Analysis of Students' Enrollment and Graduation Rates in Gulu University in Uganda. A Case Study of Gulu University

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Abstract: *This research's main objective was to investigate the enrollment and graduation rates at Gulu University in Uganda. An approach to quantitative research was used in this work. All Gulu University students from the academic period 2002/2003 to 2019/2020 made up the study's population. Document from the admissions office with secondary data for the study was the primary tool utilized to collect data. The information came from academic management systems, which are employed to oversee daily academic activities. Because these systems are maintained by transactional databases, which are frequently modified and lack the ability to archive histories of data instances, they are unsuitable for performing the analysis on enrollment prediction and graduation prediction. Asked on the likelihood of enrollment based on the fact that department in charge of recruiting students are left to guess. In the majority of cases, this is incorrect because it causes budget shortages and resource strain. Universities experience difficulty predicting how many students will graduate from the school of interest in addition to speculating on those who are likely to enroll. There are various causes why a student doesn't complete their degree of study, such their financial situation and family history. As a result, models for forecasting enrollment and graduation are put forth to help in making forecasts about how many admitted students will enroll and how many will graduate. The components of the suggested The inputs to the proposed prediction system were sourced from student data stored in a worksheet regarding to student details the proposed system then transforms By include a time variant, this data was converted into time series data, which was then submitted to regression analysis using the appropriate econometric model in Stata. The enrollment and graduation of students will then be predicted using the generated models. With a 59% accuracy rate, the model's accuracy was remarkably good. The dataset utilized, which was noisy because it was taken from actual student transactional databases, resulted in the proposed model having a slightly poorer accuracy in comparison to some of the papers assessed.*

Keywords: Students enrollment, graduation rates, graduates

Background

Public universities have methods for selecting its students in every country, but these methods' scope and makeup differ significantly from nation to nation. Studying this and other factors is essential for understanding a higher education admissions system. Understanding a higher education admission system requires both assessing this autonomy and exploring the mechanics of how selection and guidance take place. In Ugandan universities in the past, the number of admitted students has continuously exceeded the number of students enrolled. Following the recruitment process, admission letters are usually distributed to a large number of students to various schools or faculties with the assumption that a nearly equal number will enroll. However, not every candidate who is accepted enrolls for a variety of reasons. The preponderance of Ugandan universities have a high school mean grade as their entry requirements. On the other hand, enrollment actually took place when the student pays one certain cost and signs up for a specific number of courses or units that the institution is offering, as is the norm in most institutions. Institutional yield is the percentage of enrolled students to those that were admitted (Arcilla, 2012). One of the most dependable measures of an institution's quality and competitiveness is its institutional yield. This is primarily due to the ongoing studies on the advantages of a higher education for both individuals and society. The institutional yield might seem like a simple rate and a logical metric. However, it is significantly more difficult to compute and interpret than one might imagine, which can eventually lead to misrepresenting the true state of an institution's performance.

The success of any academic program largely rests on the student completion rate, regardless of the fact that enrollment trends are crucial (Borena, 2014). The ratio of all students who successfully complete the last year of their program in a given year to all students receiving an official diploma in the population is known as the student completion rate.

Due to the hidden expenditures that are always spent by both students and the university, not completing a program on time raises its cost (Bean & Metzner, 1985). For instance, due to the backlog of students who need to be cleared after graduating, students are charged extension fees, and university resources like libraries and research supervisors are overused. Once a student enrolls in a course, their universities must make sure that the appropriate student services are put in place to help them. It is imperative that once a student signs up to a course, their universities should ensure that necessary student services are put in place to guide the student

through to a successful completion. Therefore, the question of completion of students relating to the university should be studied with a bifocal lens. Student completion rate in higher education in Uganda should be critically assessed by researchers and higher education providers. Therefore, all related issues that improve the current trends should be identified and worked on. To achieve this, extensive research in this area should be encouraged so as to help gather the needed information.

