

# Non-linear Effect of Socio-spatial features on academic performances of HND Statistics students of the Federal Polytechnic Ado-Ekiti

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## Abstract

Students' performances worldwide is a phenomenon that attracts researches since education is considered to be a tool to social and economic advancement of a nation as well as its citizenry. Nigeria situation in the recent time has been considered critical. Many earlier works have shown a general agreed decline in education while that decline has equally been attributed to ranging factors; primary and secondary schools were said to be shambles, while these underperforming schools are mainly considered as public or government school in Nigeria due to many social and economic downturns that are not the subject of this research. An attempt is made in this research work to delve into the general performances of students in higher institution using the the higher national diploma (HND) results of Statistics students of the Federal Polytechnic Ado-Ekiti to examine the context of spatial study, the contribution of factors such as sex (peer effect), state, primary and secondary school type attended as well as the ages of students. Tests show significant effect of the variables and further investigation reveal higher influence between performance and type of primary school attended, however positive relationship declined for secondary school attended. The graphical illustration shows that age is found to have a non-linear influence on the academic performances.

**Keywords:** Students, school attended, age, significant effect, performances

## 1. Introduction

In many institution the rule for grouping students in the same academic year is depends on date of birth of the students. Generally speaking, students born in the same year are gathered together in the same course (Cervera, Jiménez, and Lorenzo, 2013). This measure seeks for students to have the minimum possible differences among them. In Spain, for example, students are grouped according to the calendar year from January 1 to December 31. In Britain, England, and Wales, students born between September 1 and August 31 of the following year are grouped in the same course. This generates differences of up to one year of age in children with the same chronological age in addition to differences in biological age due to different maturation rhythms of students. The differences in the experiences and maturation of older students involve a relatively better performance in academic settings, which is known as the relative age effect (RAE) (Musch and Grondin (2001), Wattie, Cobley, and Baker (2008)).

Several studies have attempted to explain this phenomenon, although inconsistencies in their results have been found. The total time of schooling (Sharp, Hutchison, and Whetton, 1994) has been considered when some students spend more time in school than others, also with unequal results (Daniels, Shorrocks-Taylor, and Redfern (2000)). At the moment, the hypothesis that has proved to be more reasonable is the RAE (Verachtert, De Fraine, Onghena, and Ghesquière (2010)). Kuh and Love (2004) found that students who made cultural connections

through social groups that reflect their culture of origin were more likely to persist in higher education. Tierney (2004) proposes that students should not be required to leave their identity at home while furthering their education. In their longitudinal study, Makuakane-Drechsel and Hagedorn (2000) found that GPA was the most significant predictor of persistence for both liberal arts and vocational community college students of Hawaiian ancestry, with financial aid being the second most significant predictor. Hagedorn, Lester, Moon, and Tibbetts (2006) made similar findings in that high school GPA was a significant factor in attaining a bachelor's degree. Benedict and Hoag (2004) found that students who indicate a preference for sitting in the front of the class room have a higher probability of receiving As and those who have a preference for sitting in the back of the classroom have a higher probability of receiving Ds and Fs, regardless of whether they actually sat in the back of the room or not. While Gossard, Jessup, and Casavant (2006) found being female to be a significant predictor of higher GPAs, Anderson, Benjamin, and Fuss (1994) found male students performed significantly better than female students in introductory economics courses and Lumsden and Scott (1987) found female students generally perform better on essay exams but male students performed better on multiple choice questions. Marshall and Losonczy-Marshall (2010) considered grades and attendance across five different seating configurations: row, column, front of the room versus back of the room, center of the room versus the perimeter of the room, and middle of the room versus sides of the room. Their findings indicated that students who sat in the middle or central part of the room had better grades and attendance and that female students generally had better attendance although females did not necessarily perform better academically.

