

Accuracy of the Moving Averages and Deseasonalizing Methods for Trend, Cyclical and Seasonal Data Forecasting

Yoga Fromega Saragih^{1*}, Open Darnius²

¹Bachelor Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Indonesia

²Lecturer at Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Indonesia

*Corresponding Author. E-mail: yogafromega99@gmail.com

Article Info	ABSTRACT
<p>Article History Received : 20 Januari 2023 Accepted: 31 Oktober 2023 Published: 31 Oktober 2023</p> <p>Keywords: Moving Averages, Deseasonalizing, Method effectiveness</p>	<p>Forecasting or forecasting is an attempt to predict future conditions based on past state data. Moving Averages or moving average is a forecasting method that calculates the average value of a time series and then uses it to estimate the value in the next period. Deseasonalizing is part of the decomposition method which is included in the time series method. In this study, the Moving Average method and the Deseasonalizing method were used. The use of these two forecasting methods is to determine the accuracy of the forecasting method which is more accurate and close to the Mean Absolute Error (MAE) and Mean Squared Error (MSE) values. In this study the procedures used were problem identification, problem formulation, observation, data analysis and conclusion. The data taken in this study is data that contains trend, cyclical, and seasonal. For data containing trends on the moving averages method 15245.28 and 1430419308, for the Deseasonalizing method 28121.9504 and 1204814887. For Cyclical data on the Moving Averages method 4454.314465 and 28200197.22 for the Deseasonalizing method 13357.71283 and 254833253.4. For Seasonal data on Moving Averages 126.3839286 and 25479.38393 for the Deseasonalizing method 244.9971767 and 75372.32397. And for data containing these three patterns in the Moving Averages method 193.5385 and 65781.02 for the Deseasonalizing method 901.9566 and 1351418. From these results it can be concluded that the most effective trend data is the Deseasonalizing method, for Seasonal data the most effective method is the Moving Averages method, and for Cyclical Data the most effective method is the Moving Averages. Meanwhile, for data containing the three data patterns is the Moving Averages method.</p>

This is an open access article under the [CC-BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license



To cite this article:

INTRODUCTION

Forecasting or forecasting is an attempt to predict future conditions based on past state data. Forecasting requires taking historical data and projecting it into the future by some form of systematic modeling. Forecasting is a method used to estimate future uncertainty as a form of effort to make a better decision. The development of more modern forecasting techniques and in line with advances in

computer software, has also made forecasting techniques more numerous and developed according to the needs required (Makridakis, 1993).

Moving Average is a forecasting method that calculates the average value of a time series and then uses it to estimate the value in the next period. The Moving Average is obtained by adding and finding the average value of a certain period, then removing the oldest value and adding a new value. This Moving Average method is better used to calculate data that is stable or data that does not fluctuate sharply (data that changes up and down very drastically).

Future historical data can be predicted using averaging methods in various ways. The time series forecasting method is based on the analysis of the pattern of the relationship between the variables to be estimated and the time variable which is a time series.

The deseasonalizing method is part of the decomposition method which is included in the time series method. The basic concept of using this method is done by eliminating the influence of seasonal variations. Eliminating seasonal influences makes it possible to focus on the overall long-term trend. The deseasonalizing method is based on the fact that what has happened will recur with the same pattern.

For forecasting purposes, there is a well-known model, namely the time series model. There is no one forecast method that is the best and is always suitable for making forecasts for all kinds of things. One method may be well suited for forecasting one thing but not suitable for forecasting another. To choose a suitable method, which can minimize forecast errors.

In this study, the Moving Average method and the Deseasonalizing method were used. The use of these two forecasting methods is to compare forecasting methods that are more accurate and approach the values of the Mean Absolute Error (MAE) and Mean Squared Error (MSE).

