International Journal Of Science, Engineering, And Information Technology
Volume 03, Issue 02, July 2019
Journal homepage: https://journal.trunojoyo.ac.id/ijseit

Forecasting the Number of Admission of New Students of State Polytechnic Using Exponential Single Smoothing Methods

Eka Larasati Amalia[a], Dimas Wahyu Wibowo[b], Deasy Sandhya Elya I[c]

[a,b,c]Information Technology, Malang State Polytechnic, Malang, East Java, Indonesia

A B S T R A C T

Forecasting is a prediction of uncertain events in the future. Forecasting the number of new students is one of the things that can be used for planning materials for the teaching and learning process, therefore it is necessary to predict the number of new students. This research was conducted at Malang State Polytechnic. The annual data analyzed was taken from 2011 to 2017. To predict the number of new students, the Single Exponential Smoothing method was used. This forecasting method focuses on decreasing the priority exponentially on the previous observation object. In exponential smoothing or exponential smoothing there are one or more smoothing parameters determined explicitly, and this result determines the weight imposed on the observation value. Based on the calculation results, the smallest error value is found at the value of α = 0.9 with MAD value 8.41, MAPE 7.21%, and RMSE 10.7.

Keywords: Forecasting, Students, Single Eksponential Smoothing

Article History
Received 25 October 18 Received in revised form 12 February 19 Accepted 20 July 19

1. Introduction

Forecasting is an activity that predicts or predicts what will happen in the future based on past data. Forecasting is an important thing in a company or organization in making a management decision. Whether or not the results of a study are largely determined by the accuracy of the predictions made.

Malang State Polytechnic is a vocational education in Malang City which has several departments with different levels of interest. One of the departments is Electrical Engineering, Mechanical Engineering, Information Technology, Civil Engineering, Chemical Engineering, Accounting, and Commerce Administration. The progress of a college is influenced by the size of the quality of graduation. Judging from the number of applicants for Malang State Polytechnic, they have large applicants from within or outside the region each year. This of course requires a prediction or forecasting system to predict the number of prospective new students with the aim of making decisions and prioritizing how many prospective students will be accepted.

To make a prediction system or forecasting the number of prospective new students required a good forecasting method and sufficiently precise calculations to predict the number of prospective students who register. In this study, the method to be taken is single exponential smoothing. This method is done by repeating calculations continuously using the latest data.

2. Methodology

2.1. Forecasting

According to Heizer and Render (2009: 162), forecasting is art and science to predict future events. Forecasting is the most important part in making a decision in an organization or company. This is because forecasting can be the basis of short, medium, or long-term planning for the company. In addition, forecasting can also be used to find out when an event will occur, so that appropriate action can be taken. In making predictions strived for uncertainty can be minimized, by calculating prediction errors. Forecast errors can be measured by:

- Mean absolute deviation (MAD)

MAD is a value calculated by taking the number of absolute values of each forecasting error divided by the number of periods of data (n). The following equation 1 is the MAD calculation formula.

$$MAD = \frac{\sum|actual - forecasting|}{n} \quad (1)$$

- Mean absolute percent (MAPE)

It is the average of the overall percentage of errors (differences) between actual data and forecasting data. Accuracy measures are matched

* *Corresponding author.*
E-mail address: *eka.larasati@polinema.ac.id, dimas.wahyu@polinema.ac.id, deasy.sandhya@polinema.ac.id.*

E-ISSN 2548-4214

with time series data, and are shown in percentages. The following equation 2 is the MAPE calculation formula.

$$MAPE = \frac{\sum(absolute\ deviation/value)*100}{n} \quad (2)$$

- Mean squared error (MSE)

Each error or remainder is squared. Then added up and added to the number of observations. This approach regulates large forecasting errors because they are squared. The following equation 3 is the MSE calculation formula.

$$MSE = \frac{\sum(forecast\ error)^2}{n} \quad (3)$$

- Root mean squared error (RMSE)

It is rooted in the value of the MSE that has been searched before. V The smaller the value generated the better the forecasting results will be done. The following equation 4 is the RMSE calculation formula.

$$RMSE = \sqrt{\frac{\sum(forecast\ error)^2}{n}} \quad (4)$$

2.2. Single Exponential Smoothing

The Exponential Smoothing Forecasting Method is widely used to predict the demand for goods (demand) which is very fast. This method is not influenced by trend and season. The formula is as follows:

$$St+1 = \alpha\ Xt + (1 - \alpha)\ St \quad (5)$$

Where :

St + 1 : Prediction for period to t + 1
Xt : Real value of period to t
St : Forecast for period t
α : Weight which shows the smoothing constant

3. Result and Discussion

Many decisions can be made depending on the number of students including the ratio of the number of lecturers and students, the building for the teaching and learning process and other facilities on campus. Malang State Polytechnic is one of the campuses where the number of students increases every year. For this reason, a research system was created to help predict the number of students accepted each year. In collecting data, it is based on student data received in the last 7 years starting in the 2011 school year until the school year 2017. The data used are data from 9 D3 study programs and 8 D4 study programs. The following table 1 is the data used.