## 2. Methodology

Most common method to analyse binary response data is the Logistic regression. It is used to model relationships between the response variable and several explanatory variables, which may be discrete or continuous. This is used for the situation where the response (Y) can only take one of two possible values usually alive/dead, or present/absent in practice. Logistic regression is useful in situations where the interest is to predict the presence or absence of a characteristic or outcome based on values of a set of predictor variables. This situation also arises frequently in medical trials, where at the end of the trial period, the patient has either recovered or has not. It is convenient to denote the two levels by 0 and 1 and to refer to the categories as a "failure" or a "success". Statistical software used are STATA 14 which was employed in the analysis due its enormous abilities in handling categorical data, others are BayesX 2.1 and GRASS GIS 7.2.1. In order to ease the various computations necessary before obtaining the result, the response variables were made to have categories of two levels (dichotomous), hence the use of logistic regression to model the data.

### 2.1 Logistic Regression Model

To fit a binary logistic regression model, a set of regression coefficients that predict the probability of the outcome of interest are estimated. The same logistic model can be written in different ways. The version that shows what function of the probabilities results in a linear combination of parameters is:

$$\ln\left(\frac{\text{prob}(\text{event})}{1 - \text{prob}(\text{event})}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k \dots \dots \dots (1)$$

The logit is the log of the odds that an event occurs. (The odds that an event occurs is the ratio of the number of people who experience the event to the number of people who do not. This is obtained when the probability that



Table 1: GPA by social – spatial factors (HND 1)

Variables	GPA	
	lower & below	Upper & above
<b>Primary</b>		
Public	14 (40%)	6 (50%)
Private	21 (60%)	6 (50%)
<b>Secondary</b>		
Public	20 (57.14%)	8 (66.67%)
Private	15 (42.86%)	4 (33.33%)
<b>Sex</b>		
Male	19 (54.29%)	5 (41.67%)
Female	16 (45.71%)	7 (58.33%)
<b>Age</b>		
20-24	29 (82.86%)	8 (66.67%)
25 & above	6 (17.14%)	4 (33.33%)
<b>State</b>		
Benue	0 (0%)	1 (8.33%)
Oyo	5 (14.29%)	2 (16.67%)
Osun	7 (20%)	3 (25%)
Ekiti	14 (40%)	3 (25%)
Ondo	9 (25.71%)	3 (25%)