Time series or time series is a collection of data observations ordered in time (Hanke & Winchern, 2005: 58). The time series method is a forecasting method using an analysis of the relationship pattern between the variables to be estimated and the time variable. Forecasting a time series data needs to pay attention to the type or pattern of data. In general, there are four kinds of time series data patterns, namely horizontal, trend, seasonal, and cyclical (Hanke and Wichren, 2005: 158). Horizontal patterns are unexpected and random events, but their appearance can affect fluctuations in time series data.

Trend patterns are trends in the direction of data in the long term, which can be in the form of increases or decreases. Seasonal patterns are fluctuations in data that occur periodically within one year, such as quarterly, quarterly, monthly, weekly or daily. While the cyclical pattern is the fluctuation of the data for more than one year.

RESEARCH METHOD

Data collection on the number of Simalungun residents based on sub-districts was carried out at the Simalungun Regency Statistics Office which belongs to the trend pattern, rainfall data at BMKG region 1 belongs to the seasonal pattern, data on Toyota car sales in Indonesia belongs

to the cyclical pattern and data Bank Rakyat Indonesia's share prices are classified into trend, cyclical and seasonal patterns.

The type of method used is the moving averages method and the deseasonalizing method. This method is used to find the accuracy of data that contains trend, cyclical, seasonal and data that contains three data patterns at once by looking for MAE (Mean Absolute Error) values and MSE (Mean squared error) values using Excel software.

This research was conducted with the following steps:

A. Metode Moving Averages

1. Membuat scatter diagram

2. Determine the equation of the line

3. Choose the right moving averages method based on patterns obtained from existing time series data

B. Metode Deseasonalizing

In general, the steps for forecasting using the deseasonalizing method are as follows.

1. Compile quarterly data for each year.

2. Make a scatter diagram of the distribution chart.

3. Calculating a certain seasonal index using the ratio method to the moving average.

4. Calculate a specific quarterly index.

5. Calculating deseasonalizing data from population data.

6. Scatter diagram of original data with deseasonalizing data.

7. Find the deseasonalizing equation (trend line equation) with the formula in.

$$\hat{Y} = a + bt$$

Furthermore, to measure forecast errors, Mean Absolute Error or Mean Squared Error is usually used

1. Mean Absolute Error (MAE)

Mean absolute error (MAE) is the average absolute error value of forecasting errors (no matter the positive or negative sign).

$$MAE = (\sum_{t=1}^n |X_t - F_t|) / n$$

With X_t : data actually happened

F_t : forecast data calculated from the model used at time or year t

n : a lot of forecast data

2. Mean Squared Error (MSE)

Mean squared error (MSE) is the average of the squared forecast errors

$$MSE = (\sum_{t=1}^n [(X_t - F_t)]^2) / n$$

With X_t : data actually happened

F_t : forecast data calculated from the model used at time or year t

n : a lot of forecast data

RESULTS AND DISCUSSION

A. The accuracy of the Moving Averages method for forecasting the number of residents in Simalungun in the period 2010 to 2021.

1. Make Scatter Diagrams

From the data on the population of Simalungun by sub-district from 2010 to 2021 it can be presented in a scatter diagram with the help of Excel software and added trend lines, so you can see how linear the trend lines are, patterns and tendencies up or down.