Problem Statement

In most Ugandan universities, the frequency of student admissions has been followed by a corresponding uncertainty in funding allocation. Planning and budgetary challenges have emerged as a result of the uncertainty around the number of students who could really enroll, as was mentioned previously. It is up to the departments responsible for accepting students to predict how many will enroll. Most of the time, this is incorrect since it causes the budgets to be understaffed and the resources to be strained, as was said previously. The problem of admitting quality students who can successfully complete their degrees and graduate on time arises from the growth in enrollment numbers. The number of students who really are likely to enroll in the institution's various academic programs and finish their course of study on time cannot currently be successfully predicted by any institution of higher education in Uganda. Instead, academic routines are managed daily with the help of academic management systems. Transactional databases, which support these systems, are frequently edited and, as a result, lack the ability to archive histories of data instances, rendering them unsuitable for conducting predictive analytics on enrollment and student completion rate. Based on this situation, an empirical test was conducted on data from Uganda's public universities regarding student enrollment and graduation rates. A case study of Gulu University was the subject matter of this study.

Specific Objectives

1. To examine student's enrollment and completion trends at Gulu University
2. To determine the student completion rate per faculty in Gulu University

Research Questions

1. What are the trends of enrollment and completion rates at Gulu University?
2. What is the student completion rate per faculty?

RESEARCH METHODOLOGY

System analysis

The cornerstone for ensuring the accuracy of research is a high-quality data set. The researchers formulated answers that addressed the research questions, systematically collected data from reliable sources, and then evaluated the findings. Filtering the necessary data from a vast data set while ensuring data accuracy, however, was a difficult task. To avoid using false data and to uphold the standard of the research, extensive scrutiny is needed for data from secondary sources (Kumar, 2005).

This study acquired a significant amount of information about student enrollment and graduation and performed a thorough analysis to compile fresh enrollment and graduation statistics for each year. All of the students that enrolled at the university were the subject of the analysis. The qualitative approach and the quantitative approach are the two often used ways to forecasting, according to Albandoz (2001). Subjective inputs, which are a major aspect of qualitative methods, often resist prescribed numerical models. However, compared to their qualitative counterparts, quantitative forecasting techniques are more completely objective.

Quantitative methods forecast using historical data. They typically steer clear of the personal biases that may taint qualitative methods. Evaluating how the time series behaved in the past depends heavily on the data pattern. If this pattern of behavior persists in the future, selecting a suitable forecasting technique is guided by the historical trend. Furthermore, the performance of forecasting can be enhanced by bringing together the qualitative and quantitative methods. The management's opinion and judgment about the critical political and economic factors can significantly advance the forecasting performance better than a quantitative model alone, which may lag behind real world data. Based on the data analysis outcomes, this study selected an exponential smoothing method to develop the quantitative forecasting model.

Research design

This research design approach followed manipulating pre-existing statistical data using computational techniques. This research design suited this research since data relating to student's admission enrollment graduation was collected. This study involved 17 years of analysis of Gulu university students' enrollment and graduation.

Target Population and Sampling

Students served as the study's analysis unit. This study concentrated primarily on Gulu University students who were enrolled, the next stage of institutional recruitment, and then nearing graduation. The target population was divided into two groups for the secondary data for peer approval. The staff in the admissions office and the admitted students were the first end users of the suggested model.

Data Collection and Procedure

Secondary sources of data were used in this study. The data used in training the model was collected from secondary sources such as existing databases. Data was collected from staff within the admissions department. Other secondary sources that were used in data collection were written reports and journals regarding existing systems or models or algorithms that were being employed for enrollment prediction by universities in Uganda.

Data analysis.

Data analysis is the method of critically analyzing gathered and organized data in order to identify patterns and relationships between both the variables that are related to the object being studied as well as to analyze its characteristics (Kumar, 2005).

The process of data analysis used quantitative methods. Excel and Stata software were used in this work to enter, purify, and analyze the gathered data.

The model was developed using econometric models like the semi-log model. A regression analysis will be performed on the output that the model produced.

