

Modeling students enrolment in Statistics Department using time series analysis

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Abstract – The research paper seeks to investigate the trend of student’s enrolment within the Statistics Department of Bolgatanga Polytechnic. Time series analysis was conducted on a historic data of student’s enrolment for sixteen consecutive years, from 2003 to 2019. Box-Jenkins methodology was employed in the study. The study revealed that student’s enrolment was best described by quadratic trend and ARIMA (0,4,0). The findings further revealed that the granger causality test in table 5 indicated that the p-values=0.0000 was less than 0.05 suggesting that the enrolment at lag 1 and 2 jointly cause the student's enrolment to increase in the department. The findings revealed that students’ enrolment follows a random walk model which implies that it is likely that the department record zeroes enrolment in particular year group since there is randomness in regards to students’ enrolment in the department. The research paper concluded that students’ enrolments are likely to stagnate in the future as indicated on the forecasted curve. The statistics department needs strategic marketing techniques to help market their program to potential students in the general public in order to increase students’ enrolment of the department.

Keywords: Autocorrelation Function, Partial Autocorrelation Function, Stationarity, Parameter Estimation, Parsimonious model and Differencing, Time Series Analysis, Linear trend model and Quadratic trend model,

Introduction

The development is critical to the progress and industrial development of each nation. The set of skills that empowers a population to contribute meaningfully to the event of a rustic through their various chosen fields or occupations remains the mission link in Ghana’s government for since economic development. It provides advanced technical and vocational training and training the government of Ghana. Redesigned technical institutes in Accra, Kumasi and Takoradi polytechnic in 1963, Cape Coast polytechnic was established in 1984, Tamale polytechnic which was a trade Centre was elevated to a polytechnic in 1986. Similarly Ho polytechnic technical institute was upgraded to a polytechnic in 1986 while that of Sunyani and Koforidua were elevated in 1987 subsequently, Bolgatanga and Wa polytechnics were established in 1999 and 2000 to satisfy government policy of established a polytechnic in each of administrative regions of the country at the time Polytechnic education has become more critical today than ever as successive governments have seen the need to address the critical staffs’ gap in the rest for economic development.

Since 1992, when Government directed Polytechnics in Ghana to run Tertiary programmes, significant gains are made within the output of the Polytechnic graduates. The Polytechnics provide the majority of our people with technical education that's relevant, up-to-date in technology, and forward looking in approach (Owusu-Agyeman, 2006).

Countries around the world are redefining policies governing tertiary education so as to ensure fair access to tertiary education for all people. The growing numbers in high school enrollment and the need for individual growth and survival necessitated this.

Writing on the study of trend analysis, Bell and Best (1986) claimed that "it is focused on longitudinal consideration of historical data which indicates what happened in the past, what the present situation shows and what is likely to happen in the future focused on this data." According to Koul (1995), pattern studies are "taken at regular intervals by documentary study or survey." Several researchers have used the push and pull theory of migration to describe the gaps between the students' goals of enrolling in educational programs and the factors that keep them out of programs.

Ndudzo and Nyatanga (2013) used the push and pull theory to analyze the factors that promote student enrolment and to explain the factors that deter students from studying in tertiary institutions. Certain drivers provide ease, flexibility fee schedule and personality and career growth. The major factors that deter (push) learners from pursuing polytechnic education include insufficient contact time with tutors, complexity of learner enrollment, computer and internet inaccessibility, lack of financial resources to finance education, and unfavorable fee payment schemes.

Education is a tool which promotes a country's socio-economic and cultural growth. Besides this, education provides inspiration for change, introduces innovation in the ideas required for a country's development, and is also one of the basic human rights laid down by the UN Charter. Education also raises economic returns and has major effects on deprivation, distribution of wealth, health, fertility, longevity, population growth, and quality of life that are important factors in economic development. Therefore, education is a powerful development tool that allows long-term commitment of immense value to society as a whole (Ajayi&Ekundayo, 2007).

Researchers have reported questions about declining enrolment (Waldrop, 2013). Daily guide (March 19, 2018) learned that for the 2017/2018 academic year, the Bolgatanga Polytechnic in Sumbrungu, in the Upper East region, is currently facing low enrollment.

Problem statement

The Bolgatanga Polytechnic, established in 1999, is among two Polytechnics in the country that have not been elevated to Technical University status. The polytechnics Tamale, Sunyani, Kumasi, Koforidua, Ho, Cape-Coast, Accra and Takoradi were elevated, leaving behind Wa and Bolgatanga. Checks revealed that before the conversion some of the polytechnics to technical universities, Checks showed that prior to the conversion of some of the polytechnics to technical universities, Bolgatanga Polytechnic had accepted higher numbers of fresh students to read various Polytechnic Higher National Diploma (HND) courses.

Unfortunately, the school subsequently cannot speak of attracting the same number or even higher, fresh students. Although the department of statistics was first to be founded in the polytechnic with the enrolment of higher students, the department continues to experience low student intake in the following years.

This condition was due to many problems including the transfer of Polytechnics to Technical University, student understanding of the statistics system, perceived complexity existence of the program, infrastructure, human resource and others issues which would be discovered by this research.

General objective

The main objective of this study is to determine the trend analysis of students' enrolment in Bolgatanga Polytechnic since inception.

Specific objectives

- To determine the trend of students enrolment in statistics department.
- To develop appropriate model that best fit students' enrolment in statistics department.
- To make a two year forecast of the students enrolment in statistics department to aid planning.
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Research questions

- Is there any trend of students' enrolment in statistics department?

- What is the appropriate model that best fit students' enrolment in statistics department?
- What is the two year forecast of the students' enrolment in statistics department?

Literature review

Using time series data, Soen and Davidovitch (2004) established the inauguration of fully accredited public and private colleges as well as the academisation of the teaching profession as the main cause of the drastic increase in Israel's graduate enrolment. The study showed that as Israel's higher education grew, all ethnic groups thereby increased their enrolment levels removing ethnic inequalities. Akilagpa (2002) conducted a case study of some selected African countries and described as historical the major factor for enrollment explosion in African higher education.

The historical consideration was the need to fill in the increased demand arising from colonial and immediate post-colonial conditions. At the time, in virtually all African countries, the potential for local university education was limited, but there was a particular need to employ the growing public services, careers and businesses in newly independent states. Other factors found are high population growth rates in virtually all African countries, and a persistent increase in the pool of high school graduates from which a small number can be admitted to university.

