e^{\sum_{k=1}^j X_i \beta_k}} \quad (3.3)$$

For a polytomous outcome Y , and p predictors $x_1, x_2, x_3 \dots \dots x_p$, the systematic part of the model is defined as follows:

$$\log \left[\frac{P(x_1, x_2, x_3 \dots \dots x_p)}{1 + P(x_1, x_2, x_3 \dots \dots x_p)} \right] = \beta_{0j} + \beta_{1j} X_{1j} + \beta_{2j} X_{2j} + \dots + \beta_{pj} X_{pj} \quad (3.4)$$

This can be re-expressed in terms of the individual category outcome probability by solving for the unique probabilities to give:

$$P(x_1, x_2, x_3 \dots \dots x_p) = \frac{e^{(\beta_{0j} + \beta_{1j} X_{1j} + \beta_{2j} X_{2j} + \dots + \beta_{pj} X_{pj})}}{1 + e^{(\beta_{0j} + \beta_{1j} X_{1j} + \beta_{2j} X_{2j} + \dots + \beta_{pj} X_{pj})}} \quad (3.5)$$

For a given predictor x_i , the coefficient β_j gives the change in log odds of the outcome associated with a unit increase in x_i , for arbitrary fixed values for the remaining predictors $x_1, x_2, x_3 \dots \dots x_p$. The exponentiated regression coefficient $\exp(\beta_j)$ represents the odds ratio associated with a one unit change in x_i (O' Connell, 2006) .

Logistic slope coefficients is interpreted as the effect of a unit of change in the X variable on the predicted logit with the other variables in the model held constant. That is, how a one-unit change in X affects the log of the odds when the other variables in the model held constant.

3.6 The Likelihood Function

The likelihood function for a given model interpreted as the joint probability of the observed outcomes expressed as a function of the chosen regression model (Dietz et al. 2005). The model coefficients are unknown quantities and estimated by maximizing this probability. It is useful when investigating the contribution of more than one predictor, or for predictors with multiple levels. According to Shakhawat et al. 2012 the likelihood function is given:

$$L(\beta) = \prod_{i=1}^n \pi_{i1}^{y_{i1}} \pi_{i2}^{y_{i2}} \dots \pi_{ij}^{y_{ij}} (1 - \pi_{i1} - \dots - \pi_{ij})^{1-y_{i1}-\dots-y_{ij}} \quad (3.6)$$

$$L(\beta) = \prod_{i=1}^n \left(\frac{e^{\sum_{k=1}^j X_i \beta_k}}{1 + e^{\sum_{k=1}^j X_i \beta_k}} \right)^{y_{ij}} \quad (3.7)$$

The maximization process to estimate the coefficients accomplished by getting the log of the likelihood function, log-likelihood is:

$$l(\beta) = \sum_{i=1}^n [(\hat{X}_i \beta_1) y_{i1} + (\hat{X}_i \beta_2) y_{i2} + \dots + (\hat{X}_i \beta_j) y_{ij}] - \sum_{i=1}^n y_{ij} \log[1 + \sum_{k=1}^j X_i \beta_k] \quad (3.8)$$

3.7 Ordinal Logistic Regression Parameter Estimator

The linearized log-likelihood function is easy to compute compared to the likelihood function to obtain the maximum likelihood estimates. To maximize the log-likelihood function, find the derivative of $l(\beta)$ with respect to the unknown parameters, which are the coefficients. As illustrated in Equation (3.9)

$$\frac{\delta l(\beta)}{\delta \beta_j} = \sum_{i=1}^n [(\dot{X}_i \beta_1) Y_{i1} + (\dot{X}_i \beta_2) Y_{i2} + \dots + (\dot{X}_i \beta_2) Y_{i1}] - \sum_{i=1}^n \left(\frac{e^{\sum_{k=1}^j X_i \beta_k}}{1 + e^{\sum_{k=1}^j X_i \beta_k}} \right) = 0 \quad (3.9)$$

To obtain the maximum likelihood estimate of the coefficients we use iterative methods (i.e. the Newton-Raphson Method).

3.8 The Odds Ratio in Ordinal Logistic Regression

The odd ratio is calculated using the logistic function:

$$\pi_{ij} = \frac{e^{\sum_{k=1}^j X_i \beta_k}}{1 + e^{\sum_{k=1}^j X_i \beta_k}}, \quad j = 0, 1, 2, 3$$

$$\pi_{10} = \frac{1}{1 + e^{\sum_{k=1}^j X_i \beta_k}}$$

To simplify the notation, the individual probabilities for the π_{ij} , for the odds to be given as:

$$OR = \frac{\pi_{ij}}{1 - \pi_{ij}} = \frac{\frac{e^{\sum_{k=1}^j X_i \beta_k}}{1 + e^{\sum_{k=1}^j X_i \beta_k}}}{\frac{1}{1 + e^{\sum_{k=1}^j X_i \beta_k}}} \quad (3.10)$$

$$\frac{\pi_{ij}}{1 - \pi_{ij}} = e^{(X\beta)}$$

Taking the natural logarithm of the equation (3.10), the OR is obtained as:

$$\ln \left[\frac{\pi_{ij}}{1 - \pi_{ij}} \right] = X\beta,$$

$$X\beta = \beta_0 + x_1\beta_1 + x_2\beta_2 + \dots \dots + x_i\beta_j$$

The derivative to get the relationship between the estimated parameters and the odds ratio is:

$$\frac{\delta \ln \left(\frac{\pi_{ij}}{1 - \pi_{ij}} \right)}{\delta x_i} = \beta_j \quad (3.11)$$

