Implementation of Linear Regression to Predict New Student Admissions as a First Step to Determine Campus Marketing Strategy

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ABSTRACT: New student Admission is a routine activity carried out by all educational institutions in Indonesia every year. One of the educational institutions in Indonesia is a private university. Predictions of the development of new student admissions so far have only been made based on speculation using data from previous years. Linear regression is one method that can be used to predict good results. Therefore, this study uses a linear regression method. The test results in this study indicate that the linear regression method has a low error value measured by the error rate using the Mean Absolute Percentage Error (MAPE), which is an average of 2.76%. This proves that using the linear regression method can predict new student admissions well so that it can assist universities in developing various strategies to maintain their existence, especially marketing strategies.

KEYWORDS: Prediction, Linear Regression

I. INTRODUCTION

Admission of new students is an agenda that is routinely carried out by a higher education institution. The number of new student admissions can increase or decrease each year. A decrease in the number of new student admissions can certainly have a negative impact on the sustainability of tertiary institutions, while an increase in new student admissions also has the potential to have a negative impact on tertiary institutions if not addressed properly. Campus managers must be sensitive to consumers in the marketing process, students are an important asset in college life [1]. Therefore, it is necessary to have an effort to predict the number of new student admissions so that the tertiary institution can determine what policy direction will be taken regarding the condition of the number of new student admissions that will be faced. Prediction can be done by various methods, one of which is linear regression. This method is a method of forecasting techniques that will describe the relationship between at least one/more independent variables and one dependent variable with the aim of predicting the value of the dependent variable in relation to the value of certain independent variables [2] [3]. Linear regression has the advantage of being simple in application, good results in predicting, as well as being able to see the effect of one parameter on another.

Research on predicting the number of new students has been carried out before. Like research [4] which conducted research on forecasting the number of prospective new students who will register in the next period. This research uses the Single Exponential Smoothing algorithm, according to his research the single exponential smoothing method is a procedure for continuous improvement in forecasting of the latest observation objects. Where this method will focus on decreasing priority exponentially on the object of previous observations. Based on the research results, the best forecast to predict the number of prospective students who register for the following year is to use alpha = 0.1.

Another research was conducted by [1] predicting new student admissions with the concept of artificial intelligence using a multi-layer perceptron. Based on the results of the experiment, a Neural Network with 5-9-1 architecture is the best architecture for predicting the number of new student admissions at the University of Semarang. From the results of testing this method can produce the minimum MSE of 0.1. Thus, this method can be used as an alternative solution for setting targets for new student admissions. by Semarang University Public Relations.

In addition to research on new student admissions, there is also quite a lot of research on the use of the linear regression method for the need to make predictions/forecasting, such as research conducted by [2] discussing opening new classes at STIKOM Bali using linear regression. The purpose of his research is to find out the number of opening classes in the next period.

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The research uses historical data from the previous 3 years. The researcher concluded that by applying linear regression to support the class opening system, it was able to provide convenience in carrying out calculations and reduce the occurrence of class drops.

Another study was conducted by [5] regarding the prediction of volume and circulation of waste management in the city of Bandung. This study uses a linear regression method. The results of this study tell us that the prediction results for the volume of waste in 2021 and 2022 using the linear regression method based on data for 2011-2020 are 489,148 tons and 506,709 tons. The predicted results for waste transportation trips for 2020 are 100,042 times or an average of 274 repetitions/day and 103,819 times for 2022 or an average of 284 repetitions/day. The average volume of waste transported/ritated is 4.89 tons for 2021 and 4.88 tons in 2022. Linear regression can be used as a tool that can predict waste transportation cycles so that it can be used as a basis for compiling a budget, planning availability and the capacity of TPS, TPA and cleaning staff.

Research conducted by [6] applied the linear regression method to predict stock availability of tablet-type drugs. Based on the analysis of drug sales transaction data at the Banten Bay Clinic using a simple linear regression method, the results obtained an accuracy of 98.505%. So it can be concluded that the simple linear regression method can determine accurate prediction results for predicting drug stocks in the management of tablet-type drug supplies (ibu profen) which can be applied to the Banten Bay Clinic.