Akilagpa (2002) saw the striking characteristic of the African higher education terrain as the rapid increase in enrolment rates after political independence in the 1960s. From the report, the overall enrolment of students rose at a remarkable pace from an approximate number of 181,000 in 1975, with a triple rise in five years, according to public figures, to more than 600,000 by 1980 and more than doubled in a decade, to 1,750,000 by 1995.

The study noted that the increase in enrolment persisted, not just in the sense of economic and political crises, all amid drastic cuts in job prospects for university students.

The notion of the "qualification-escalation ratchet" process as captured by Coleman had clarified this persistence of demand for university education in the face of declining job opportunities:

When you've set your eyes on a commercial sector job and find that your junior high school certificate doesn't get you one, there's nothing left but push ahead to seek and get a senior high school certificate, and if that doesn't succeed you're moving on to university. (Coleman, p. 335 in 1994)

Sissoko and Shiau (2005) empirically presented the determinants of black students' enrolment at Historical Black Colleges and Universities (HBCUs) from 1976 to 1978 as the average tuition cost and Pell Grant per student, the retention rate, federal policies and the trend in black population. The result showed statistically significant negative association between enrolment and cost of college, but positive for Pell Grant per student as opposed; positive but negligible was the coefficient of the real median black income.

This is an increase in the actual average tuition costs will lead to a decrease in black student enrolment at HBCUs. The study further revealed that an improvement in the federal government's need-based grant would allow a large number of black high school graduates to pursue higher education. It was concluded that the access of Blacks to higher education would be difficult without regular rises in financial aid to minimize the impact of inflation.

DeMeulemeester and Rochat (1996) used panel analysis to classify some of the main explanatory variables of the enrolment rate at Belgian universities. The variables analyzed were unemployment rate, average fiscal income per capita, proportion of intellectual employees in the workforce and supply variables (such as number of universities by district or distance from closures universities). The study revealed that unemployment rate had a global negative effect on enrolment while positive signs are provided by coefficients of average fiscal revenue and variable accounting for cultural distance from the university.

However, the supply impact on the university enrolment rate varies from district to district. The study showed that the Flemish-speaking students were immune to the number of universities in their district, while French-speaking students seemed more immune to the university's "physical gap." The differences in supply variable effects indicate that university choice is governed by proximity and also by the type of institutions, especially in the north.

Including the factors influencing enrolment in African countries, the president of the Association of Universities and Colleges of Canada; Claire (2007) described the reasons for increased enrolment in Canada as: increased labor market requirements for skilled workers, demographic shifts, and the more important factor was participation rate in Canada. He noted that increasing demand for the knowledge-based economy in Canada would continue to contribute to growth in national enrolment. For a job market that needs more and more professional knowledge workers, Canadians will continue to search for higher education to grow the skills and expertise they need

Research methods

The data for the study was primarily secondary historical annual data of students' enrolment in statistics department of the Bolgatanga Polytechnic since inception, the data spans from 2003 to 2019.

The Box-Jenkins technique (Box & Jenkins, 1976) is a step-wise statistical approach used in the study and construction of model forecasting that best represents a time series. This forecasting approach integrates self-correlation information based on autoregressive integrated moving average models.

The technique has the following advantages;

- It is logically and statistically reliable
- It makes effective use of historical time series data
- Predictability is improved the process is of four distinct stages namely; detection, estimation, diagnostic testing, forecasting.

Identification: Identification methods are procedures that are applied to a collection of data to show the type of representational model to be examined further. The goal here is to get some idea of the values p , d and q needed in the general linear ARIMA model and to get initial estimates for the parameters. The task here is to find a suitable subclass of the general ARIMA family models which can be used to depict a given time series. This includes an analysis of the autocorrelation and partial coefficients determined for the data

Estimation: Once the preliminary model is chosen, the stage of estimation begins. The aim of the calculation is to find estimates of the parameter, which minimize the mean square error. An iterative non- least squares procedure is applied to the parameter estimates of an ARMA (p , q) model.

The method minimizes the sum of squares of error given to form the model and data. Typically the projections converge to an optimal value for the parameters with a small number of iterations.

Diagnosis Checking: Residuals from the fitted sample are tested to ensure the configuration is (randomly) sufficient. The error term autocorrelation is calculated and plotted to determine whether statistically zero. The observed value is therefore evaluated as a result of an error in sampling. This is the first Suitability Test

The second adequacy test is the Q-test, as discussed earlier. Many ARMA model can be tried under conditions with unsatisfactory results before a suitable model is obtained.

Forecasting: When a model is defined and validated, forecast can be made on multiple cycles for one time and there. As the forecast period gets further forward, the probability of forecast error becomes greater. As new observations are obtained for a time series, the model should be re-examined and appropriateness tested. When identifying and validating a model, forecasting can be rendered for once and there on several cycles.

As the prediction period goes forward further, the probability of forecast error increases. As new observations are obtained for a time series, the model should be re- and appropriateness tested

However, if bigger variations in the size of the forecast error are found, then a new model is needed, returning to the first phase of the Box-Jenkins method.

RESULTS AND ANALYSIS

The exploratory data study was also used on the enrolment of students for the sixteen consecutive years, using mostly vector autoregressive and the time series study Box-Jenkins technique. Some estimates were made to obtain the concise statistics about the enrolment of students first, followed by time series plots and a trend analysis

Table 1: summary statistics of the student’s enrolment

<i>STAT</i>	
Mean	16.94117647
Standard Error	2.274330199
Median	17
Mode	22
Standard Deviation	9.377303639
Sample Variance	87.93382353
Kurtosis	1.174183354
Skewness	0.821678186
Range	36
Minimum	5
Maximum	41
Sum	288
Count	17
Largest(1)	41
Smallest(1)	5
Confidence Level (95.0%)	4.821364641

The minimum enrollment for students was found to be 5 and a maximum of 41, while the average enrollment was 16.94 with an corresponding standard deviation of 9.38, suggesting that the data were distributed widely around the mean. The variation coefficient of 13.42 percent also shows a very high variance in the results. The enrolment distribution of the students also shows positive skewedness of 0.82 suggesting that the majority of the enrolment is distributed to the right of the mean and has a positive kurtosis value of 1.17 suggesting that the data is platykurtic, has a flattened and that more students are enrolled at either end of the distribution, hence flattened than usual peak. Currently, the polytechnic runs ten programs with overall enrolment of students in the statistics department to be 41, which is unsustainable and so factors that militate against student enrolment should be tackled immediately to safeguard the department from collapse.