The parameter β_j represents the percentage change in the log-odds ratios from a unit change in one of the predictor variables x_i . To establish the relationship between the odds ratios and the probability of π , this is given as follows:

$$\log - odds = \ln \left(\frac{\pi_{ij}}{1-\pi_{ij}} \right) = \ln(\pi_{ij}) - \ln(1 - \pi_{ij}) \quad (3.12)$$

$$\frac{\delta(\log-odds)}{\delta\pi_{ij}} = \frac{1}{\pi_{ij}} - \frac{1}{(1-\pi_{ij})^2} \quad (3.13)$$

$$\frac{1}{\pi_{ij}} - \frac{1}{(1-\pi_{ij})^2} = \ln \left(\frac{\pi_{ij}}{1-\pi_{ij}} \right) - \ln \left(\frac{\pi_{0j}}{1-\pi_{0j}} \right) = \beta_j,$$

π_{ij} and π_{0j} probabilities defining the change in the log – odds ratio.

Therefore,

$$\ln \left\{ \frac{\frac{\pi_{ij}}{1-\pi_{ij}}}{\frac{\pi_{0j}}{1-\pi_{0j}}} \right\} = \beta_j \quad (3.14)$$

Moreover, on introducing the natural logarithm to both sides of Equation (3.14):

$$\frac{\frac{\pi_{ij}}{1-\pi_{ij}}}{\frac{\pi_{0j}}{1-\pi_{0j}}} = e^{\beta_j} \quad (3.15)$$

Equation (3.15) represents the odds-ratio, given in ratio form of the individual probability odd ratios of the non-reference categories of the response variable compared to the reference category of the response variable.

3.9 Goodness of Fit

The likelihood ratio statistic computed as twice the difference between log-likelihoods from the two models, and be referred to the χ^2 distribution for significance testing. Likelihood ratios used to test for the contribution of the variables in an ordinal logistic regression model to the overall relationship between the dependent variable and individual independent variable. Because the likelihood for the full or larger model must be larger than the likelihood for the smaller (nested) model, the difference will always be positive, therefore using the logit model the likelihood ratio R^2 value given as:

$$R^2 = 2 \left[\frac{\log\text{-likelihood}(\text{larger or full model})}{\log\text{-likelihood}(\text{nested model})} \right] \quad (3.16)$$

Deviance statistics

Deviances statistics involves a comparison of the log of the maximum of the full model and the null model- a model with the intercept only.

$$D = -2[l(\text{nested model}) - l(\text{full model})]$$

This gives the deviance statistics based on a comparison between the full and nested models of the Ordinal logistic regression equation. Whenever the log-likelihood of the null model is small relative to the log-likelihood of the full model, then the value of D is large, an indicator that the current model is not good, hence a small value of D gives a good model for use.

CHAPTER FOUR - RESULTS AND DISCUSSION

4.1 Data Analysis, Results and interpretation

Table 3: Frequencies of the Study Variables

	Study variable frequencies and percentage			
Variable	Category	Frequency	Percent	Cumulative percent
KCSE grade	A	166	24.6	24.6
	B	204	30.2	54.8
	C	175	25.9	80.7
	D	130	19.3	100
Primary school type	Public	351	48	48
	Private	324	52	100
Student's age [years]	16	3	0.4	0.4
	17	159	23.6	24.0
	18	311	46.1	70.1
	19	146	21.6	91.7
	20	32	4.7	96.4
	21	13	1.9	98.4
	22	9	1.3	99.7
	24	1	0.1	99.9
	28	1	0.1	100
Secondary school type	Public	583	86.4	86.4
	Private	92	13.6	100
Secondary school	County	112	16.6	16.6
	District	162	24.0	40.6

category	Extra county	91	13.5	54.1
	National	218	32.3	86.4
	Private	92	13.6	100
Student's	Female	272	40.3	40.3
gender	Male	403	59.7	100

The performance in KCSE is evenly distributed over four grades for the sampled students in the study. Primary school enrollment to private and public school was almost equal. On the contrary, at secondary schools level, public school had the highest number of student enrollment compared to those who had enrolled in private school. Table 3, shows that 324 and 351 students had enrolled in private and public primary schools respectively. However, in secondary schools, the private schools enrollment decreased to 92 students, yet the public schools' enrollment increased from 351 to 583 students.