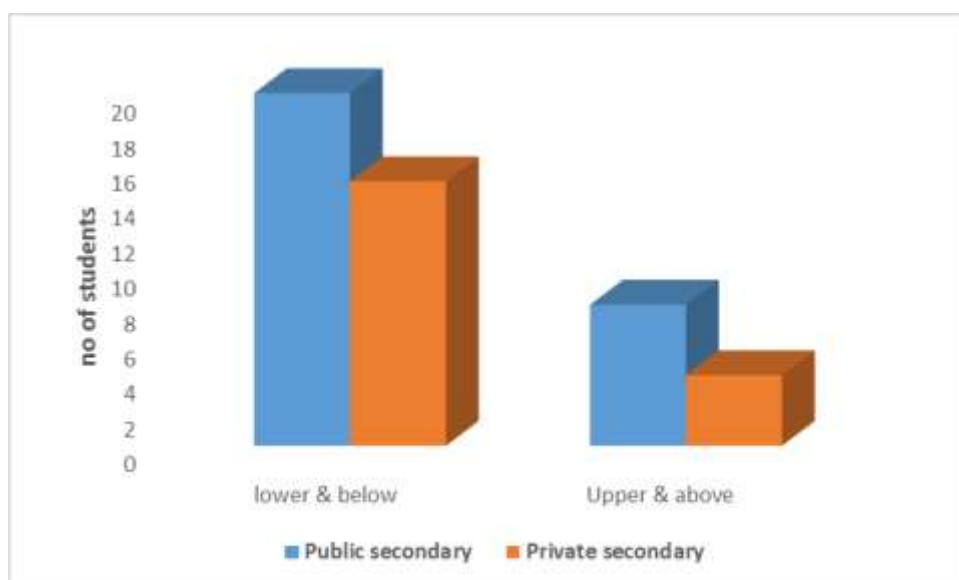


Fig.2: GPA by type of secondary school attended

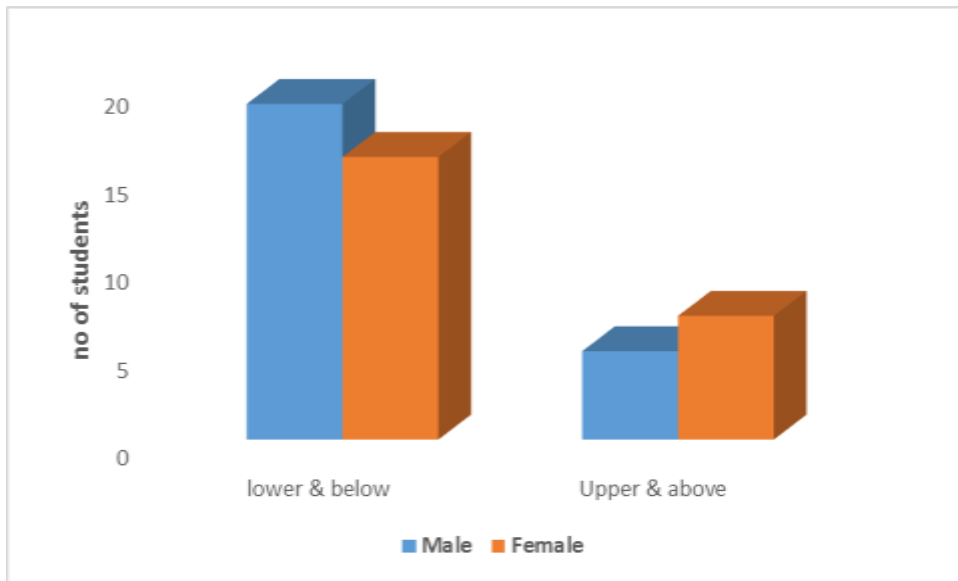


Fig.3: GPA by type of primary school attended

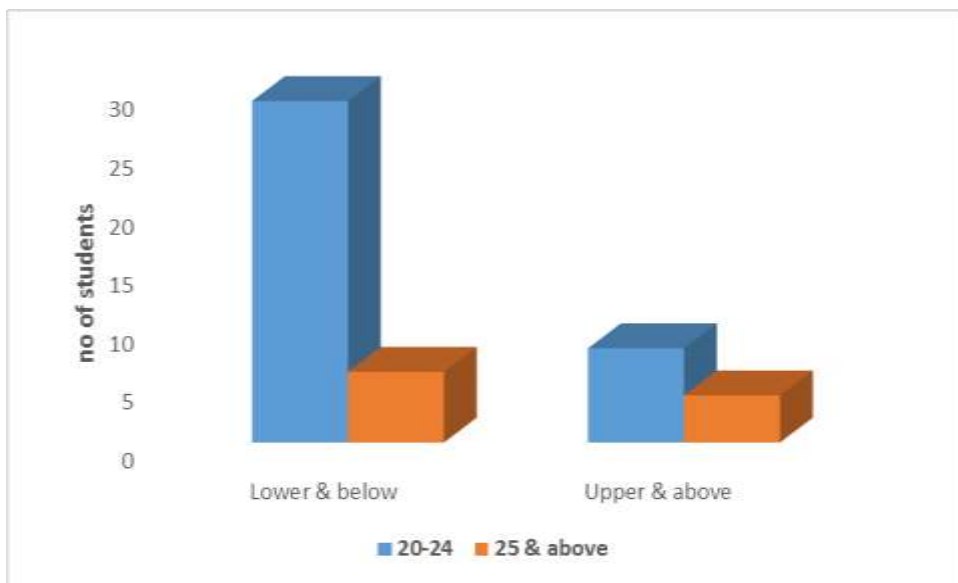


Fig.4: GPA by age group

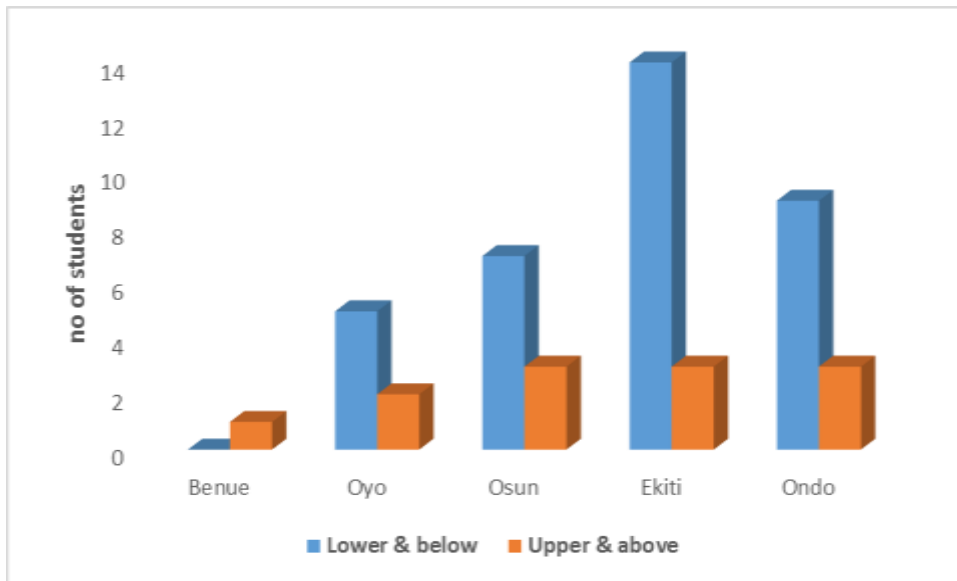


Fig.5: GPA by state of origin

Table 2: Fixed effects (HND I)

Variable	Mean	STD	2.5%-Quant.	Median	97.5%-Quant.
const	-1.05545	0.440557	-1.91822	-1.06505	-0.126146
sex	1.38671	4.83918e-08	1.38671	1.38671	1.38671
primary	-1.0235	3.50671e-08	-1.0235	-1.0235	-1.0235
secondary	-0.311741	4.39304e-09	-0.311741	-0.311741	-0.311741

Table 3: Fixed effects (HND II)

Variable	Mean	STD	2.5%-Quant.	Median	97.5%-Quant.
const	-12.6448	9.62357	-32.5556	-10.1753	1.40502
sex	-1.05222	0.313118	-1.88395	-1.05207	-0.163982
primary	-1.58152	0.244489	-2.12196	-1.60021	-0.807474
secondary	2.91832	0.725447	0.304212	3.17748	3.17748

