# Forecasting Error Calculation with Mean Absolute Deviation and Mean Absolute Percentage Error



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# Forecasting Error Calculation with Mean Absolute Deviation and Mean Absolute Percentage Error

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**Abstract.** Prediction using a forecasting method is one of the most important things for an organization, the selection of appropriate forecasting methods is also important but the percentage error of a method is more important in order for decision makers to adopt the right culture, the use of the Mean Absolute Deviation and Mean Absolute Percentage Error to calculate the percentage of mistakes in the least square method resulted in a percentage of 9.77% and it was decided that the least square method be worked for time series and trend data.

## 1. Introduction

The use of forecasting or prediction has been widely employed in organizational activities to prepare conditions that may occur in the future[1][2]. Predictions are also the basis for all business decisions even if they are not precise, but the organization can get a picture for future decisions. In made the prediction does not close the possibility of the organization less attention to the pattern of data owned, so finally using predictive methods that are less of the data pattern[2][3]. The predicted results obtained are not maximal in helping the organization determine the steps in the future, so the understanding of the pattern of data owned is essential[2].

Prediction errors are common and almost all forecasting methods have errors in predicted results[1], one of the forecasting methods that can be used is the least square method that performs calculations with time series data and has a seasonal trend[4], with time series calculated data error possibility Prediction will also occur frequently[4], these prediction errors can be computed using the Mean Absolute Deviation method and Mean Absolute Percentage Error.

Mean Absolute Deviation and Mean Absolute Percentage Error is a method that can be used to calculate margin error from predicted least square method of data [5], both approaches have different concepts in performing calculations with different results, the use of both of these ways in calculating the predicted error gives The organization's choice to consider the utilization of a method of prediction..

## 2. Theory

Forecasting models are then validated using some indicators, indicator used is Mean Absolute Deviation and Mean Absolute Percentage Error, and here is the explanation:

a. Mean Absolute Deviation

The method for evaluating forecasting methods uses the sum of simple mistakes. Mean Absolute Deviation (MAD) measures the accuracy of the prediction by averaging the alleged error (the absolute value of each error). MAD is useful when measuring prediction errors in the same unit as the original series[5][6]. The value of MAD can be calculated using the following formula.

$$MAD = \frac{\sum |y1 - yt'|}{n}$$

b. Mean Absolute Percentage Error

Mean Absolute Percentage Error (MAPE) is calculated using the absolute error in each period divided by the observed values that are evident for that period. Then, averaging those fixed percentages. This approach is useful when the size or size of a prediction variable is significant in evaluating the accuracy of a prediction[7][8]. MAPE indicates how much error in predicting compared with the real value.

$$MAPE = \frac{\sum \frac{|y1 - yt'|}{y1}}{n} \times 100\ \%$$

## 3. Result and Discussion

Testing validation error performed actual data below before the prediction process, the data displayed has time series and trends, and data below is the request data items in Kg:

**Table 1.** Actual Data before Prediction

| No | Month | Year | | |
|---|---|---|---|---|
| | | **2011** | **2012** | **2013** |
| 1 | January | 41,2 | 39,5 | 42,81 |
| 2 | February | 43,7 | 45,9 | 52,3 |
| 3 | March | 38,8 | 47,9 | 55,4 |
| 4 | April | 42,6 | 35,76 | 54,69 |
| 5 | May | 36,7 | 37,8 | 45,9 |
| 6 | June | 39,8 | 41,34 | 52,79 |
| 7 | July | 45,9 | 45 | 57,6 |
| 8 | August | 42,89 | 42 | 49,87 |
| 9 | September | 41,89 | 37,5 | 42,9 |
| 10 | October | 39,8 | 31,4 | 32 |
| 11 | November | 43,05 | 38,2 | 39,87 |
| 12 | December | 45,87 | 40,3 | 45,8 |
| ∑ | | 502.2 | 482.6 | 571.93 |

The actual data above is then calculated by the least square method to get prediction every month for the year 2014-2015 starting from September and got a result as follows:

**Table 2.** Data Prediction

| No | Year | Month | Number of Requests |
|---|---|---|---|
| 1 | 2014 | September | 41,77 |
| 2 | 2014 | October | 26,6 |
| 3 | 2014 | November | 37,19 |
| 4 | 2014 | December | 43,92 |
| 5 | 2015 | January | 43,585 |
| 6 | 2015 | February | 60,2 |
| 7 | 2015 | March | 72,26 |
| 8 | 2015 | April | 62,485 |
| 9 | 2015 | May | 53,93 |
| 10 | 2015 | June | 64,125 |

| | | | |
|---|---|---|---|
| 11 | 2015 | July | 67,05 |
| 12 | 2015 | August | 55,39 |
| Total Request | | | 628.505 |