Table2 : ANOVA

<i>Source of Variation</i>	<i>SS</i>	<i>Df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	31874124	1	31874124	844767.2	2.6E-68	4.170877
Within Groups	1131.938	30	37.73125			
Total	31875256	31				

From table 2 it is clarified that student enrolment over the study period is statistically important. This indicates that the statistics department has undergone substantial decreases in student enrolment over the past seventeen years and this trend is correlated with several factors such as parents ' infrastructure, pull and push factors and understanding of statistics, job market for graduate statistics.

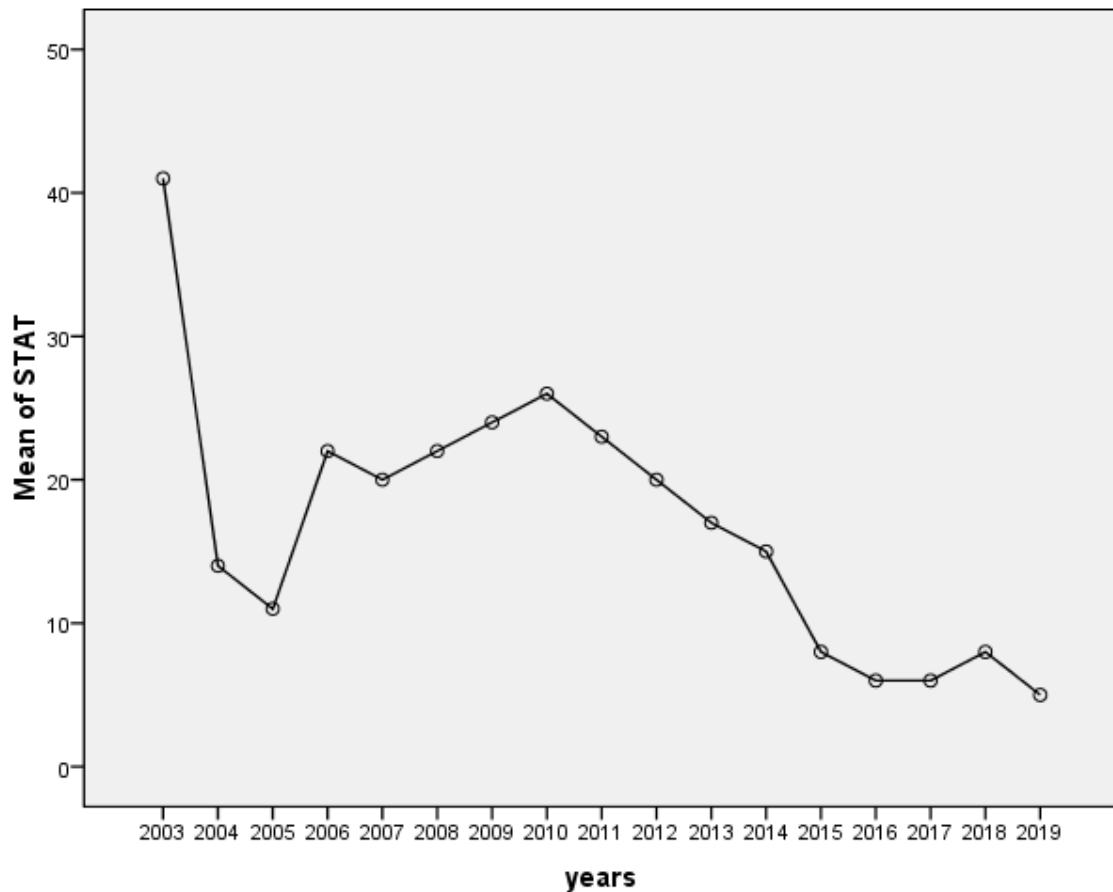


Figure 1 shows the data obtained by student’s enrolment in statistics department for sixteen-year period. The graph depicts an overall weak enrolment in the statistics department. It can be seen that students’ enrolment depict an increased from 2003 and decreased drastically from 2004 to 2005. In particularly, student’s enrolment picks an increase from 2006 to 2010 and started steady decrease from 2011 to 2019. The worse students’ enrolment was recorded in 2019 suggesting that the department needs to wake up from their dream before it is too late.

Table 3: VAR system, lag order 1

	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-ratio</i>	<i>p-value</i>	
Const	7.29158	3.42098	2.1314	0.05126	*
enrolment_1	0.460547	0.172937	2.6631	0.01855	**

Mean dependent var	15.43750	S.D. dependent var	7.266074
Sum squared resid	525.6552	S.E. of regression	6.127544
R-squared	0.336242	Adjusted R-squared	0.288830
F(1, 14)	7.092011	P-value(F)	0.018549
Rho	0.494561	Durbin-Watson	0.728194

F-tests of zero restrictions:

All lags of enrolment $F(1, 14) = 7.092 [0.0185]$

Vector auto-regression was performed to model the dynamic relationship of the student’s enrolment over time. It is clear from the table 3 that students enrolment was statistically significant decrease over time and these findings affirms the results in table 2. 28.89% of the total variation in enrolment is being explained by time and remaining 71.11% is explained by other factors as indicated by the Adjusted R-squared.

Table 4: vector auto-regressive model estimation

Estimation Proc:

=====
LS 1 2 ENROLMENT

VAR Model:

=====
ENROLMENT = C(1,1)*ENROLMENT(-1) + C(1,2)*ENROLMENT(-2) + C(1,3)

VAR Model - Substituted Coefficients:

=====
ENROLMENT = 0.966536534808*ENROLMENT(-1) - 0.083318825913*ENROLMENT(-2) + 1.46738904683
The vector auto-regressive make use of lags as the independent variables. The enrolment was used as the dependent variable and lags were use as the independent variables and the model was estimated as ENROLMENT = 0.966536534808*ENROLMENT(-1) - 0.083318825913*ENROLMENT(-2) + 1.46738904683. The coefficients of the lag 1 and 2 are both significant and need to be included in the model.

Table 5: Granger causality test

Wald Test:

System: %system

Test Statistic	Value	Df	Probability
Chi-square	29.89562	2	0.0000

Null Hypothesis: C(1)=C(2)=0

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	0.966537	0.197295
C(2)	-0.083319	0.150886

Restrictions are linear in coefficients.