Data Analysis

The research approach taken in this study was quantitative. The system with which the researcher interacted with was considered to be mostly user friendly and fast enough to be used in data analysis. The accuracy levels were acceptable though it was taken into advisement that the accuracy of the model should improve with time.

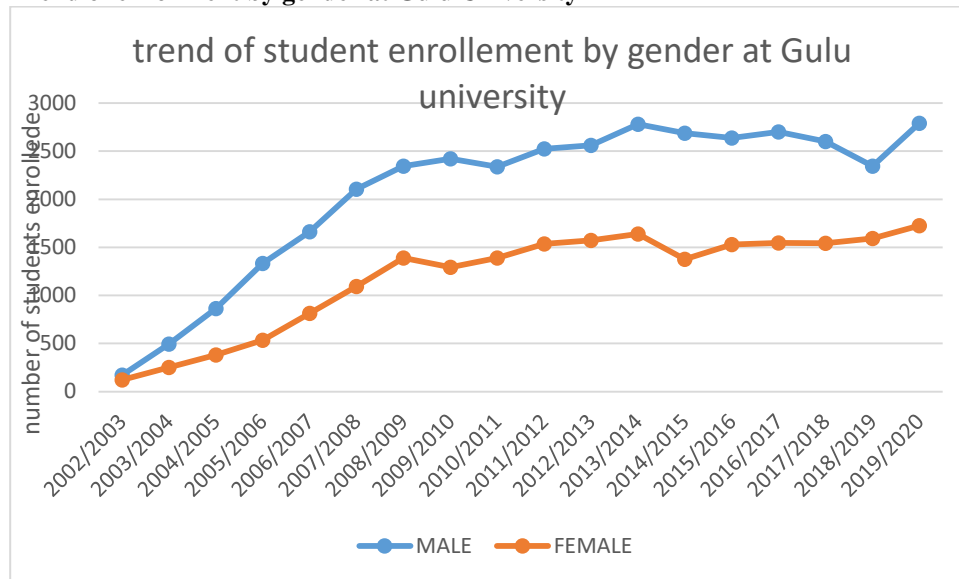**Trend of enrollment by gender at Gulu University**

Figure 1: Trend of enrollment by gender

In the academic year 2002/2003, there were 291 students admitted, with men making up more than half of that total (58.4%), while women made up 41.8%. The enrollment climbed steadily from 291 to 744, 1244, 1866, 2476, 3196, and 3735 in the academic years 2003–2004, 2004–2005, 2005–2006, 2006–2007, and 2008–2009, respectively. The attendance had increased by 11 (or 84%) from the academic year 2002/2003 to the academic year 2008/2009. The percentage contribution of male participation to combined population in the academic years 2003–2004, 2004–2005, 2005–2006, 2006–2007, 2007–2008, and 2008–2009 was 66.4%, 69.4%, 71.4%, 67.1%, 65.8%, and 62.8%, respectively. The enrollment in the academic year 2009/2010 declined slightly to 3712. Males enrolled more than females with a percentage of 65.2% of the total enrollment. This was followed by a small increase in enrollment in the academic year2010/2011 with enrollment total of 3729. Still males enrolled more than females contributing 62.7% of the total enrollment. In the academic year 2011/2012, enrollment increased sharply to 4059. The males are still the major contributor to