Based on original data contained in Table 1 and predicted data using the least square method in Table 2, error calculation is done by using Mean Absolute Deviation and Mean Absolute Percentage Error. The details of forecasting error calculation using Mean Absolute Deviation (MAD) and Mean Absolute Percentage Error (MAPE) is as follows:

a. Period of September

**Table 3.** Forecasting Error Analysis September

| Year | Data Actual (y1) | Forecasting (yt') | (\|y1- yt'\|) |
|---|---|---|---|
| 2011 | 41,89 | 42,275 | 0,385 |
| 2012 | 37,5 | | 4,775 |
| 2013 | 42,9 | | 0,625 |
| ∑ | 122,29 | | 5,785 |

$$MAD = \frac{\sum|y1 - yt'|}{n} = \frac{5,785}{3} = 1,92$$

$$MAPE = \frac{\sum\frac{|y1 - yt'|}{y1}}{n} \times 100\ \% = \frac{0,04}{3} \times 100\ \% = 4,7\ \%$$

Then the calculation error is 4,7% by using MAPE method

b. Period of October

**Table 4.** Forecasting Error Analysis October

| Year | Data Actual (y1) | Forecasting (yt') | (\|y1- yt'\|) |
|---|---|---|---|
| 2011 | 39,8 | 42,275 | 17,1 |
| 2012 | 31,4 | | 8,7 |
| 2013 | 32 | | 9,3 |
| ∑ | 103,2 | | 35,1 |

$$MAD = \frac{\sum|y1 - yt'|}{n} = \frac{35,1}{3} = 11,7$$

$$MAPE = \frac{\sum\frac{|y1 - yt'|}{y1}}{n} \times 100\ \% = \frac{0,34}{3} \times 100\ \% = 11,3\ \%$$

Then the calculation error is 11,3% by using MAPE method

c. Period of November

**Table 5.** Forecasting Error Analysis November

| Year | Data Actual (y1) | Forecasting (yt') | (\|y1- yt'\|) |
|---|---|---|---|
| 2011 | 43,05 | 35,6 | 7,45 |
| 2012 | 38,2 | | 2,6 |
| 2013 | 39,87 | | 4,27 |
| ∑ | 121,12 | | 14,32 |

$$MAD = \frac{\sum|y1 - yt'|}{n} = \frac{14,32}{3} = 4,77$$

$$MAPE = \frac{\sum \frac{|y1 - yt'|}{y1}}{n} \times 100\ \% = \frac{0,11}{3} \times 100\ \% = 11,8\ \%$$

Then the calculation error is 11,8% by using MAPE method

d. Period of December

**Table 6.** Forecasting Error Analysis December

| Year | Data Actual (y1) | Forecasting (yt') | (\|y1- yt'\|) |
|---|---|---|---|
| 2011 | 45,87 | 43,885 | 1,985 |
| 2012 | 40,3 | | 3,585 |
| 2013 | 45,8 | | 1,915 |
| ∑ | 131,97 | | 7,485 |

$$MAD = \frac{\sum |y1 - yt'|}{n} = \frac{7,485}{3} = 2,495$$

$$MAPE = \frac{\sum \frac{|y1 - yt'|}{y1}}{n} \times 100\ \% = \frac{0,05}{3} \times 100\ \% = 1,8\ \%$$

Then the calculation error is 1,8% by using MAPE method

e. Period of January

**Table 7.** Forecasting Error Analysis January

| Year | Data Actual (y1) | Forecasting (yt') | (\|y1- yt'\|) |
|---|---|---|---|
| 2011 | 41,2 | 43,585 | 2,385 |
| 2012 | 39,5 | | 4,085 |
| 2013 | 42,81 | | 0,775 |
| ∑ | 123,51 | | 7,245 |

$$MAD = \frac{\sum |y1 - yt'|}{n} = \frac{7,245}{3} = 2,415$$

$$MAPE = \frac{\sum \frac{|y1 - yt'|}{y1}}{n} \times 100\ \% = \frac{0,058}{3} \times 100\ \% = 1,93\ \%$$

Then the calculation error is 1,93% by using MAPE method

The above calculation process is some process of fault validation process that achieved by using MAD and MAPE method, here is the result of error checking until August 2015:

**Table 8.** MAD and MAPE Calculation results

| **Year** | **Month** | **Method** | |
|---|---|---|---|
| | | **MAD** | **MAPE** |
| 2014 | September | 1,92 | 4,7 % |
| 2014 | October | 11,7 | 11,3 % |
| 2014 | November | 4,77 | 11,8 % |
| 2014 | December | 2,495 | 1,8 % |
| 2015 | January | 2,415 | 1,93 % |
| 2015 | February | 12,9 | 9,09 % |
| 2015 | March | 24,95 | 17,5 % |
| 2015 | April | 18,135 | 13,6 % |

| | | | |
|---|---|---|---|
| 2015 | May | 13,79 | 11,45 % |
| 2015 | June | 19,48 | 14,54 % |
| 2015 | July | 17,55 | 11,81 % |
| 2015 | August | 10,47 | 7,7 % |