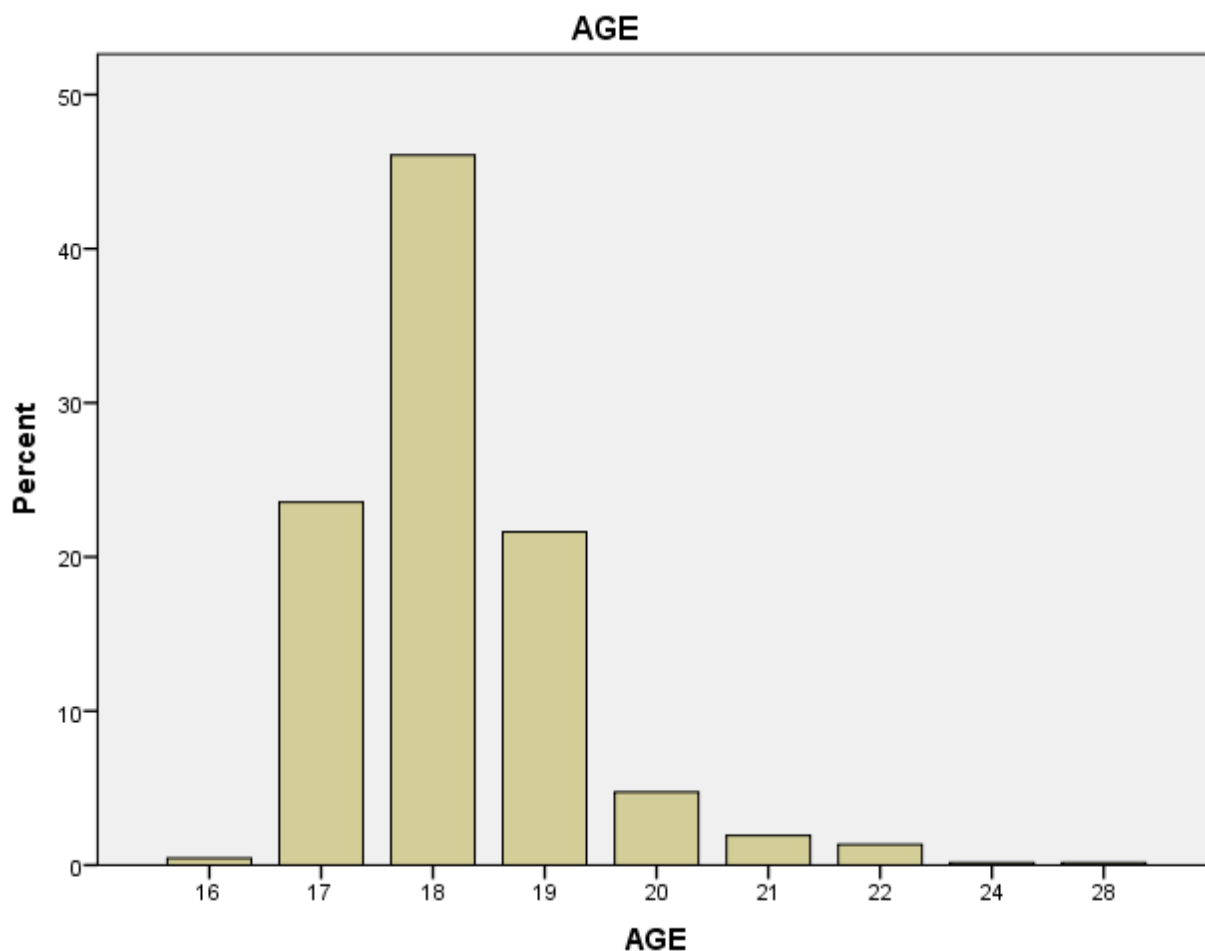


Figure 1: Frequencies for the Sampled Student's Age

The average age for students in high school was 18 years, but the sampled population age ranged from 16 to an extreme of 28 years of age (Figure 1). There were more male students enrolled, taking their KCSE exams from the sampled population, compared to the female students, at 59.7 % and 40.3 % respectively. While Primary school enrolment is near parity, the case is not the same with secondary school enrolment, despite the fact that this level of education plays social and economic development. A study by Mburu P.D. (2013) had similar findings concerning learner's parity; Females continue to be disadvantaged particularly at the secondary and post-secondary levels. The process therefore of achieving gender equality especially at secondary school and higher levels of education continue to be a goal yet to be achieved in the country's education sector.