The researchers’ wants to establish that enrolment at lag 1 and 2 can jointly cause the students enrolment to change. it is clear from the wald test in table 5 that the p-values=0.0000 which less than 0.05 suggesting that the enrolment at lag 1 and 2 jointly cause the students enrolment to increase in the department. This implies that if the department wants to increase students enrolment they should considered factor such push and pull, disabused the minds of student about the program, routine advertise the program and preaching the goods news of pursuing the statistics program.

Time series analysis

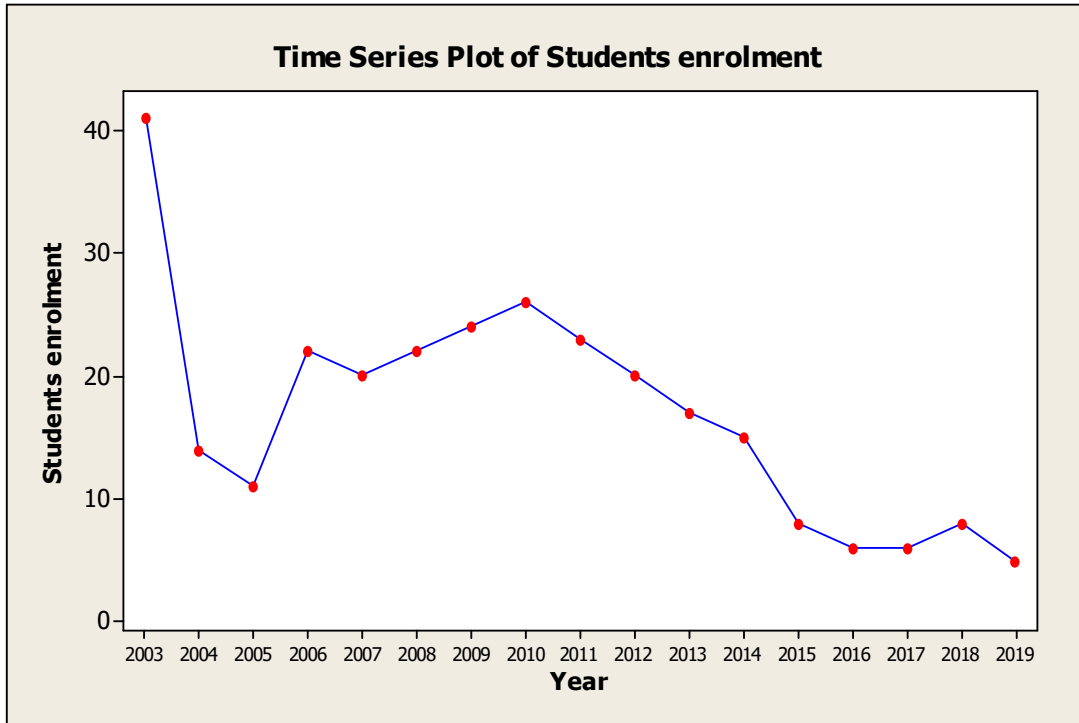


Figure 1: students’ enrolment in statistics department between 2003-2019

The plot in Figure 1 shows the fluctuation pattern of students’ enrolment with respect to time. It can be observed, generally, from the figure 1 that decreasing trend in the plot is significantly sharp between 2011 and 2019. Students’ enrolment however, took a significant downward turn at 2012, 2015, 2017 and 2019 respectively. The series depicted a generally increasing and decreasing pattern in the time graph indicating that there is a change of the mean whilst the sharper fluctuations over time shows unstable variance suggesting the series is not stationary.

Table 6: Stationary test

Test	Test statistic	p-value
ADF	0.12565,	0.01
KPSS	-5.6951,	0.1

The series were difference four times in order to achieved stationarity and after the forth difference the results are shown in table 3. From the KPSS test values on table 3, at 5% significance level, the conclusion is that the series is *stationary* since the p-value (0.1) is greater than 0.05. However, the ADF test with a reverse null hypothesis indicates that the data is stationary with p-value 0.01. In all, the data is concluded to be stationary based on the evidence of the time plot, correlogram, KPSS and ADF test, hence after the forth difference.