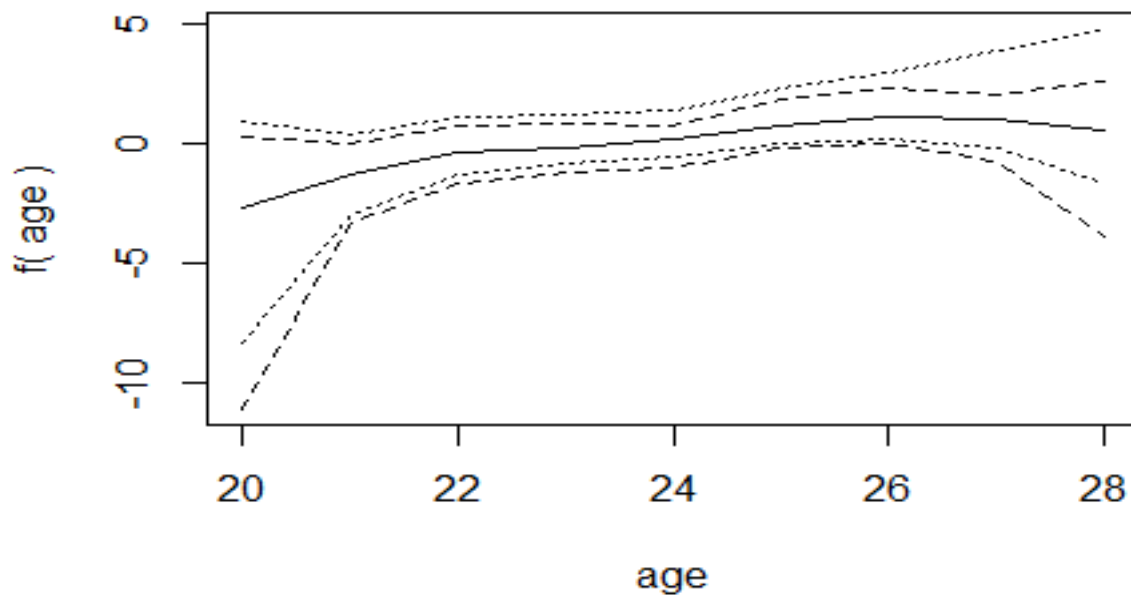


Fig. 6: Non-Linear Effect of Age of HND I students. Shown are the posterior means together with 95% and 80% pointwise credible intervals.

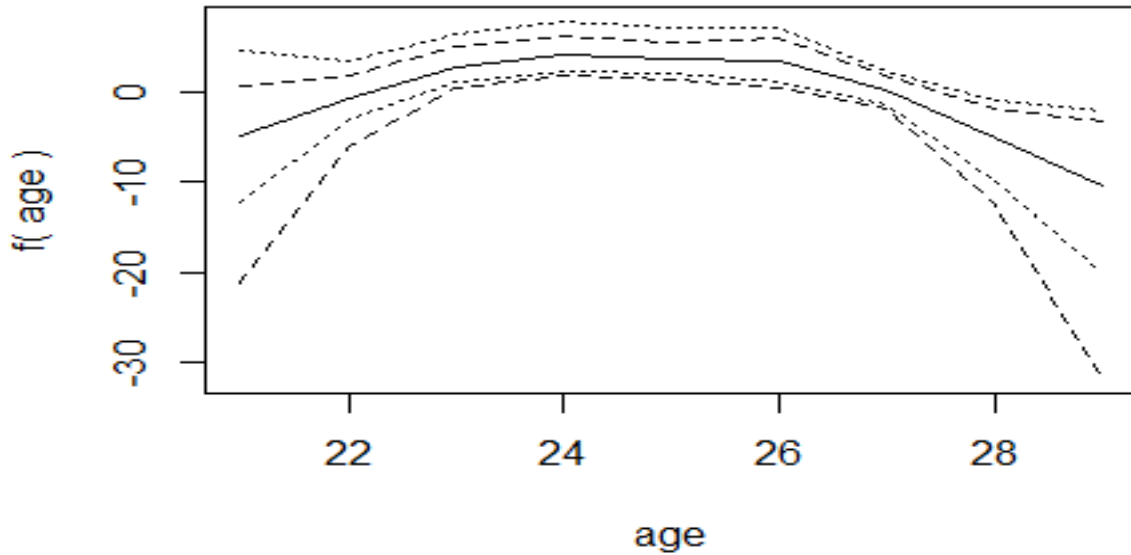


Fig. 7: Non-Linear Effect of Age of HND II students. Shown are the posterior means together with 95% and 80% pointwise credible intervals