enrollment with a composition of 62.8% of the total enrollment. The enrolment increased from 4059 in the academic year 2011/2012 to 4136 and 4421, respectively, between the academic years 2012/2013 and 2013/2014. In the academic years 2012–2013 and 2013–2014, respectively, the percentage contribution of male registration was 61.9% and 62.9% contrasted to the percentage contributions of female admission of 39.1% and 27.1%. The number of students enrolled decreased from 4421 in the previous academic year to 4063 in 2014–2015. In comparison to men, who make up 66.2% of the overall membership, fewer women enroll. The enrollment is found to have increased from the academic years 2015–2016 to 2016–2017, reaching 4166 and 4248, respectively. Male enrolment has been higher than female attendance during the course of these two academic years. Through all these two academic years the number of male enrolment has been bigger compared to female enrollment with a percentage contribution of 63.3% and 63.6% in the academic year 2015/2016 and 2016/2017 respectively. The enrolment decreased to 4142 and 3939 in the academic years 2017–2018 and 2018–2019, respectively. Although there has been a drop in enrollment, men still represent the majority of students. Finally, enrollment increased once more to 4515 in the 2019–2020 school year. According to the data set, Gulu University enrollees are more likely to be male.

In general, the trend of enrollment was seen to be increasing from the academic year 2002/2003 to the academic year 2008/2009. Later, the tendency began to oscillate as enrollment numbers were down and then rose up until the 2019–2020 academic year. Male enrollment is typically 75.16% higher than female enrollment.

```
. ttest enrolledmales== enrolledfemales

Paired t test

------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
e~dmales |      18    2075.278   193.5212    821.0411    1666.984    2483.572
e~emales |      18    1184.778   123.5667    524.2492    924.0748    1445.481
---------+--------------------------------------------------------------------
    diff |      18       890.5   77.45618    328.6187    727.0818    1053.918
------------------------------------------------------------------------------
    mean(diff) = mean(enrolledmales - enrolledfemales)       t =  11.4968
Ho: mean(diff) = 0                              degrees of freedom =       17

Ha: mean(diff) < 0              Ha: mean(diff) != 0            Ha: mean(diff) > 0
Pr(T < t) = 1.0000           Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
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Table 1 analysis of students that enroll by gender at Gulu University.

Over the years, the number of students enrolled have been increasing. The number of males enrolled are more compared to that of females, since the P=0.0000<0.05 which is statistically significant. This implies that over the years, less females enroll compared to male students.
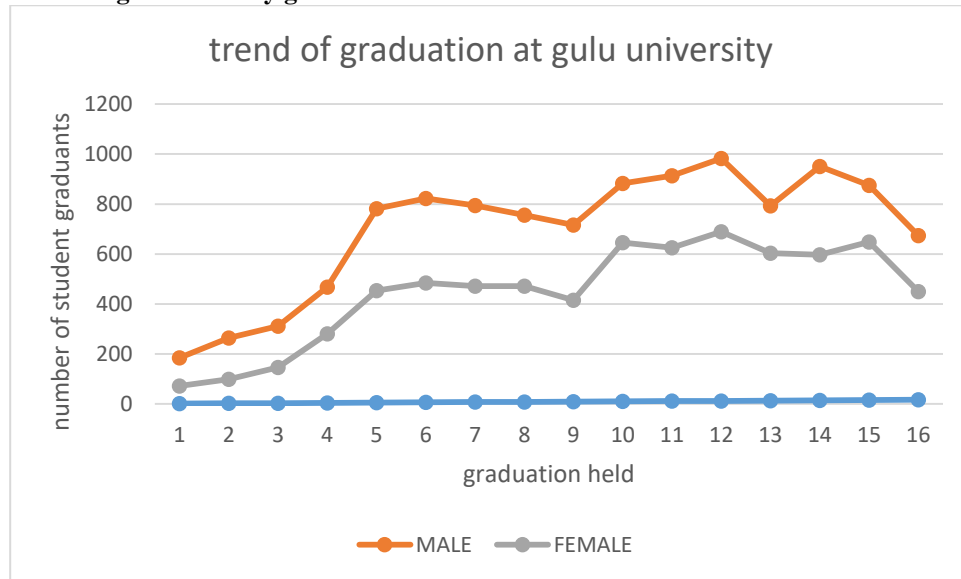
Trend of graduation by gender

Figure 2: Trend of graduation by gender

257 students got diplomas during the first graduation. With a percentage composition of 71.98% of the total number of graduates and females at 28.02%, men are perceived to be more numerous than women. Grandaunt numbers rose significantly from the first graduating to the sixth graduation, reaching 363 for the second graduation, 457 for the third, 1235 for the fourth, and 1307 for the fifth. On these graduations, males still outnumber girls by percentage compositions of 72.7%, 68.05%, 62.57%, 63.32%, and 62.97%, respectively. By the sixth graduation, there were 4 more grandmothers, an increase of 8%. The number of recipients fell from 1307 at the sixth graduation to 1265 at the seventh graduation to 1228 at the eighth graduation to 1131 at the ninth graduation. From the seventh graduation up to the ninth graduation, the number of students who graduated decreased from 1307 on the sixth graduation to1265 to1228 to1131 on the seventh, eighth and ninth graduation respectively. On these graduations females were dominated by males with percentage composition of 37.23%, 38.44% and 36.69% of the total number of grandaunts respectively. On the tenth, eleventh and twelfth graduation the number of students who graduated increased steadily to 1529, 1539 and 1672 respectively. The male grandaunts dominate on these graduations with percentage compositions of 57.75, 59.94% and 58.79% of the total number of grandaunts in these graduations respectively.

The number of grandaunts decreased dramatically to 1396 at the graduation on the thirteenth. With a percentage composition of 56.81% of the total number of grandaunts, men are still perceived as being more numerous than women. The rise to 1548 came after the fourteenth graduation. With a percentage composition of 61.43%, men outnumber women. On the fifteenth and sixteenth graduations, it ultimately dropped to 1523 and 1123. These graduations still have a 57.45% and 60.02% male proportion makeup, respectively. From the first commencement up to the sixth graduation, the trend of graduation was generally observed to be rising.

The number of grandaunts has been decreasing and then rising from the seventh to the sixteenth graduation, according to the trend.

