

Estimation of new student admissions using the Moving Average method

ABSTRACT

Acceptance of new students at several tertiary institutions, both public and private, will affect the learning and teaching process at these tertiary institutions. Because knowing the number of new students accepted is one way that can be used in determining the teaching and learning process.

This study aims to predict the number of new students for the coming year with the Moving Average method and calculate the absolute mean error rate for this type of data analysis. This method is applied to one of the private universities in Indonesia. To know the prediction of the number of new students every year, or to find out the estimated number of new students for the coming year.

The data used is the previous 7 years at one of the Indonesian private universities

The results of this study are expected to be able to assist these tertiary institutions in planning a good teaching and learning process, because the number of new students will affect the number of existing lecturer ratios.

Keywords: estimation, moving average, new students, mean absolute error

1. INTRODUCTION

New students or commonly abbreviated as maba are the status attached to students in the first year of college. As a student who has just entered the world of higher education, students will face the transition of life from adolescence to adulthood.

In addition, new students will also experience changes in the learning methods experienced at the previous school. While at school, a person learns by following the study schedule set by the school. While in tertiary institutions, the learning method applied is using a semester credit unit (SKS) system.

The number of new students accepted at several universities, both public and private, will affect the learning and teaching process at these universities. Knowing the number of new students is one of the things that can be used for planning material in the teaching and learning process, because it will be related to the number of existing lecturer ratios.

Therefore, it should be necessary to predict the number of new students to prepare for everything by using forecasting/prediction.

There are many forecasting methods available, so in this study the authors tried to predict the number of new students with one method, namely using the moving average method. And to find out the error rate or level of validity of the data using MAE, MSE, MPE and RMSE.

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

Heizer and Render (2015: 113) define forecasting as an art and science in predicting future events. Forecasting will involve taking historical data (last year's sales) and projecting them into the future with a mathematical model. For forecasting this time, it is predicting the number of new student admissions using the moving average method.

The stages/flow in the research to be carried out can be seen from the following figure:

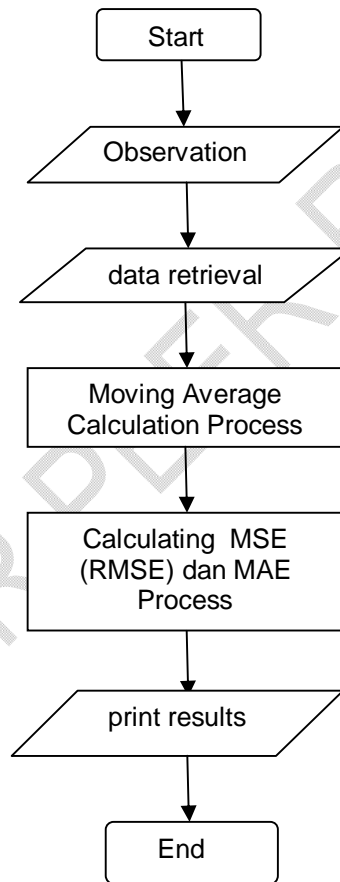


Fig 1 : Flow in the Research

2.1. Moving average method

Moving average is one of several existing forecasting or prediction methods. This method is the same as the moving average, but the most recent value in the time series is given a greater burden to calculate the forecast [2].

The Weighted Moving Average method is given a different weight for each available past historical data, with the assumption that the most recent or recent historical data will have greater weight than the old historical data because the most recent or most recent data is the most relevant data for forecasting [4].

To find out the forecasting calculation used the formula:

$$WMA_n = \frac{\sum (D_i W_i)}{\sum W_i} \quad (1)$$

Information :

WMA = Weighted Moving Average

i = Number of Periods in the Moving Average

D_i = Actual data in periods i

W_i = Assessment according to the length of periods

With a total weight = 1.

For weights adjusted to the number of periodic forecasting. For example, for a 3-years period, we can use the 0.25 rule; 0.5; 0.25 with a total weight of 1. For selection the weight is seen from the period that has a high value of the average n years to be examined, then the weight used is greater than the period that has a small value.