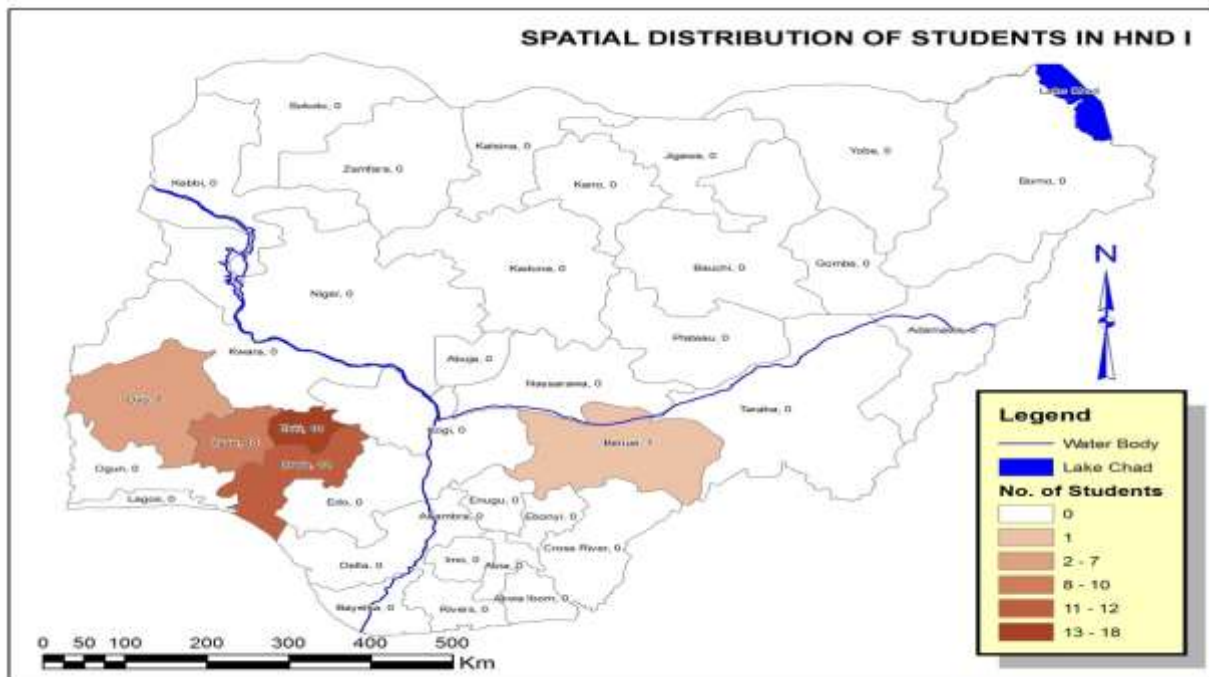


Fig. 8: Spatial distribution of students in HND I



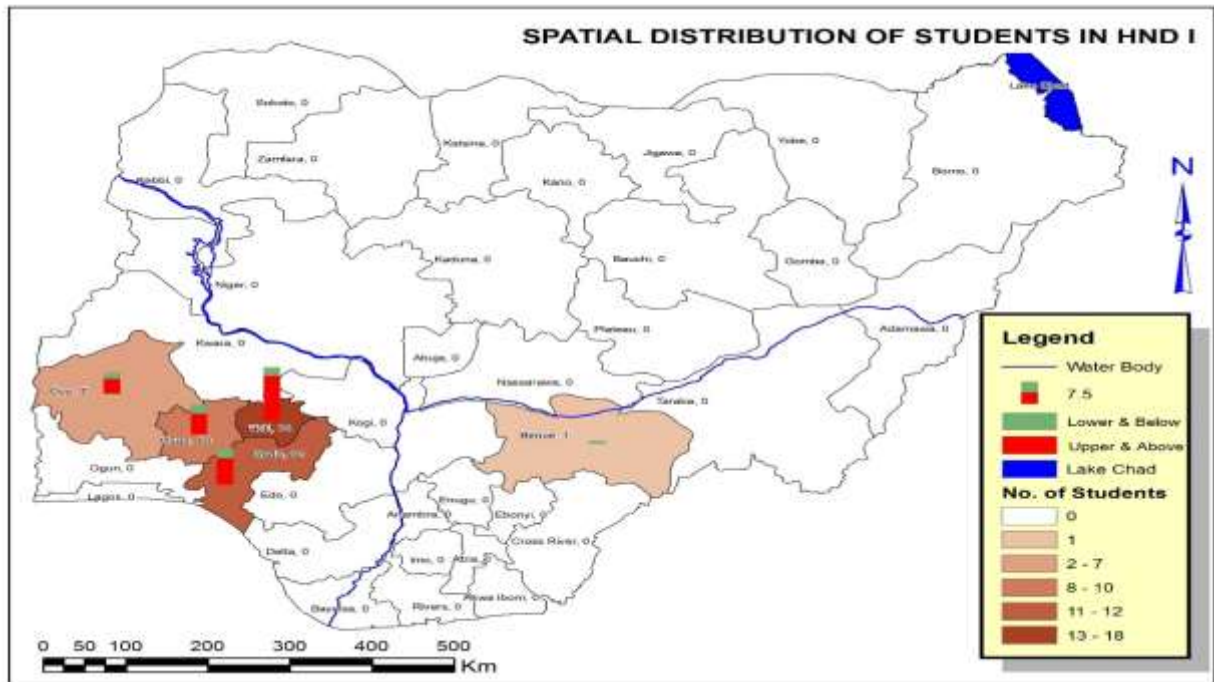


Fig. 9: HND I students GPA by states

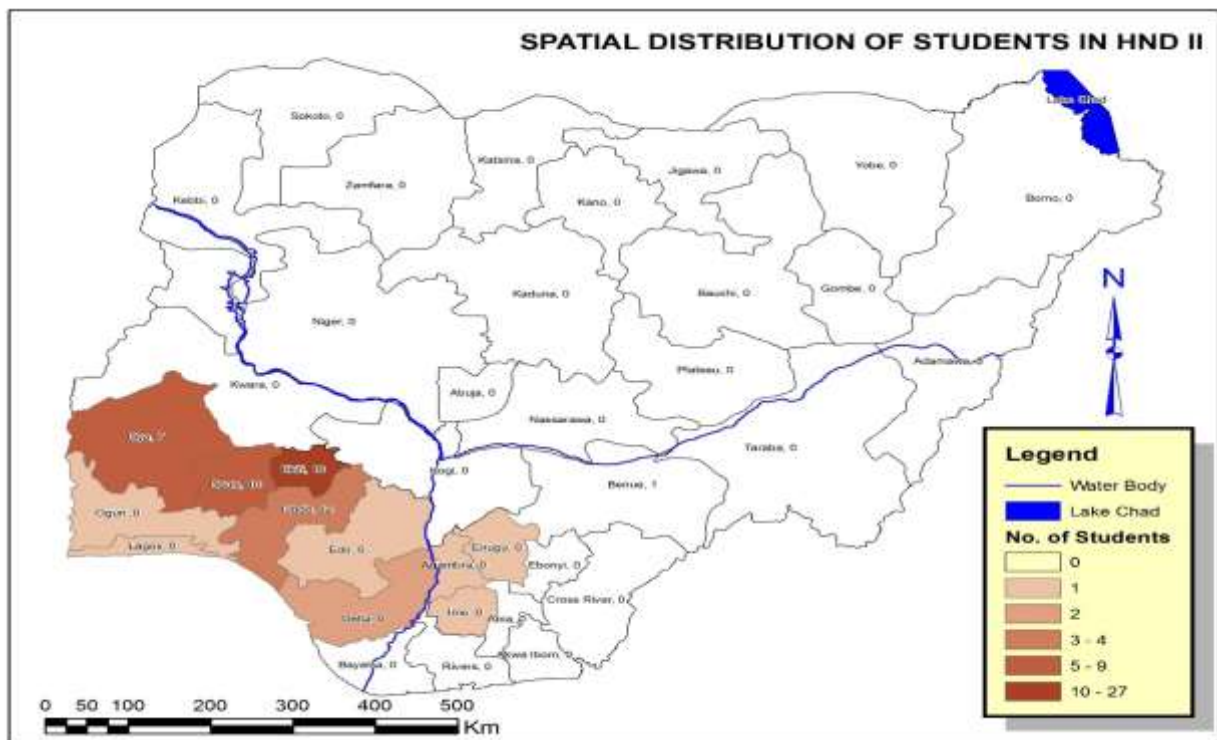


Fig. 10: Spatial distribution of students by in HND II

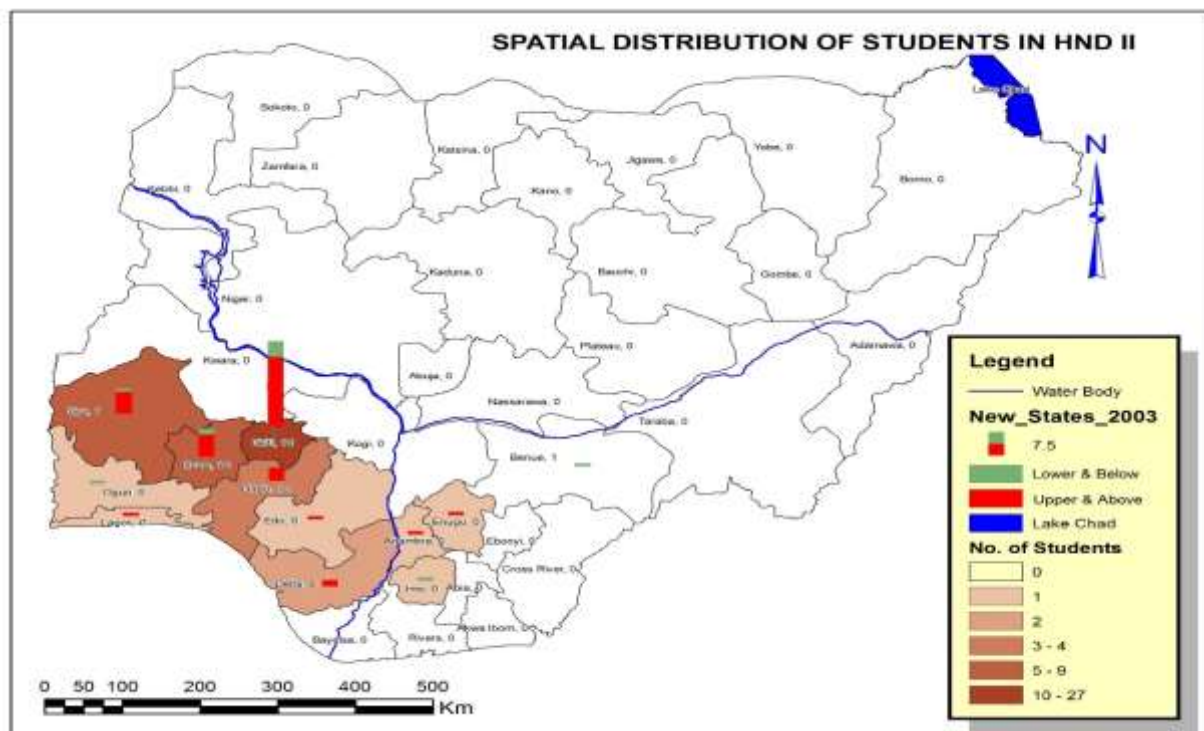


Fig. 11: HND II students GPA by states

### 3. Discussion of Results

It can be observed from fig.1 and 2 that students who attended private primary school are the ones having higher number of lower credit and below, while those from public primary schools perform better (40% and 60% respectively). Same experienced is noticed in the type of secondary school attended. This may be due to various kinds of strange and stressful activities the students from private schools were exposed to for the first time in their academic lives. Males appear to perform better than their female counterparts as revealed by their GPA. Also, students of age group 20-24 have higher number of upper credit than the other age group. Analysis and tests using logistic regression (tables 2 and 3) show that the variables have significant effect on the students' academic performances. Further investigations reveal higher influence or relativity between performance and type of primary school attended and secondary school attended. However there is positive relationship decline for secondary school attended. The graphical illustration in figs. 6 and 7 show that age is found to have a non-linear influence on the academic performances. The effect of sex, primary and secondary schools attended are all significant at 97.5% credible interval. It can be seen in figs. 5, 8, 9, 10 and 11 that Osun, Ekiti and Ondo students have the highest proportion (20%) of upper credit.

### 4. Conclusion and Recommendation

The type of primary and secondary schools, gender, age, and states of origin have significant effect on the academic performances of the higher national diploma (HND) students of Mathematics and Statistics department of the Federal Polytechnic Ado-Ekiti, Nigeria. Policy makers and other stake holders in education sectors are advised to do the needful in preparing the students for the challenges ahead. Younger students are advised to work hard as older students tend not to perform as expected as revealed in the research output. Students from

other states where performances are low should be made to be more dedicated to their academic activities.

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