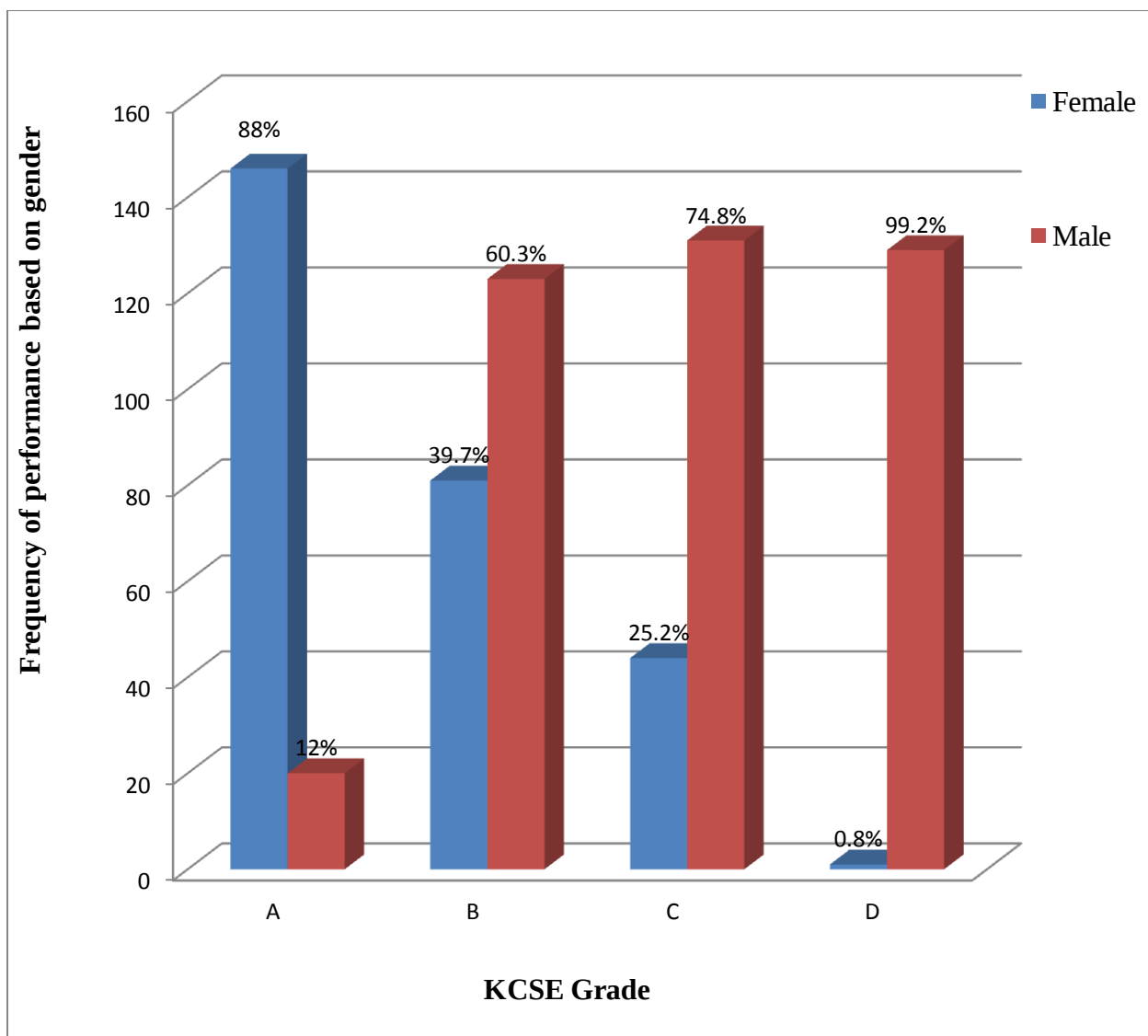


Figure 2: KCSE Performance in 2013 within the Sampled Secondary Schools in Kiambu County Based On Gender

A contradiction appears on Mburu (2013) findings of the disadvantage females had in performance, in the sampled population of students, where the female students performed better compared to their male counterparts (Figure 2). While 88% of the “A” scored from the study sample were by female students, only 12% of the male who were more compared to the female students, scored an A grade. Similar to the D grade score, 99% of the male sampled students got a poor grade (D), only 0.8% of the sampled female students scored a D grade.

The overall best performances were from the students within national schools. Graduating from a national school was associated with an increase in the KCSE score of 30 percent of a standard deviation.

Table 4: A Cross tabulation Table on the Transition Trends of Primary School Graduates to Secondary Schools Based on the School Type

		Type of secondary school		Total
		PRIVATE	PUBLIC	
Type of primary school	PRIVATE	64	260	324
	PUBLIC	28	323	351
Total		92	583	675

The transition rate from a public primary school to a private secondary school is minimal, accounting for 4.15 % of the study population, while 9.5 % of the sampled students in this study, move from private primary school to private secondary schools. There is enormous enrollment to private primary school since the introduction of free primary education. Yet on pursuing secondary school education 80.2% of the students who had enrolled to private primary schools moved to public secondary schools. An indication that public secondary schooling is dominant over the private secondary schooling, and a contradiction to the trend observed at the primary school level of education. The largest percentage (92%) of those who were in public primary schools still enrolled in public secondary schools after their KCPE exams.

According to the sampled study population of 2009 form one- cohorts in Kiambu County (Table 4), the enrollment within private learning institutions at the primary and secondary school level decrease from 324 to 92, a difference of 71.6 %. While the transition to public

secondary schools from both the private and public primary schools increased from 351 to 583, giving a difference of 39.8 % transition rate.

Table 5: The Students Gender Based on the Primary School they attended

	Student's Gender		Total
	Female	Male	
Primary school type PRIVATE	164	160	324
PUBLIC	108	243	351
Total	272	403	675

There were more male students in the study sample compared to the female learners. Sixty percent of the sampled female learners attended private primary schools while the remaining 40 % attended public primary schools. While a small percentage – 40% of the female went to public schools, 60 % of the male, had public primary school education as shown in Table 5.