```
. ttest graduatedmales== graduatedfemales

Paired t test
```

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
g~dmales	16	698.25	63.14081	252.5633	563.6685	832.8315
g~emales	16	446.8125	50.03909	200.1563	340.1567	553.4683
diff	16	251.4375	18.19729	72.78916	212.6509	290.2241

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     mean(diff) = mean(graduatedmales - graduatedfemales)          t =   13.8173
Ho: mean(diff) = 0                                  degrees of freedom =        15

Ha: mean(diff) < 0              Ha: mean(diff) != 0              Ha: mean(diff) > 0
Pr(T < t) = 1.0000          Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
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Table 3 analysis of students that graduate by gender at Gulu University

Over the years, the number of students graduating have been increasing. The number of males graduating are more compared to that of females, since the P=0.000 <0.05 which is statistically significant. This implies that over the years, less females graduate compared to male students.

Graduation rates
Students' completion rate is the ratio of the total number of students graduating in faculty in a given year to the total number of students of official graduation in the population. The graduation rates are analyzed per faculty per graduation. Mathematically

$$graduation\ rate = \frac{total\ no.\ of\ students\ graduating\ in\ faculty}{total\ number\ of\ students\ of\ official\ graduation\ in\ the\ population.}$$

The table below show the graduation rates in percentages that are computed using the above formula. The figures are not the exact figures but are rounded up to the nearest whole number where applicable or to one decimal place.
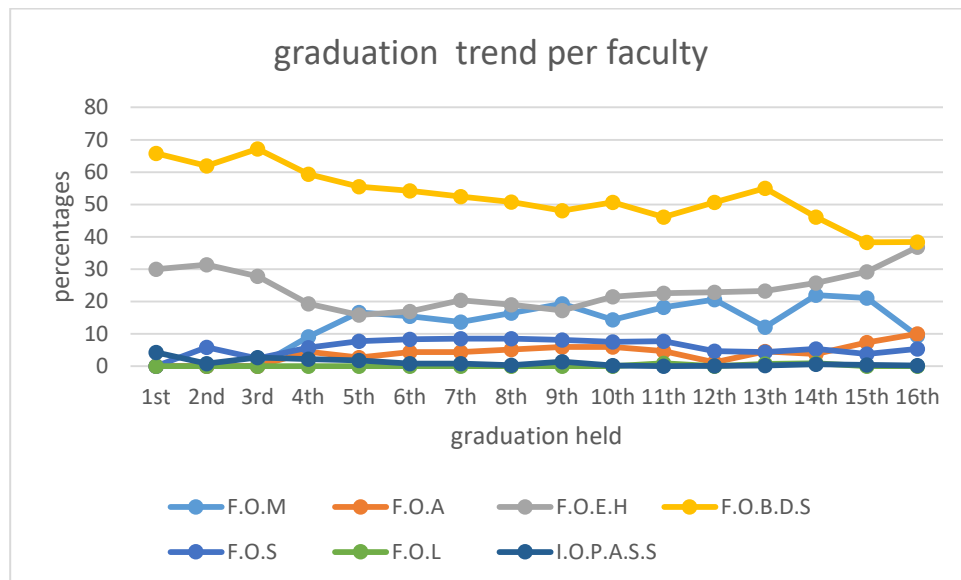

Figure 3: Graduation rates in percentages

F.O.M	-	Faculty of medicine
F.O.A	-	Faculty of Agriculture
F.O.E.H	-	Faculty of Education and Humanities
F.O.B.D.S	-	Faculty of Business and Development Studies
F.O.S	-	Faculty of Science
F.O.L	-Faculty of Law I.O.P.A.S.S	-institute of peace and strategic studies

No students from F.OM, F.O.A, F.O.S, or F.O.L graduated on the first occasion. Therefore, there are no students from these faculties. Grandaunts from F.O.E.H. made up 29.9611% of the populace, F.O.B.D.S. made up 65.7588%, and I.O.P.A.S.S. made up 4.2802%.

On the second graduation, 65.7588% of the students came from F.O.B.D.S, 31.405% from F.O.E.H, 5.7851% from F.O.S, and 0.8264% from I.O.P.A.S.S, whereas F.O.L., F.O.M., and F.O.A had 0% of the graduates.