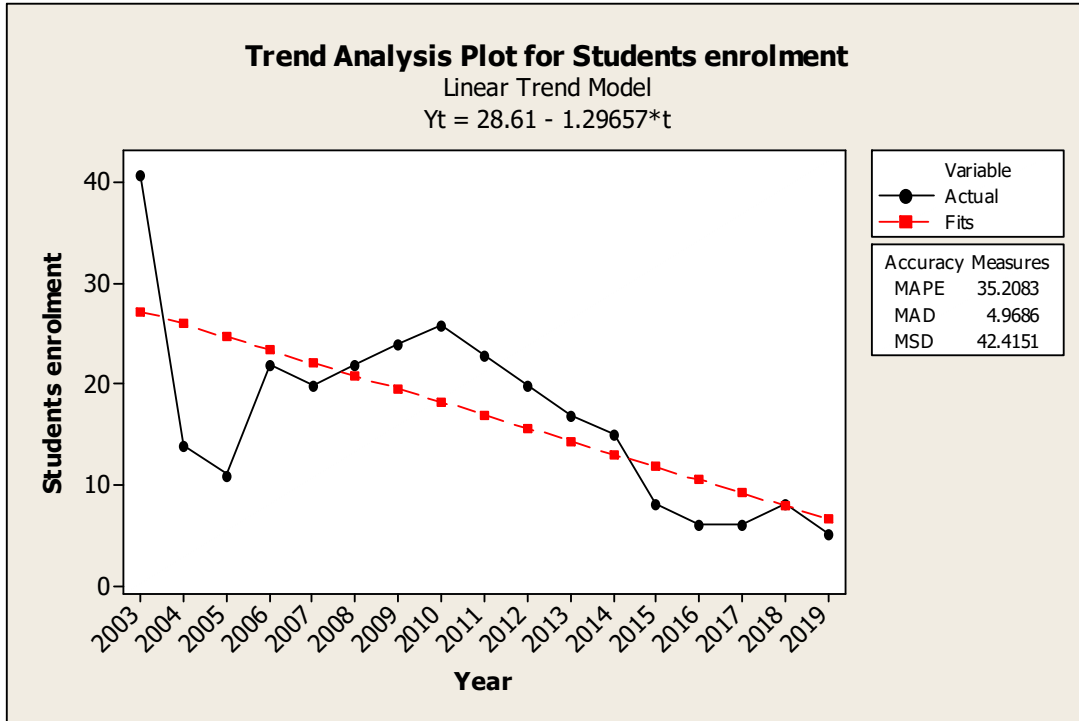


Figure 2: Linear trend plot of students' enrolment in statistics department

Quadratic trend

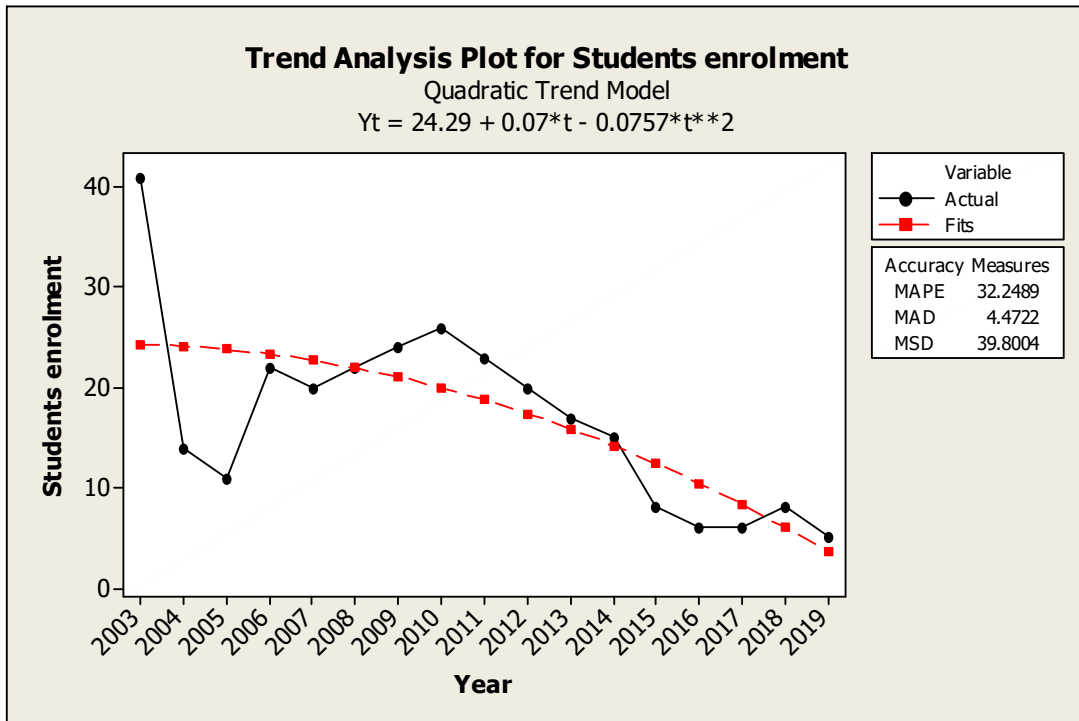


Figure 2: Quadratic trend plot of students' enrolment in statistics department

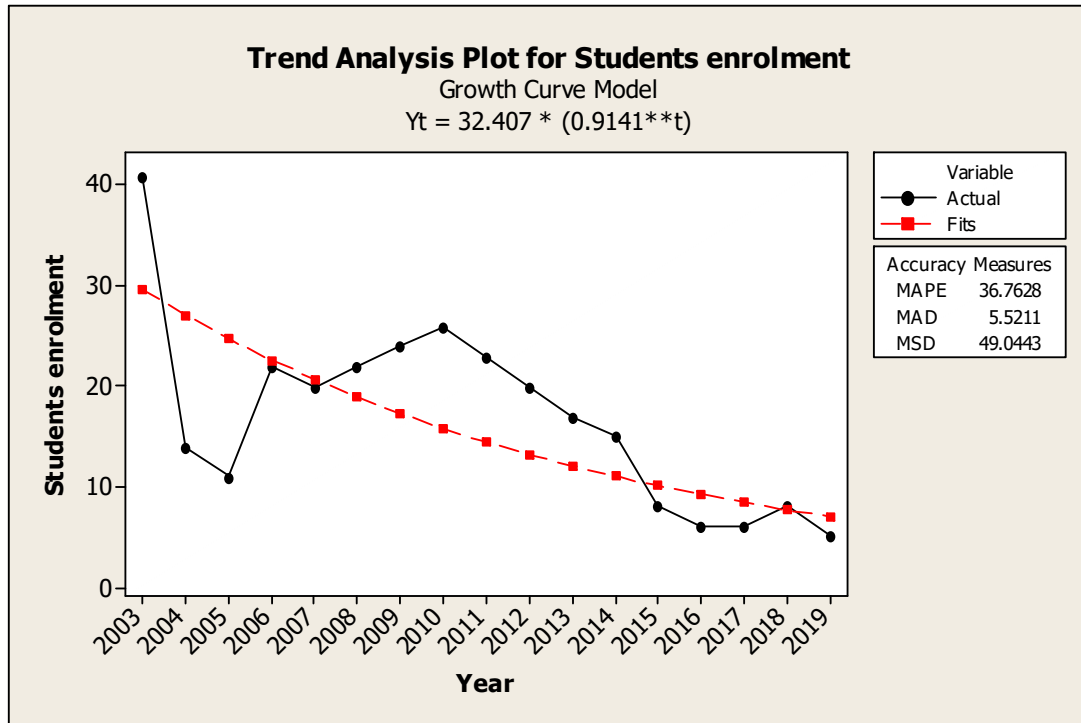


Figure 4: Exponential trend plot of students’ enrolment in statistics department

Figures 2 , 3 and 4 shows the linear, quadratic and exponential models respectively. In each of the figures, round dotted lines represent the actual values of students’ enrolment whereas the square dotted lines represent the fitted values based on the various models.

Table 7: Measures of accuracy

Model	MAPE	MAD	MSD
Linear	35.2083	4.9686	42.4151
Quadratic	32.2489	4.4722	39.8004
Exponential	36.7628	5.5211	49.0443

From **Table 7** the most appropriate model that describes the trend in students’ enrolment is the one with minimal errors. A closed observation of the errors produced by three models, the quadratic model has the minimum MAPE, MAD and MSD thus, is considered to be the best model in describing the trend in students’ enrolment in the statistics department.