Table 6: The Students Gender Based on the secondary School they attended

	Student's Gender		Total
	Female	Male	
Secondary School Type			
PRIVATE	54	38	92
PUBLIC	218	365	583
Total	272	403	675

Table 6 shows that public secondary schools had the highest level of student enrollment compared to private schools. Similar to the primary school female enrollment trend, there are more females enrolled to private secondary schools compared to the male students enrolled to private secondary schools, at 58.7 % and 41.3 % respectively. Tables 5 and 6 indicate that gender parity in school enrollment has not yet been achieved within the study area, and thus the whole country. There are more male learners enrolled to schools compared to their female counterparts, especially at the secondary school level.

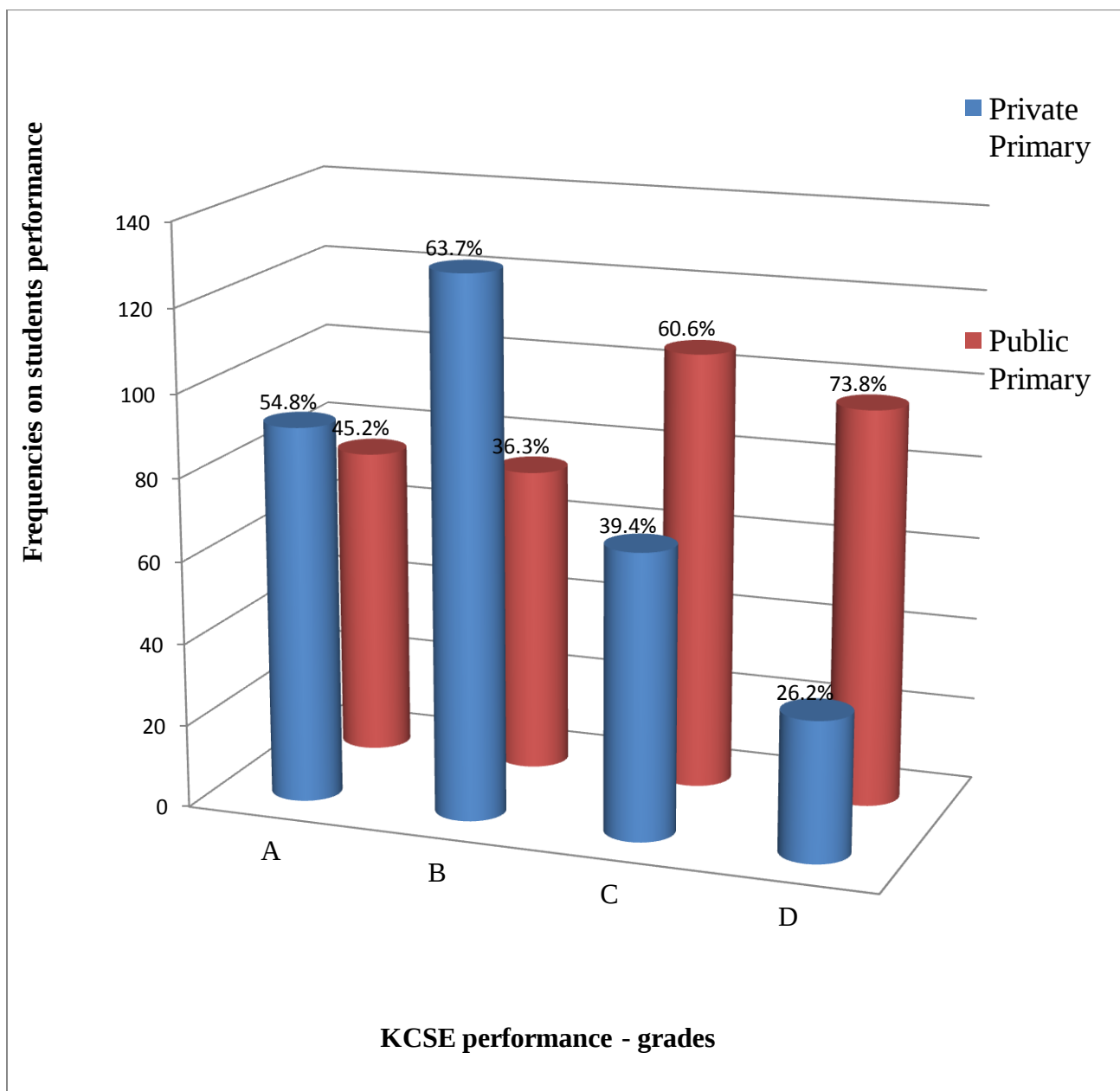


Figure 3: Frequencies on the Sampled Students KCSE Performance Based on their Primary School Type: Private or Public Primary School

Private primary schooling had a positive impact on the students' performance in the final secondary school examination- KCSE. Private primary school graduates within the sampled student population had higher levels of performance for grades "A" and "B" compared to those who attended public primary schools. Fifty four percent of those who scored grade A were from private primary schools while 63.7 % of the students who scored grade B in their

KCSE exams were still private primary school graduates in 2009 (Figure 3). Public primary school graduates within the sampled student population had higher levels of performance for grades C and D compared to those who had attended private primary schools. The highest number of students scoring grade C at their KCSE examination level had gone to public primary schools, at 60.6% compared to 39.4 % of those who had gone to private primary schools. Seventy-three percent, compared 26.2 % who scored grade D in their 2013 KCSE exams from the sampled population of students within Kiambu County, had gone to public primary schools and private primary schools respectively.