Research conducted by [7] concerning predicting the number of patient visits at Cilacap Hospital, states that the linear regression prediction method can produce predictions with several criteria, where there are 26 linear regression prediction models that have an error value of less than 20%, meaning it has an accuracy of 80%. or included in the very good and good category. Then there are 3 linear regression prediction models that fall into the bad category, namely the error value is more than 50%. And there is 1 linear regression prediction model which is included in the sufficient category or has an error value of 20% to 50%. In future research it is hoped that it will produce better MAPE, and there are no predictive results with MAPE in the poor category. In future research, it is necessary to pay attention to external factors such as the weather which can be used to predict the number of outpatient, inpatient and emergency patient visits more accurately.

Subsequent research [8] applied linear regression to predict sales and cash flow in restaurant point of sales applications. The results of this study explain that linear regression is able to produce information in the form of predictive results for drug supply in the process of selling tablet-type drugs. Based on calculations using the linear regression method, an accuracy of 98.505% is obtained, which means that this method can be implemented in making predictions of tablet-type drug stocks (profen mother) at the Teluk Clinic.

Based on the history of previous research, this study tries to apply the linear regression method to predict the number of new student admissions at private universities based on historical data available at each university.

II. METHODOLOGY

This research was conducted in several stages, including: Data Collection, Data Preparation, Modeling, and Evaluation. These stages can be seen in the following figure:
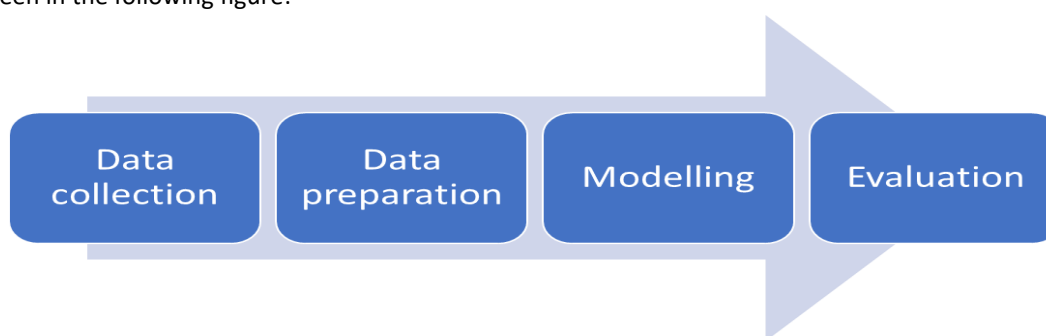

Figure 1. research methodology

A. Data Collection

This stage is carried out by collecting data related to the number of new students who register, re-register, and students who are active/continue to continue studying after 2 semesters. Data were obtained directly from private universities in Aceh, including: Al Muslim University, UNIKI, and Cut Nyak Dien University. The data collected is data from the last three years.

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B. Data Preparation

The data that has been obtained is then cleaned, and prepared for processing according to the selected model

C. Modelling and implementation

Data modeling was carried out using the linear regression method. This model was chosen in order to be able to make predictions about the potential number of new students in the following year, as well as to see the magnitude of the influence of the variables used on the results obtained. Regression analysis is a form of relationship between the independent variables on the dependent variable whose equation is Y = f(X). the formula for the simple regression model is as follows:

$$Y_t = \alpha + \beta X_1 + e_i; \qquad i = 1,2,3, \dots, n$$

- Calculating α

α is calculated using the following equation:

$$\alpha = \frac{(\sum Y)(\sum X^2) - (\sum Y)(\sum X^2) - ((\sum X)(\sum XY)}{n.\sum X^2 - (\sum X)^2}$$

- Calculating β

β is calculated using the following equation

$$\beta = \frac{n(\sum XY) - (\sum X)(\sum XY)}{n.(\sum X^2) - (\sum X)^2}$$

D. Evaluation

At this stage an analysis of the results obtained is carried out, in accordance with the model that was planned in the previous stage. Model analysis is carried out by looking at the magnitude of the standard error which is calculated by the following equation:

$$S_e^2 = \frac{\sum Y^2 - \beta^2.\sum X^2}{n-2}$$

In addition, a correlation analysis will also be carried out using equations:

$$r = \frac{n \sum XY - \sum X.\sum Y}{\sqrt{[(n.\sum X^2 - (\sum X)^2] - [n.\sum Y^2 - (\sum Y)^2]}}$$