The results above are the percentage of error that obtained by using Mean Absolute Deviation and Mean Absolute Percentage Error, as for the resulting graph as below

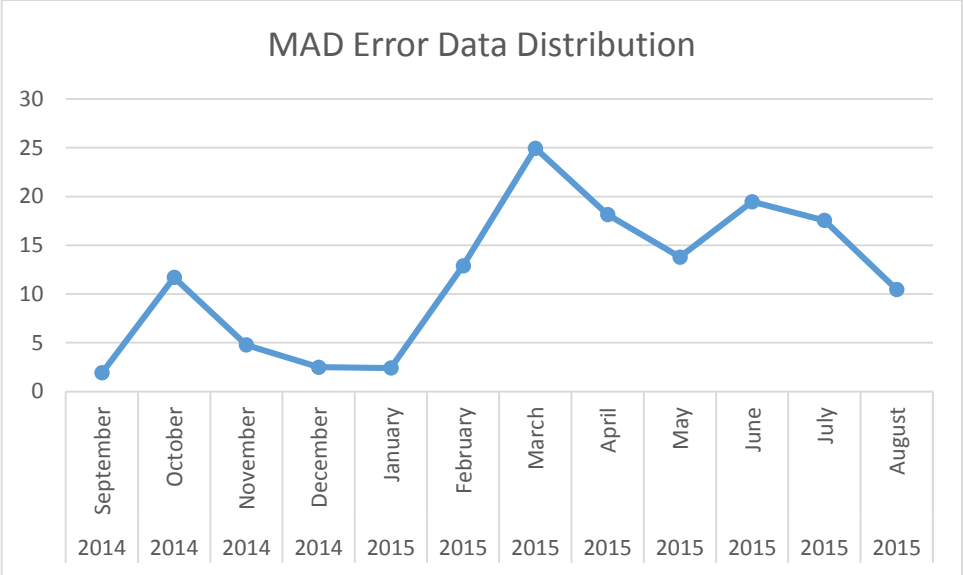


**Figure 1.** MAD Error Graph Distribution

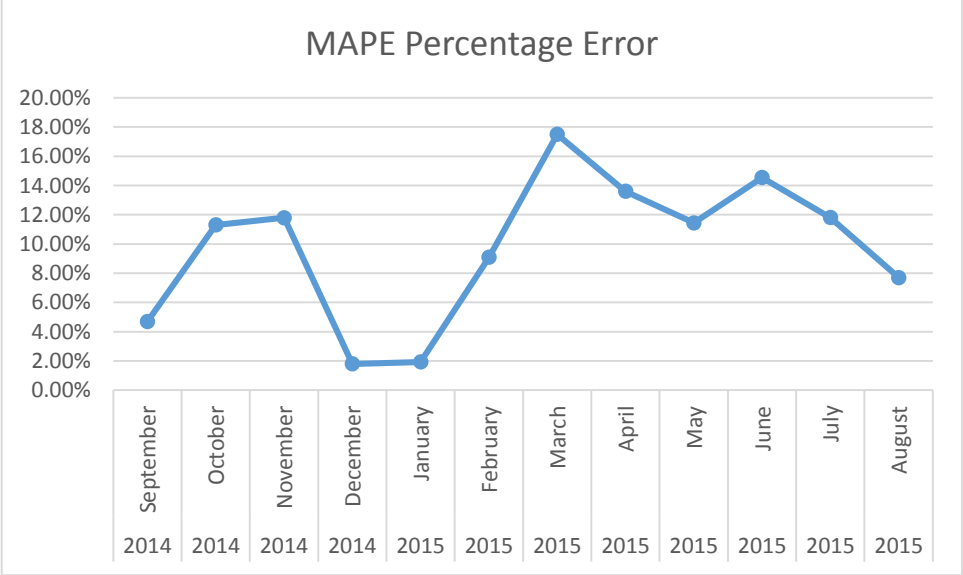


**Figure 2.** MAPE Percentage Error

## 4. Conclusion

Based on forecasting error testing conducted on predicted data with least square method found that the average error percentage 9.77%, this figure is quite rational because not exceeding 10% margin of error, the method of Mean Absolute Deviation and Mean Absolute Percentage Error can be applied well for

Checking the result of prediction result of least square method and also do not close possibility to another method.

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