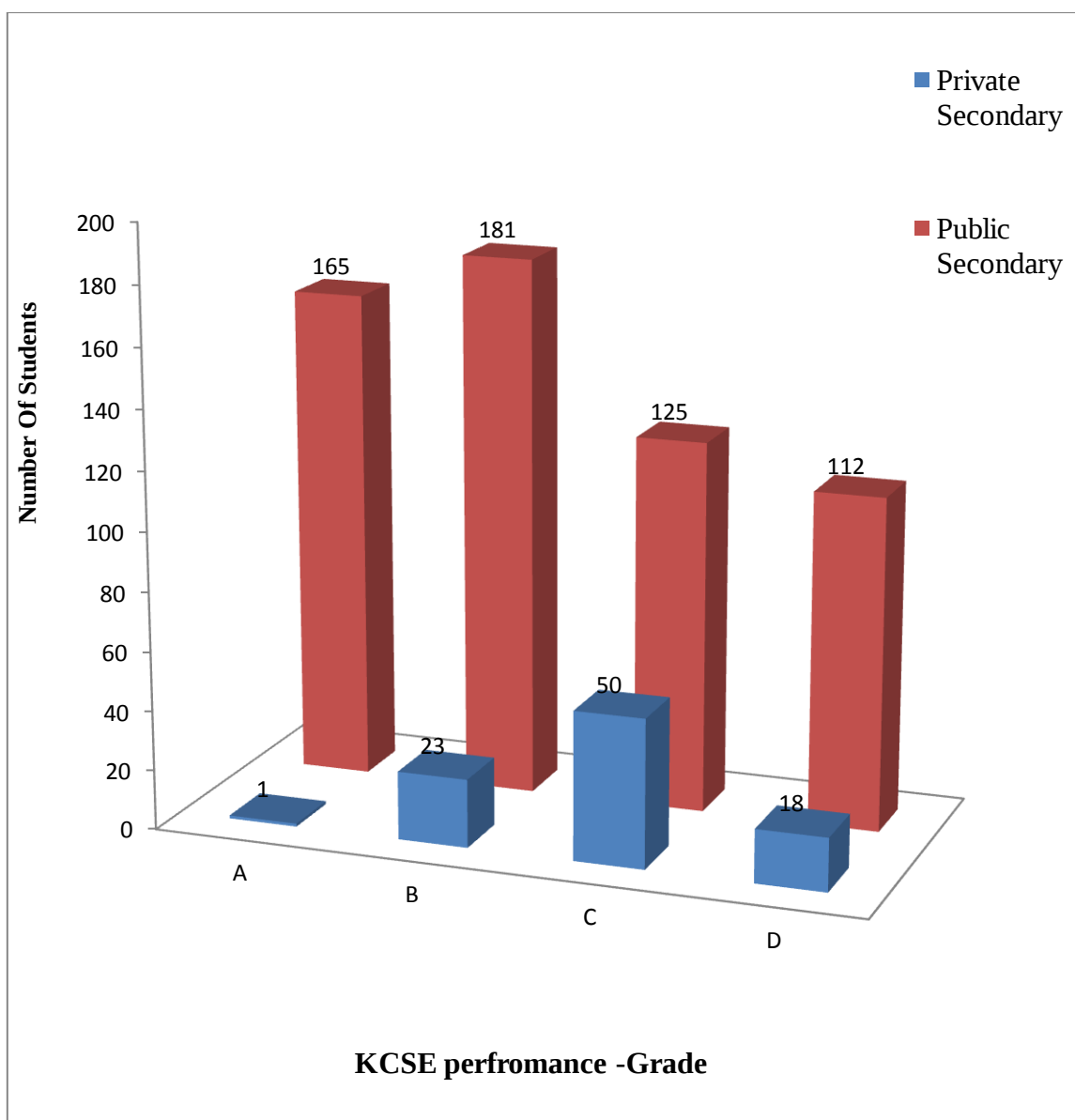


Figure 4: Frequencies on the Sampled Students KCSE Performance Based on their Secondary School Type: Private or Public Secondary School

Public secondary schools achieved better performance compared to private secondary schools. Only one student from the sampled private secondary schools scored grade A in their 2013 KCSE examinations (Figure 4). Almost all of the students who scored grade A in their KCSE from the sampled population of students within Kiambu County (99.4 %) were from public secondary schools. A similar situation was observed from the students who showed good performance by scoring grade B; one hundred and eighty-one students out of two

hundred and four who scored grade B were from public secondary schools. Although public secondary schools had the highest population, six times that of those in private secondary schools, their performance in 2013 KCSE, was still commendable compared to that of their counterparts from the private schools.