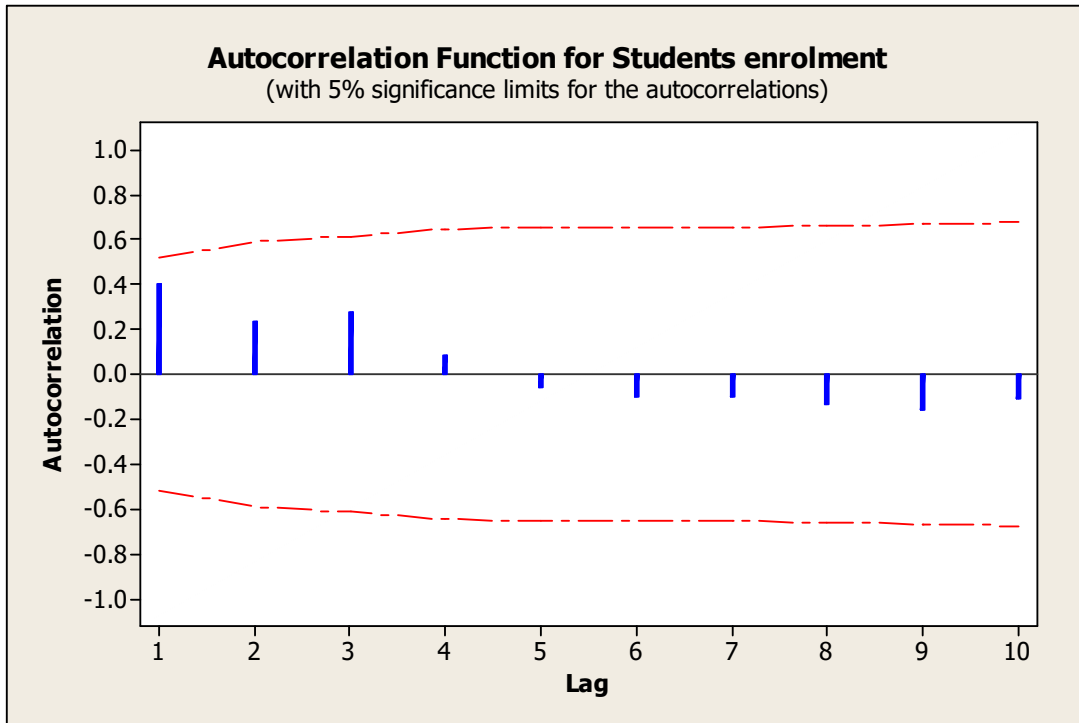


Figure 5: ACF plot of student’s enrolment in statistics

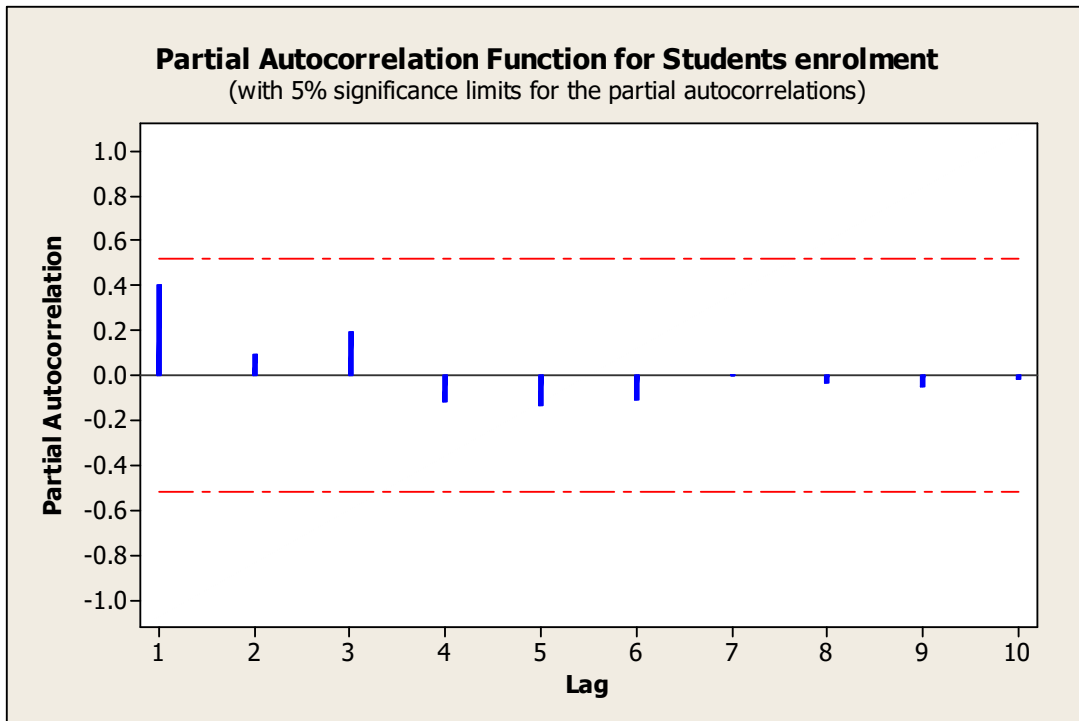


Figure 6: PACF plot of student’s enrolment in statistics department

Figure 5 and 6 shows the ACF and PACF of students’ enrolment in statistics department

Further analysis was conducted and checks made on the Autocorrelation Function (ACF) plots and those of the Partial Autocorrelation Function (PACF). It can be observed that with 95% confidence interval the data appears

to be stationary after the fourth difference. The ACF is significant spikes at lags 0 and 0 of the PACF as illustrated in Figures 6. These suggest that there is no increased or non-decreased in both ACF and PACF re-affirmed that the series is stationary.

Table 8: Model identification

Model	AIC	BIC	HQ
ARIMA(0,4,0)	107.9721	108.6802	107.9646
ARIMA(0,4,1)	111.6628	113.7870	111.6402
ARIMA(0,4,2)	111.1366	113.9688	111.1064
ARIMA(0,4,3)	113.0733	116.6135	113.0356

The most appropriate model for the series is the one with the minimum Akaike Information Criteria (AIC), Bayesian information criterion (BIC) and Hannan-Quinn (HQ) . Thus, by an inspection of all the competing models in table 8 the ARIMA (0, 4, 0) model has the minimum values and therefore the best model for forecasting. This implies that student’s enrolment in statistics department is random in nature and can only be predicted by naïve approach. This call for the department and school authorities should critical investigates why low student’s enrolment in the statistics department and the way forward.

Table 9: PARAM

ETER ESTIMATION

Coefficient	std. error	z	p-value

Const	1.60000	2.21209	0.7233 0.4695

Table 9 displays estimates of the parameters of the ARIMA (0, 4, 0) model. The parameters of constant are not significant at 5% levels with coefficients and p-values of (0.4695) respectively. P-value great than 0.05 indicating there parameters are not significance.