Meanwhile, the coefficient of determination is calculated using the formula:

$$r^2 = \left(\frac{n \sum XY - \sum X.\sum Y}{\sqrt{[(n.\sum X^2 - (\sum X)^2] - [n.\sum Y^2 - (\sum Y)^2]}}\right)^2$$

III. RESULT AND DISCUSSION

This study uses data sourced from 3 private universities in aceh, namely: Al Muslim University, Indonesian National Islamic University (UNIKI), and Cut Nyak Dhien University. The data used is student enrollment data for the last three years starting from 2020, 2021 and 2022. Each university has a different number of study programs. Al Muslim University has 25 study programs, UNIKI has 11 study programs, and Cut Nyak Dhien University has 13 study programs. A recap of total student admissions for each university is shown in the following table:

Table 1. Recapitulation of student admission data for the last 3 years

No	University	Year	Registration	Re-Registration
1	Al Muslim	2019	6766	5665
2	Al Muslim	2020	6945	5853
3	Al Muslim	2021	7705	6504
1	Cut Nyak Dhien	2019	1726	1421
2	Cut Nyak Dhien	2020	1725	1377
3	Cut Nyak Dhien	2021	2116	1728
1	UNIKI	2019	3571	2981
2	UNIKI	2020	3835	3283
3	UNIKI	2021	4848	4008

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Each university has different achievements every year. Prediction results will of course also be different. The forecasting results for each university are shown in the following table:

a.   Forecasting results for Al Muslim University

Table 2. Al Muslim University

No	Year	Regist (X)	Daftar (Y)	X^2	Y^2	XY	Yt	e	PE
1	2019	6766	5665	45778756	32092225	38329390	5710.82	45.82	0.81
2	2020	6945	5853	48233025	34257609	40649085	5861.18	8.18	0.14
3	2021	7705	6504	59367025	42302016	50113320	6499.58	4.42	0.07
	Total	48399	40570	317189769	224205054	266668009	18071.58	58.42	1.02

α = 27.38
β = 0.84
MAPE = 1.02 / 3 = 0.34 %

b.   Forecasting results for Cut Nyak Dhien University

Table 3. Cut Nyak Dhien University

No	Year	Regist (X)	Daftar (Y)	X^2	Y^2	XY	Yt	e	PE
1	2019	1726	1421	2979076	2019241	2452646	1501.17	80.17	5.64
2	2020	1725	1377	2975625	1896129	2375325	1500.34	123.34	8.96
3	2021	2116	1728	4477456	2985984	3656448	1824.87	96.87	5.61
	Total	32550	27074	174243120	122454558	146060633	4826.38	300.38	20.21

α = 68.59
β = 0.83
MAPE = 20.21/3 = 6.74 %

c.   Forecasting results for UNIKI

Table 4. UNIKI

No	Year	Regist (X)	Daftar (Y)	X^2	Y^2	XY	Yt	e	PE
1	2019	3571	2981	12752041	8886361	10645151	2989.97	8.97	0.3
2	2020	3835	3283	14707225	10778089	12590305	3209.09	73.91	2.25
3	2021	4848	4008	23503104	16064064	19430784	4049.88	41.88	1.04
	Total	39237	32820	214773333	151281718	180242454	10248.94	124.76	3.59

α = 26.04
β = 0.83
MAPE = 3.59/3 = 1.2 %

Based on the prediction results that have been made on each university data, it can be seen that the error rate obtained is below 7%. For the prediction results from the Al Muslim university, there was a prediction error of 0.34%, the prediction for Cut Nyak Dien University was found to be an error of 6.74%, and for predictions from the Indonesian National Islamic University, there was an error of 1.2%. The mean error of the three predictions is 2.76%. This error rate is classified as a very low error rate, which means that the prediction results have a fairly high degree of truth.

V. CONCLUSIONS

Linear regression can predict student acceptance well with very low errors. Linear regression can be implemented in the case of new student admissions, so that it can assist universities in developing various strategies to maintain their existence, especially marketing strategies.

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