Table 7: Test of Parallel Lines

Test of Parallel Lines ^a				
Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	793.764			
General	758.014	35.751	18	.234

The null hypothesis states that the location parameters (slope coefficients) are the same across response categories.

a. Link function: Logit.

The significance value of the parallel line test is greater than alpha at 0.05 hence we accept the null hypothesis that the location parameters are the same across the response categories and hence the link function used is appropriate (Table 7).

Table 8: Study Variable Maximum Likelihood Parameter Estimates

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Interval	
							Lower Bound	Upper Bound
Threshold	[KCSEGRD = A]	-10.610	1.788	35.198	1	.000	-14.115	-7.105
	[KCSEGRD = B]	-7.110	1.746	16.586	1	.000	-10.532	-3.688
	[KCSEGRD = C]	-3.370	1.714	3.868	1	.049	-6.729	-.011
Location	AGE	-.103	.082	1.560	1	.212	-.265	.059
	POINTS	-.180	.012	227.209	1	.000	-.203	-.156
	KCPEMARKS	.001	.001	.683	1	.409	-.001	.002
	[PRIMARYSCHOOLTYPE=PRIVATE]	.052	.211	.060	1	.806	-.465	.362
	[PRIMARYSCHOOLTYPE=PUBLIC]	0 ^a	.	.	0	.	.	.
	[GENDER=0]	1.434	.473	9.181	1	.002	.506	2.361
	[GENDER=1]	0 ^a	.	.	0	.	.	.
	[Sec.Type=PRIVATE]	-.171	.427	.160	1	.689	-.666	1.008
	[Sec.Type=PUBLIC]	0 ^a	.	.	0	.	.	.
	[Sec.Categories=COUNTY]	1.464	.571	6.569	1	.010	.344	2.584
	[Sec.Categories=DISTRICT]	2.060	.599	11.824	1	.001	.886	3.235
	[Sec.Categories=EXTRA-COUNTY]	1.928	.595	10.489	1	.001	.761	3.094
	[Sec.Categories=NATIONAL]	0 ^a	.	.	0	.	.	.

Link function: Logit.

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

Table 8 has several important elements. The Walds statistics and the associated probabilities using the logit (β) provide the index of the significance of each predictor in the Ordinal logistic equation. Table 8, shows that the significant factors in determining a students' performance at the KCSE level were: the KCPE points a learner scored in their KCPE, gender of the learner (male or female) and category of secondary school the learner attended.

KCPE performance, according to Lucas Othuon, (1993) was found to be a moderate predictor of Success in KCSE and overall life performance, which is also a common finding in this

study. For all the logit equations, KCPE points were significant in predicting what one scores in their KCSE exams, a significance level of 0.000. A unit decreases in KCPE points a learner was 0.18 times more likely chances to score lower cumulative grades in their KCSE. Therefore, those who registered excellent performance in KCPE were more likely to score higher grades compared to those whose performance was fair.

Females were more likely to get higher cumulative scores compared to their male counterparts. There was a 1.434 time more likely increase in logs odds of scoring higher cumulative grades given that all the other variables in the model are held constant. The students' gender had no impact on their performance considering the logit for the response category. To the contrary, the respective logit (β) was 1.434 giving an extreme exponential value, although gender was significant in the model. This disputed the third hypothesis since there was a significant difference based on the students' gender. A study by Mburu P.D., (2013) on gender based type of schools performance showed that single-sex schools had a higher percentage of graduates who attended four-year colleges and a lower percentage of graduates who attended two-year junior colleges than coeducational schools.

Secondary school category; for every move from a lower category of secondary school ranking in Kiambu county, there are more likely chances of a learner scoring higher cumulative grades compared to their counterparts at the lower ranked secondary school categories. There was a 1.464, 1.928, and 2.06 for county, extra-county and district respectively times more likely chances of a student scoring higher cumulative grades.

Table 9: Pseudo R-Squared

Cox and Snell	.723
Nagelkerke	.790
McFadden	.522

Link function: Logit.

Table 9, shows that the maximum values of Cox & Snell and Nagelkerke R^2 attained is less than 1. These values indicate that the ordinal logistic regression model is useful in predicting the effect of primary school type, age, and gender in predicting KCSE performance.

Table 10: Goodness of Fit of the Model

Goodness-of-Fit			
	Chi-Square	Df	Sig.
Pearson	747.651	2001	1.000
Deviance	793.764	2001	1.000

The deviance statistics is a measure of the lack of fit between the data and the model, hence large values of deviance statics indicate a poor fit of the model to the data. The null hypothesis being tested in this case states that the observed data is consistent with the fitted model while the alternative hypothesis states that the observed data is not consistent with the fitted model. Table 10 shows that p value is equal to 1.00, a value greater than 0.05, being insignificant the null hypothesis is accepted, the observed data is consistent with the estimated values in the fitted ordinary logistic model.