Because the data was taken from 2012-2021 and the 3-year moving average was taken, the data collection for selecting the W weight was 0.25; 0.5 and 0.25 because the total weight of W is 1.

2.2. MAE (Mean Absolute Error) and MSE (Mean Square Error)

Every use of data analysis techniques certainly requires criteria that must be met. Not without reason, because data analysis techniques in forecasting need to pay attention to criteria to identify the size of forecasting errors. The types of data analysis techniques used in forecasting include Mean Absolute Error (MAE), Mean Square Error (MSE), Mean Absolute Percentage Error (MAPE) and Root Mean Square Error or RMSE. These values represent the average error (error) between the forecasting results and the actual value. This means that if the error value is getting bigger or not close to 0, it means that the method is not suitable or not valid.

Formula MAE :

$$MAE = \sum \frac{|Y' - Y|}{n} \quad (2)$$

With description:

Y' = Predicted Value
 Y = Actual Value
 n = Number of Data

Formula MSE:

$$MSE = \sum \frac{(Y' - Y)^2}{n} \quad (3)$$

With description:
 Y' = Predicted Value
 Y = Actual Value
 n = Number of Data

3. RESULTS AND DISCUSSION

By first determining the weight used is 0.25; 0.5; 0.25 to get a weight value of 1 in a 3-years period.

The new student table can be seen as follows:

Table 1. Number of New Students 2015-2021:

x	2015	2016	2017	2018	2019	2020	2021
f(x)/y	338	354	314	276	296	176	165

Information:

x = is the independent variable (th)

f(x) or y = is the number of new students

3.1. WMA Calculation Results

In this case we are trying to calculate the estimated number of new students from the existing student table.

Table 2 : The calculation results are as follows:

Year	Sum	WMA (3 years)	Prediction with WMA
2015	338		
2016	354		
2017	314	340	

2018	276	324	340
2019	296	295	324
2020	176	295,5	295
2021	165	240,5	295,5

It turns out that from the calculation results it can be seen the prediction of the number of new students.

So in 2019 the predicted number of new students is 324, the predictions for 2020 are 295 and in 2021 the prediction is 295.

Whereas in reality in 2019 it was 296, in 2020 it was 176, and in 2021 it was 165. From these results for each year it has a different value from the original data, namely in 2019 it was 28, in 2020 it was 119, and in 2021 it was 130 If calculating the error value for the year:

$$\begin{aligned}
 2019 &= |\text{true value}-\text{approximate value}| / \text{true value} \\
 &= |296-324| / 296 = 0.0945 \\
 2020 &= |\text{true value}-\text{approximate value}| / \text{true value} \\
 &= |176-295| / 176 = 0.6761 \\
 2021 &= |\text{true value}-\text{approximate value}| / \text{true value} \\
 &= |165-295| / 165 = 0.7878
 \end{aligned}$$

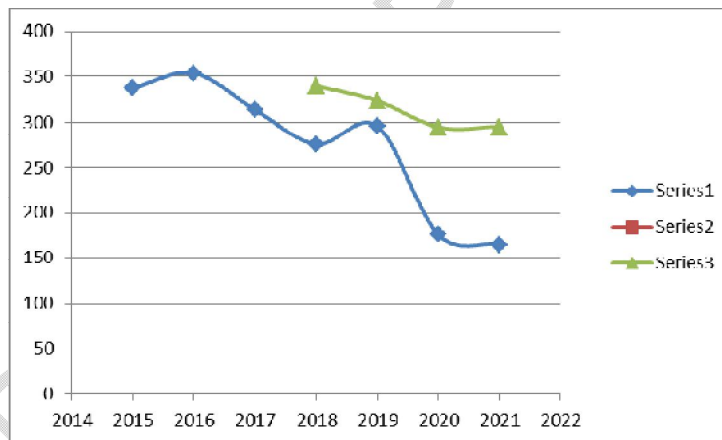


Fig.2. WMA Prediction Results Graph

Judging from the results of the calculation, the error value is getting closer to the value 1, which means that the results of calculating the number of new students are decreasing, not in accordance with the actual data.