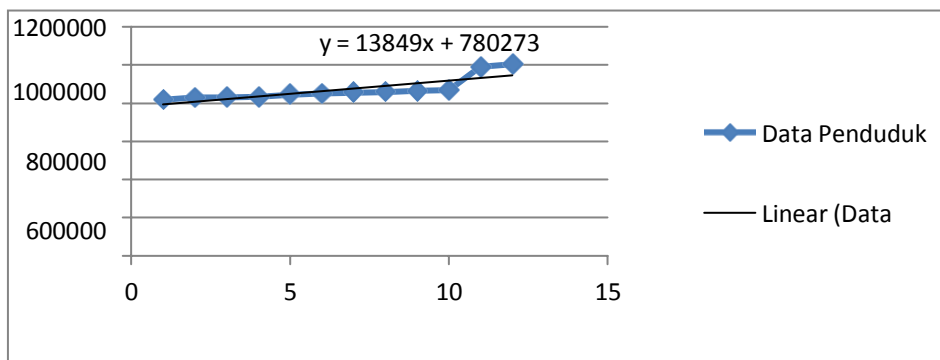


Figure 1. Simalungun Population Data Scatter Diagram

2. Determine the Line Equation

By using the scatter diagram it is shown that the trend line equation is $\hat{Y} = 13849 + 780273t$. The line equation $\hat{Y} = 13849 + 780273t$ shows that every time t increases by one, \hat{Y} increases 1298.6t.

3. Choose the right Moving Averages method.

The next step is to find the price of $F_{(T+1)}$ using the following formulas.

For the Double Moving Average Method

$$F_{(t+m)} = (2+2m/(N-1)) \bar{S}'_t - (1+ 2m/(N-1)) \bar{S}''_t$$

With

$$\bar{S}'_t = (X_t + X_{(t-1)} + X_{(t-2)} + \dots + X_{(t-N+1)})/N$$

$$S'_t = (S_t + S_{t-1} + S_{t-2} + \dots + S_{t-N+1})/N$$

4. Calculating forecasting errors

From the price F_{t+1} above, the Mean Absolute Error (MAE) and Mean Squared Error (MSE) values of each order can be calculated using the formula for the Double Moving Averages method

$$MAE = (\sum_{t=8}^{60} |X_t - F_t|) / 53$$

$$MSE = (\sum_{t=8}^{60} (|X_t - F_t|)^2) / 53$$

B. Accuracy of the Deseasonalizing Method for Forecasting Population in Simalungun

1. Compile data every quarter of each year

The number of residents in Simalungun from 2011 to 2021 per quarter (quarterly, starting from January-February-March, April-May-June, July-August-September, October-November-December, and so on)

2. Make Scatter Diagrams

Based on these data, a scatter diagram can be made with the help of excel software and a trend line is added, so that it can be seen how linear the trend line is, patterns and trends up or down.

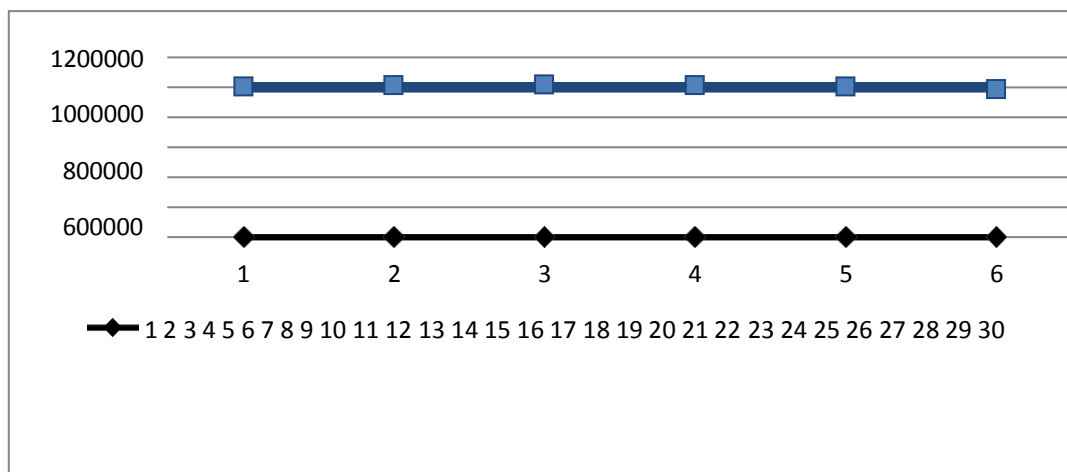


Figure 2. Scatter Diagram of Simalungun Population Data

3. Calculating a Specific Seasonal Index

The method generally used to calculate patterns certain seasonality is the ratio to moving average method. This method can remove trends, cycles, and other irregular components from the original data.