Table 11: Model-Fitting Information

Model Fitting Information				
Model	-2 Log Likelihood	Chi-Square	Df	Sig.
Intercept Only	1659.717			
Final	793.764	865.953	9	.000

Link function: Logit.

The -2 Log Likelihood of the model with only intercept is 1659.717 while that of the model with intercept and independent variables is 793.764. The difference (Chi-square statistics) is $1659.717 - 793.764 = 865.953$ that is significant at $\alpha=0.05$ and the p value is less than 0.001

hence there exist an association between the students KCSE performance and the independent variables used in the study.

CHAPTER FIVE -CONCLUSION AND RECOMMENDATION

5.1 Conclusion

KCPE points a learner scored, category of the secondary school attended and the students' gender were significant in determining the students score in their secondary school final examination based on the significance value. Although the study findings, also indicate that age, KCPE scores, secondary school type and the primary school type that a learner attended, affected their eventually performance in KCSE based on the 95% confidence interval . The first and second hypotheses: which are the primary school type, and the student's age, were not significant to the level of student's performance in KCSE while gender - the third hypothesis was significant. An increase in age beyond 20 years when a student sits for their KCSE exams had a negative impact on their academic performance.

Private primary schooling has an impact on the learner's performance in their Kenya Certificate of Secondary Education. Excellent and good performance in KCSE was evident from students who had private primary schooling while to the contrary a majority of those who had public primary schooling scored low grades. The excellent and good performances in KCSE from private primary schools had joined public secondary schools. Therefore, the transition from private primary schools to public secondary schools significantly influenced the students' performance in their KCSE exams and overall life performance.

5.2 Recommendation

A Policy on the keeping of students records detailing primary school type, performance, secondary school type, gender, age, family type, or structure the students background level of education and performance, is necessary, in order to enable schools to effectively analyze the factors affecting individual students performance level, and if possible offer assistance whenever necessary.

The Ministry of Education and the relevant bodies that carry out students' selection to secondary schools should work towards ensuring an even and fair selection allocation of secondary school spaces to both private and public primary school graduates. This will help address the current conflict over the form one selection and secondary school allocation process to different categories of secondary schools in the country, especially to national and county schools.

Further research on the effect of KCPE marks and KCPE points should be carried out to find out the difference in the two variables and their impact on a learners' KCSE performance. This is based on the study's findings for the KCPE points and marks significance.

REFERENCE

- Akomolafe M. J. And Olorunfemi-Olabisi F. A., (2011) Impact of Family Type on Secondary School Students' Academic Performance in Ondo State, Nigeria .*European Journal of Educational Studies* 3(3), 481-487
- Dietz K, Gail M., Krickeberg K., Samet J., Tsiatis A., (2005): *Regression Methods in Biostatistics; Linear, Logistic, Survival, and Repeated Measures Models*. Statistics for Biology and Health. ISBN 0-387-20275-7
- Fertig, Michael; Kluve, Jochen (2005): *The effect of age at school entry on educational attainment in Germany*, RWI Discussion Papers, No. 27
- Mbugua Z. K., Kibet K. Muthaa G. M. and Nkonke G. R., (2012), Factors Contributing To Students' Poor Performance in Mathematics at Kenya Certificate of Secondary Education in Kenya: A Case of Baringo County, Kenya. *American International Journal of Contemporary Research*, Vol. 2 (6)
- Mburu P. D., (2013), Effects of the Type of School Attended on Students Academic Performance in Kericho and Kipkelion Districts, Kenya. *International Journal of Humanities and Social Science*. Vol. (3) 4
- Mwangi N.I. and Nyagah G., (2011): Determinants of Academic Performance in Kenya Certificate of Secondary Education in Public Secondary Schools in Kiambu County, Kenya. *Journal of Education and Practice*. 4. (12), 2013
- Mwangi S.K., Tessa B., and Sandefur J.,(2013): Public and Private Provision of education in Kenya. *Journal of African Economic* . 22 (2), 39-56
- Nelson Jagero , (2013): *How Performance of Students In Kenya Certificate of Primary Education Can Predict their Performance in Kenya Certificate of Secondary Education*, Educational Research International, Vol. 1 No. 3

O'Connell Anne A., (2006): *Logistic Regression Models for Ordinal Response Variables*; Quantitative Applications in Social Sciences. Sage publications, Inc.

Othuon L., (1993), A Study of The Predictive Validity of The Kenya Certificate Of Primary Education Examination: Application Of The Hierarchical Linear Model. University of British Colombia

Shakhawat Hossain, S. Ejaz Ahmed & Hatem A. Howlader, (2012): *Model selection and parameter estimation of a multinomial logistic regression model*, Journal of Statistical Computation and Simulation, DOI:10.1080/00949655.2012.746347v

Wasanga P., Lewin K. M., Wanderi E., Somerset A., (2011): *Participation and Performance in Education in Sub-Saharan Africa with special reference to Kenya: Improving Policy and Practice*, CREATE PATHWAYS TO ACCESS Research Monograph No. 74

APPENDIX

Appendix A: Frequencies of the Sampled Students Secondary School Type