Model Diagnosis

To ensure that the selected model is the best model that suits the data the following diagnostics are performed

Residuals Plots

The patterns of the residuals over time around the zero mean as seen in figure 7 below indicates that the residuals are random and independent of each other, thus, indicating that the model is fit.

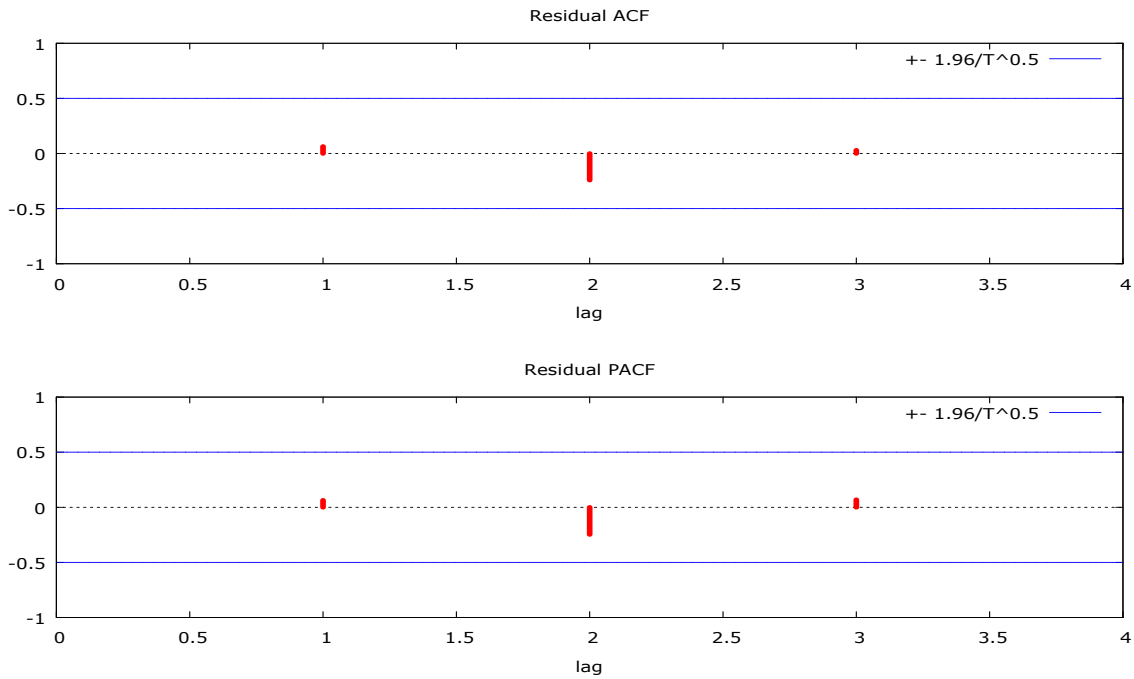


Figure 7: shows residuals plot of ACF and PACF

The Normal Q-Q Plot

The Normal Plot is another diagnostic check on the residuals to determine whether it follows the normal distribution. This is done by using the normal probability plot. It is a plot based on estimates of the quantiles. The normal plots is used to compare the distribution of a sample to a theoretical distribution. If most of the points are in line and closer to the normal line, then the model is a good fit. The normal plot in Figure 8 below shows all points along the normality line except for one outlier hence the model is deemed fit.

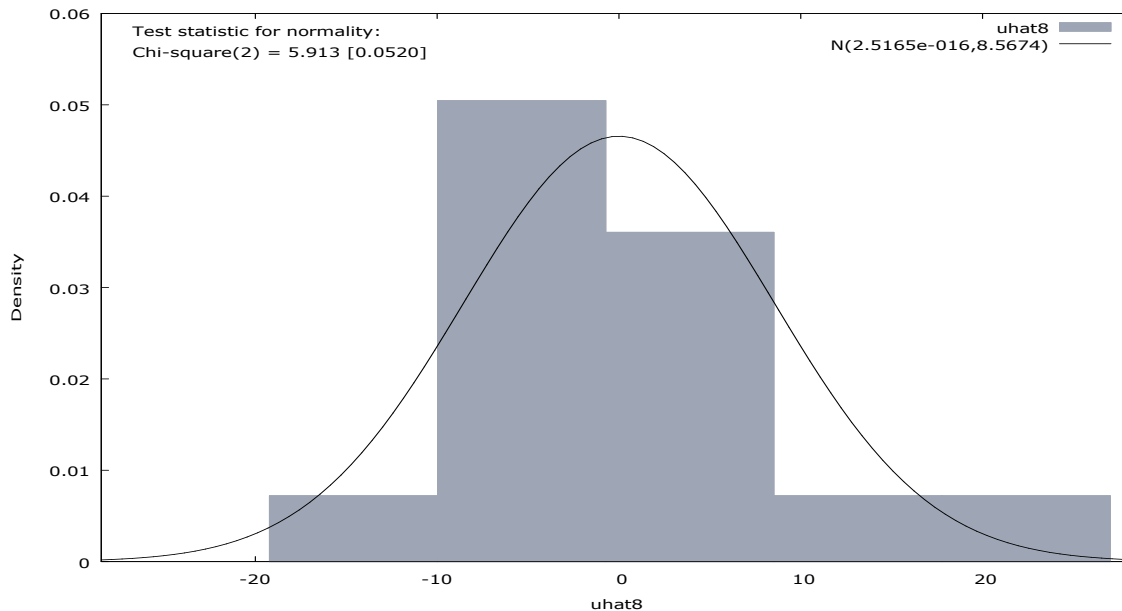


Figure 8: normal plot of residuals

Ljung-Box Q Statistics

A check of the overall model adequacy is made using the Ljung-Box Q statistics. With a p-value of 0.567 which is way greater than 0.05 indicates that the model is generally adequate.

Table 10: Ljung-Box Q Statistics

MODEL	Statistics	DF	Sig.
Arima(0,4,0)	6.8	12	0.567

FORECAST

Since the model checks out to be of good fit, we can now forecast for future values in this instance, the next 5 observations.