F.O.M, F.O.A, and F.O.L had 0% on the third graduation, indicating that no candidates from these faculties were present. The percentages from F.O.E.H, 67.1772%, 2.407%, and 2.6258%, respectively, were F.O.B.D.S, F.OS, I.O.P.A.S.S, and F.OS. On the forth graduation, F.O.L had a graduation rate of 0% while F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S and I.O.P.A.S.S had graduation rates of 9.0909%, 4.4118%, 19.2513%, 59.3583%, 5.7487% and2.139% respectively.

The graduation rates from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL, and I.O.P.A.S.S were 16.5992%, 2.6721%, 15.7895%, 55.4656%, 7.6923%, 0%, and 1.7814%, respectively.

The graduation rates from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL, and I.O.P.A.S.S were 15.4552%, 4.3611%, 16.909%, 54.2464%, 8.2632%, 0%, and 0.7651%, respectively.

The graduation rates from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL, and I.O.P.A.S.S were 13.5968%, 4.3478%, 20.3953%, 52.4111%, 8.4585%, 0%, and 0.7905%, respectively.

The graduation rates from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL, and I.O.P.A.S.S were 16.3681%, 5.1303%, 18.9739%, 50.7329%, 8.4691%, 0%, and 0.3257%, respectively.

The graduation rates from F.O.M, F.O.A, F.O.E.H, F.B.D.S, and 5.9503%, 17.2291%, 48.0462%, 8.0817%, 0%, and 1.421% on the ninth graduation. On the tenth graduation, the graduation rates were 14.3139%, 5.9094%, 21.4708%, 50.6238%, 7.4852%, 0% and 0.197% from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL and I.O.P.A.S.S respectively

On the eleventh graduation, the graduation rates were 18.1522%, 4.6845%, 22.5114%, 46.1288%, 7.6773%, 0% and0.8447% from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL and I.O.P.A.S.S respectively

On the twelfth graduation, the graduation rates were 20.5776%, 1.2034%, 22.8039%, 50.6619%, 4.633%, 0% and 0.1203% from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL and I.O.P.A.S.S respectively. On the thirteenth graduation, the graduation rates were 12.0863%, 4.5324%, 23.2374%, 54.964%, 4.3885%, 0.6447% and 0.1439%, from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL and I.O.P.A.S.S respectively

On the fourteenth graduation, the graduation rates were 21.9579%, 3.739%, 25.7648%, 46.0911%, 5.3025%, 0.8398% and 0.6118%from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL and I.O.P.A.S.S respectively

On the fifth graduation, the graduation rates were 16.5992%, 2.6721%, 15.7895%, 55.4656%, 7.6923%, 0% and 1.7814% from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL and I.O.P.A.S.S respectively.

On the sixteenth graduation, the graduation rates were 9.4086%, 9.9462%, 36.828%, 38.3513%, 5.2867%, 0% and 0.1792% from F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL and I.O.P.A.S.S respectively

The overall graduation rate is 15.41%, 4.54%, 22.79%, 49.95%, 6.25%, 0.19% and 0.63% for F.O.M, F.O.A, F.O.E.H, F.B.D.S, F.O.S, F.OL and I.O.P.A.S.S respectively.