3.2. MSE and MAE Calculation Results

Table 3 . Table of data on the number of students from 2012-2021

Year	Data
2012	358
2014	314

2015	338
2016	354
2017	314
2018	276
2019	296
2020	176
2021	165

Table 4. Table of MSE Results from 2018-2021

Year	Data	WMA	MSE (WMA)
2018	276	340	1024
2019	296	324	324
2020	176	295	240,25
2021	165	295,5	451,5625
			Result
			2039,8125

From the table above it can be concluded that the MSE result for the WMA method is 2039.8125.

Table 5. Table MAE and MPE Results

Tahun	MAE(WMA)	MPE(WMA)
2018	16	-0,2169492
2019	7	-0,0972222
2020	29,75	-0,4507576
2021	32,625	-0,5158103
	Result	Result
	85,375	-32,018481

From the table above it can be concluded that the resulting MAE result is 85.375 and the resulting MPE is -32.018481.

Table 6 . Table RMSE results

Year	RMSE(WMA)
2018	4096
2019	784
2020	14161
2021	17030,25

	Result
	94,96216352

From the results above it can be concluded that the RMSE result of the WMA method is 94.96. So it can be concluded that the WMA method is less valid in calculating the prediction of the number of new students at the university, because it has an RMSE value that is far close to zero. And if you look at the original data, it turns out that the prediction is very far from the actual data. So this needs to be studied and re-examined with different methods.

4. Conclusion

The conclusion from the results of this study is that the WMA method for predicting the number of new students at the university is invalid or does not match the original data, because the scores on MAE, MSE, MPE are far from zero. Why can it be like this maybe because the results of forecasting in practice are almost never absolutely correct. This is because circumstances and events in the future are uncertain. However, if all the important influencing factors have been taken into account and the relationship model of these factors has been well defined, care must be taken, especially in the selection of forecasting methods to be used in a particular case.

REFERENCES

1. Aritonang, Lerbin R. 2013. Business Forecasting. Ghalia Indonesia Publisher.
2. Ahmad Chamami, 2016, Interpolation to predict the number of students of FKIP PGRI, Kediri
3. Gaspersz, 2015, Production Planning and Inventory Control, Jakarta, Gramedia Indonesia
4. Munir R., 2003, Numerical Method, 2nd Edition, Bandung, Bandung Informatics.
5. Tony Yulianto, Nur Ita U, Rica Amalia, 2016, HIV Forecasting Using Lagrange and Newton Interpolation, Zeta math Journal, Vol. 2 No. 1 May 2016
6. Sri Eniyati, et al, 2019, Use of the Lagrange Method for Estimating the Number of New Students, Proceedings, SENDIU, June 2019
7. Saefurrohaman, et al, 2020, Forecasting new students using the Newton Raphson Method, Unisbank Internal Research, 2020.
8. Assauri, S. (1984). Forecasting Techniques and Methods Its Application in the Economy and Business World. Jakarta: Publishing Institute, Faculty of Economics, UI.
9. Bowerman, B. L. & O'Connell, R. T. (1987). Time Series Forecasting. Boston: Duxbury Press.
10. Makridakis, S., Wheelright, S.C., & McGee, V. E. (1999). Forecasting Methods and Applications, (U.S. Andriyanto and A. Basith, trans.). Jakarta: Erlangga.
11. Megasari, Ries Tri. (2010). Comparison Between Moving Average Method, Exponential Smoothing and Winters in Forecasting PT Satriamandiri Citramulia's Sales Volume Based on Computer. Undergraduate Thesis of Statistics Study Program, FST Bina Nusantara University, Jakarta.
12. Arsyad, Lincoln., 1997. Development Economics. STIE YKPN, Yogyakarta.
13. Assauri, S. (1984). Forecasting Techniques and Methods Its Application in Economics

- and the Business World. Jakarta: Faculty of Economics, University of Indonesia.
14. Barry Render and Jay Heizer. Operations Management Principles. PT. Salemba Emban Patria, Jakarta, 2001.
15. Djarwanto PS and Subagyo Pangestu. 2000. Inductive Statistics, Issue 4. BPFE –UGM Yogyakarta.

UNDER PEER REVIEW