Table 1. Student Data

Level of Study	Study Program	2011	2012	2013	2014	2015	2016	2017
D3	D-III T. Elektronika	96	92	99	105	127	132	128
	D-III T. Listrik	123	119	122	126	154	147	154
	D-III T. Telekomunikasi	93	94	96	104	100	122	130
	D-III M. Informatika	148	145	136	189	169	182	180
	D-III T. Mesin	196	219	226	253	253	225	237
	D-III T. Sipil	92	122	127	130	182	174	164
	D-III T. Kimia	101	129	135	161	163	157	155
	D-III Akuntansi	170	217	221	254	197	195	193
	D-III Administrasi Bisnis	161	196	201	228	207	215	209
D3 Total		1180	1333	1463	1550	1652	1649	1650
D4	D-IV T. Elektronika	46	103	87	106	109	131	134
	D-IV Sistem Kelistrikan	51	52	75	105	109	155	151
	D-IV Jaringan Telekomunikasi Digital	59	81	78	105	137	131	136
	D-IV T. Informatika	98	127	164	202	294	256	255
	D-IV T. Otomotif Elektronik	52	50	77	74	82	82	89
	D-IV Manajemen Rekayasa Konstruksi	102	120	117	137	175	190	203
	D-IV Akuntansi Manajemen	117	126	170	219	274	250	247
	D-IV Manajemen Pemasaran	86	109	145	201	227	216	210
D4 Total		611	768	913	1147	1407	1411	1425
Grand Total		1791	2101	2376	2697	3059	3060	3075

In doing forecasting using the single exponential smoothing method, the amount of alpha (α) applied is 0.2, 0.5, and 0.9. In order to predict α which results in the smallest forecast error. The following is a calculation example for alpha constants
(α = 0.2).
D-III T. Elektronika
Year 2011 : not yet determined
In 2012 : the number of prospective new students in 2011 was determined for 96 D3 Electronics study programs
Year 2013 :

$$F_{t+1} = a\ .\ X_t + (1\ -a).\ S_t$$
$$F_{t+1} = 0{,}2\ .92 + (1 - 0{,}2).\ 96$$
$$F_{t+1} = 95.2 \approx 95$$

Year 2014:

$$F_{t+1} = a\ .\ X_t + (1\ -a).\ S_t$$

$F_{t+1} = 0{,}2 \,.\, 99 + (1 - 0{,}2).\ 95$
$F_{t+1} = 96$

Table 2. Forecasting alpha = 0.2, 0.5, and 0.9

Study Program	Year	Actual Data	Forecast SES Alpha= 0.2	Forecast SES Alpha= 0.5	Forecast SES Alpha= 0.9
D3 Elektronika	2011	96	N/A	N/A	N/A
	2012	92	96	96	96
	2013	99	95	94	92
	2014	105	96	97	98
	2015	127	98	101	104
	2016	132	103	114	125
	2017	128	109	123	131

Calculates errors / errors using MAD.
Year 2013:

$$MAD = \frac{\sum |99 - 95|}{1}$$

= 4
Year 2014:

$$MAD = \frac{\sum |105 - 96|}{1}$$

= 4

Calculates errors / errors using MAPE.
Year 2013:

$$MAPE = \frac{\sum |4 - 92|}{1}$$

= 4.35%
Year 2014:

$$MAPE = \frac{\sum |4 - 95|}{1}$$

= 3.84%

Calculates errors / errors using MSE.
Year 2013:

$$MSE = \frac{(4.35)^2}{1}$$

= 16
Year 2014:

$$MSE = \frac{(3.84)^2}{1}$$

= 14.4

$RMSE = \sqrt{353.74}$
$RMSE = 18.8$

Table 3. Forecast alpha = 0.2 and forecast error

Program studi	Tahun	Data Aktual	Alpha= 0.2	MAD	MAPE	MSE
D3 Elektronika	2011	96	N/A	N/A	N/A	N/A
	2012	92	96	4	4,35%	16,0
	2013	99	95	4	3,84%	14,4
	2014	105	96	9	8,61%	81,7
	2015	127	98	29	23,02%	854,5
	2016	132	103	28	21,50%	805,7
	2017	128	109	19	14,62%	350,0
Total				**15,53**	**12,66%**	**353,74**
RMSE						**18,8**

From table 3 above, conclusions can be drawn on α = 0.2 obtained by the value of MAD 15,53, MAPE 12,66%, and RMSE 18,8.