```
. ttest totalenrolled== totalgraduants

Paired t test

Variable        Obs        Mean     Std. Err.    Std. Dev.    [95% Conf. Interval]

totale~d         16     3139.25     342.5485     1370.194     2409.125    3869.375
totalg~s         16    1145.063     112.4731     449.8925     905.3317    1384.793

    diff         16    1994.188      239.142     956.5682     1484.468    2503.907

    mean(diff) = mean(totalenrolled - totalgraduants)              t =     8.3389
 Ho: mean(diff) = 0                                  degrees of freedom =       15

 Ha: mean(diff) < 0              Ha: mean(diff) != 0              Ha: mean(diff) > 0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000
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Table 4.2.3. 1 analysis of total students enrolled and those that graduate at Gulu University

over the years ,the number of students enrolled have been increasing but the number of students graduating have been decreasing .since the $P=0.0000 < 0.05$ which is statistically significant .This implies that over the years less students graduate compared to those that enrolled.

Shortfalls of the Models
The models that are proposed are just for dimensional data. Therefore, the proposed algorithm would not scale or perform well on data from highly normal relations found in everyday transactional databases.

The suggested models provide a solution that addresses the classification issue, but not the clustering or regression issues. As a result, it is only possible to predict whether a student or group of students will enroll using the recommended models. The proposed models are not designed to be used to explain the classification results by outlining the traits that students who are enrolled or not share in common or the specific trait that might be keeping them from registering. Finally, the proposed models rely heavily on data that has been subjected to identifying activities. Since the data must be extensively pre-processed, scaled, and turned into dimensional data before being run through the models, running it continuously could be quite difficult. Presently, an automated Crony job dependent on the Linux operating systems appears to resolve this problem; nevertheless, this is not a long-term fix since data preprocessing as a necessary step would need to be automated in any other operating system for the prototype to be adopted into production scale.

Recommendations
In consideration of the results obtained from the implementation and testing of the proposed model, the following recommendations were made

1. 1. An enrollment prediction model is recommended to lower the degrees of uncertainty with regards to comprehending the number of admitted students likely to enroll.
2. 2. An institutional warehouse is suggested as a means of preserving historical snapshots of the transactional database instances that are important for raising the dimensionality of student data in order to enhance the data quality required for prediction. In order to feed the models with dimensional data and not simply transactional data that is noisy, this is necessary.
3. 3. To aid in evaluating how the university is ranked and how students feel about different programs and resources, satisfactory index data should also be included in institutional data warehouses. To ease the use of the proposed models, a web application should be adapted to interact with the models for purposes of increasing the model's performance and aiding quick availability of prediction results.

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