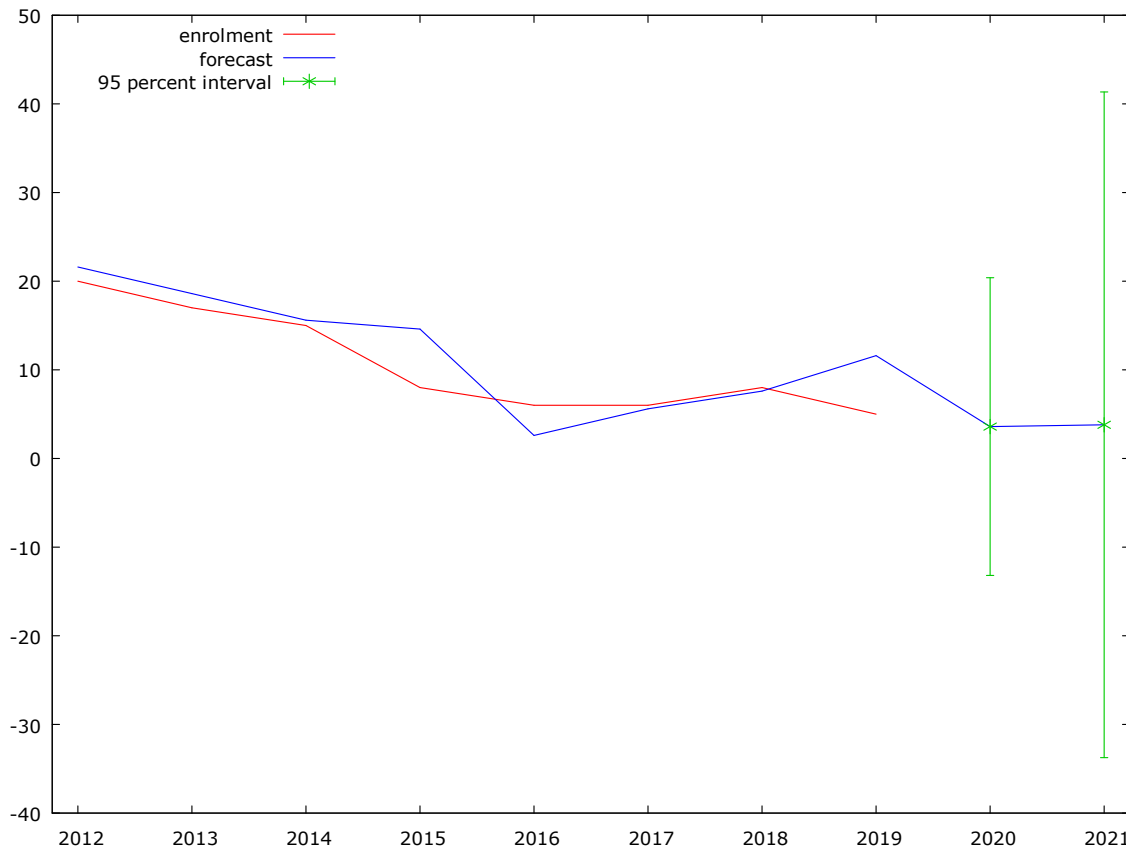


Figure 11: forecast of students enrolment in statistics department

From figure 11, it is believed that when the factors perceived to militate against increase in enrolment in the statistics department are address immediately the students’ enrolment expected to experienced gradual increase from 2020-2021 and beyond as can be seen from the figure 11.

Summary of the findings

The minimum students’ enrolment was found to be 5 and maximum 41 whilst the average enrolment was 16.94 with accompanying standard deviation of 9.38, indicating that the data is widely dispersed across the mean. The coefficient of variation of 13.42% also shows that the data has a very high variance. The students’ enrolment distribution also exhibits positive skewness of 0.82 indicating that most of the enrolment are concentrated to the right of the mean and has a positive kurtosis value of 1.17 also indicating that the data is platykurtic, thus, has a

flattened and there are many of the students enrolment at either extreme of the distribution hence flattened than normal peak. The polytechnic currently run ten programme with maximum students' enrolment in statistics department to are 41 which is unacceptable and so factors that militate against the students enrolment should be address immediate to safe the department from collapsed.

Figure 1 shows the data obtained by student's enrolment in statistics department for sixteen-year period. The graph depicts an overall weak enrolment in the statistics department. It can be seen that students' enrolment depicts an increased from 2003 and decreased drastically from 2004 to 2005. In particularly, student's enrolment picks an increase from 2006 to 2010 and started steady decrease from 2011 to 2019. The worse students' enrolment was recorded in 2019 suggesting that the department needs to wake up from their dream before it is too late

Figure 2 shows an upward and flattened trend indicating a quadratic trend with the series showing a generally no increasing trend.

The enrolment was used as the dependent variable and lags were use as the independent variables and the model was estimated as $ENROLMENT = 0.966536534808 * ENROLMENT (-1) - 0.083318825913 * ENROLMENT (-2) + 1.46738904683$. The coefficients of the lag 1 and 2 are both significant and needed to be included in the model. Figures 2, 3 and 4 shows the linear, quadratic and exponential models respectively. In each of the figures, round dotted lines represent the actual values of students' enrolment whereas the square dotted lines represent the fitted values based on the various models

Table 7 the most appropriate model that describes the trend in students' enrolment is the one with minimal errors. A closed observation of the errors produced by three models, the quadratic model has the minimum MAPE, MAD and MSD thus, is considered to be the best model in describing the trend in students' enrolment in the statistics department.

The granger causality test in table 5 indicated that the p -values=0.0000 was less than 0.05 suggesting that the enrolment at lag 1 and 2 jointly cause the students enrolment to increase in the department. This implies that if the department wants to increase students enrolment they should considered factor such push and pull, disabused the minds of student about the program, routine advertise the program and preaching the goods news of pursuing the statistics program.

Secondly, even though the data was transformed by way of differencing to achieve stationary and the tests of best fit also confirmed that the final model was adequate for the forecast, the two years predicted outcomes showed very little increase in students' enrolment over time. Thus, further demonstrating that improvement of students' enrolment in the statistics department is likely stagnate in the future if the department and polytechnic are not able address the immediate challenges facing the institution especially elevating it to Technical University to enable it compete among their counterparts Technical Universities in Ghana.

Recommendations/Suggestions

Based on the findings of this study, couples with the fact that many students' considered factors such as infrastructure, lecturers, modern lectures hall and whether the school is Technical University before gaining admissions into the school to study a programme: the study

Commends/suggests the following:

- Department should endeavour and ensure that qualified and adequate lecturers are recruited to meet the future demand of increases in students' enrolment as indicated on forecasted curve.
- The Polytechnic should have come out with long-term strategic policies to increase students' enrolment especially the statistics department as indicated in the findings that there is statistical significant decrease in students' enrolment over the past sixteen year period.

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