Table 4. Forecast alpha = 0.5 and forecast error

Program studi	Tahun	Data Aktual	Alpha= 0.2	MAD	MAPE	MSE
D3 Elektronika	2011	96	N/A	N/A	N/A	N/A
	2012	92	96	4	4,35%	16,0
	2013	99	94	5	5,05%	25,0
	2014	105	97	9	8,10%	72,3
	2015	127	101	26	20,67%	689,1
	2016	132	114	18	13,73%	328,5
	2017	128	123	5	3,96%	25,6
Total				**11,16**	**9,31%**	**192,74**
RMSE						**13,9**

From table 4 above, conclusions can be drawn on α = 0.5 obtained by the value of MAD 11,16, MAPE 9,31%, and RMSE 13,9.

Table 5. Forecast alpha = 0.9 and forecast error

Program studi	Tahun	Data Aktual	Alpha= 0.2	MAD	MAPE	MSE
D3 Elektronika	2011	96	N/A	N/A	N/A	N/A
	2012	92	96	4	4,35%	16,0
	2013	98	92	7	6,67%	43,6
	2014	105	98	7	6,34%	44,4
	2015	127	104	23	17,85%	513,7
	2016	132	125	7	5,51%	52,8
	2017	128	131	3	2,56%	10,7
Total				**8,41**	**7,21%**	**113,53**
RMSE						**10,7**

From table 5 above, it can be concluded that at α = 0.9, the MAD value is 8.41, MAPE is 7.21%, and RMSE is 10.7. In general, the lower the value of MAD, MAPE, and RMSE means the better and more accurate. From

tables 3, 4 and 5 above it can be seen that the smallest error value is found in the value of α = 0.9.

4. Implementation

- Main menu form

  In the main menu form, the user will enter a username and password to be able to access the next form.

Figure-1. Main menu form

- Forecast menu form

On this page users can do student forecasting in accordance with the study program and the desired forecast year.

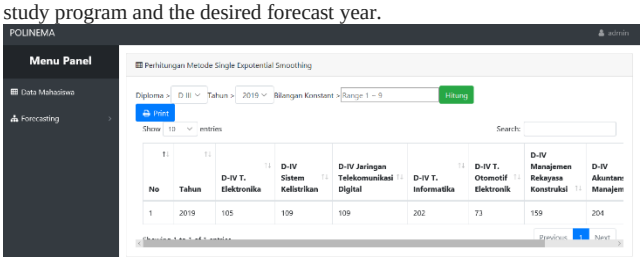

Figure-2. Forecast menu form

- Form error count

On this page the user can calculate the error value.

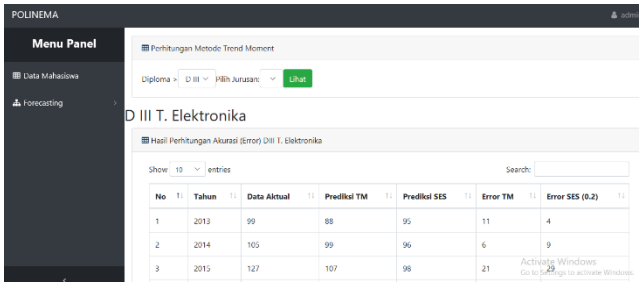

Figure-3. Form error count

5. Conclusion

1. In determining the forecasting method the number of new students is best applied to the next period by doing a forecasting comparison for some alpha values (α) so that the smallest error value can be obtained at the value α = 0.9.
2. Evaluation of forecasting results is done using the method of calculating forecasting errors MAD, MAPE and RMSE. These three methods are proven to be able to measure the performance of the model in forecasting.
3. This application can be used to forecast the number of new students at the same time for each new school year in accordance with the reports of new students' actual campus data so that they can save time in the forecasting process and the results are quite accurate.

REFERENCES

[1] Dimce Risteski, Andrea Kulakov. 2004. “Single Exponential Smoothing Method and Neural Network in One Method For Time Series Prediction”. Proceedings of the 2004 IEEE, 741-745.

[2] Everette S. Gardner Jr., Joaquin Diaz-Saiz. 2008. “Exponential Smoothing in the Telecommunication Data”. International Journal of Forecasting 24, 170-174.

[3] Heizer, Jay. & Render, Barry. Alih bahasa oleh Sungkono, Chriswan. (2009). Operations Management (Edisi kesembilan / Jilid I). Jakarta: PT Salemba Empat.

[4] Jian Kuang., Dongwei Zhai. 2013. “A Network Traffic Prediction Method Using Two-Dimensional Correlation and Single Exponential Smoothing”. Proceedings of ICCT 2013, 404-406.

[5] LI Guan-feng. 2010. “Application of Combined Forecasting Method to Prediction of Demand for the Special Purpose Vehicle in China”. The 2nd International Conference on Information Science and Engineering.

[6] Xiaona Ren. 2011. “A Dynamic Load Balancing Strategy For Cloud Computing Platform Based on Exponential Smoothing Forecast”. Proceedings of IEEE CCIS 2011, 220-224.

[7] YU F. Demand Forcast Based on Exponential Smoothing [J]. Logistics Engineering and Management, 2011, 33(5): 77-78.