4. Calculating a Specific Quarterly Index.

5. Calculating Deseasonalizing Data from Population Data.

The reason for using the Deseasonalizing method for population data is to eliminate seasonal fluctuations so that trends and cycles can be studied. To eliminate the influence of seasonal variations, the population of each quarter (which contains trend, cyclical, uncertain and seasonal effects) is multiplied by the season index for that quarter.

6. Create Original Data Scatter Diagrams by Deseasonalizing Data.

7. Determine the Trend line Equation

After deseasonalizing data is obtained, then the data is used to determine the trend equation. Steps to find the trend equation.

Based on the results of the calculation of the Deseasonalizing population to determine the trend line, it can be used to determine the trend line equation as follows.

$$3457,65013$$

$$785731,618$$

$$\text{Jadi persamaan garis trend } \hat{Y} = 785731,618 + 3457,65013t$$

8. Calculating population forecasting with deseasonalizing data. The step taken is to estimate the time t into the trend equation then make a quarterly forecast by multiplying the estimated deseasonalizing data with the seasonality index. In this case it is assumed that the past 48 quarters is a good indicator for forecasting the amount of rainfall in 2022.

9. Calculates forecasting error.

From the price of F_t in calculating the quarterly population forecast, the Mean Absolute

Error (MAE) and Mean Squared Error (MSE) prices can be calculated using the formula

$$\text{MAE} = (\sum_{t=1}^48 \left[|X_t - F_t| \right]) / 48 \text{ and } \text{MSE} = (\sum_{t=1}^48 \left[(|X_t - F_t|)^2 \right]) / 48$$

After calculating, the Mean Absolute Error (MAE) price for the Deseasonalizing method is 28121.95. Meanwhile, the Mean Squared Error (MSE) price is 1204814887.

for the next three data, the same steps will be carried out because they still use the same method.

CONCLUSION

Based on the results of research conducted in determining the accuracy of the Moving Averages method and the Deseasonalizing Method for Forecasting data containing Trend, Cyclical, and Seasonal, the MAE and MSE values are obtained so that the best method can be determined from the MAE value. Selection of the best method is taken based on the smallest value of the MAE (Mean Absolute Error) Moving Average Method and Deseasonalizing method, so that it can be concluded that for data containing Trend the most effective method is the Deseasonalizing method with a value of 28121.9504, for data containing Seasonal and Cyclical the most effective method used is the Moving Average method with a value of 126.3839286 and 4454.314465, while for data containing Trend, Cyclical, Seasonal the most effective method used is the Moving Averages method with a value of 193.5358.

REFERENCES

- Makridakis, S. Dkk. 1999. *Metode dan Aplikasi Peramalan*. Terjemahan Untung Sus Andriyanto dan Abdul Basith. Jakarta: Erlangga.
- Hanke, Winchern, 2005. Time series atau runtun waktu adalah himpunan observasi data terurut dalam waktu.
- Mason, D. Dkk. 1999. *Teknik Statistika untuk Bisnis & Ekonomi*. Terjemahan Widnyono Soetjipto, dkk. Jakarta: Erlangga.
- Subagyo, Pangestu. 1986. *Forecasting Konsep dan aplikasi*. Yogyakarta: BPFE Yogyakarta.
- Supranto, J. 2000. *Statistik Teori dan Aplikasi*. Jakarta: Erlangga
- Maricar, Azman, M, Widiadnyana Putu and Wijaya Wayan Arta. (2017) Analysis of Data Mining for Forecasting, vol. 2, No. 1.
- Marlina Marine, Keristina Br. Ginting, Ariyanto "Peramalan Jumlah Penumpang Pesawat Dengan Menggunakan Metode Dekomposisi, Vol. 01, No. 01, November 2019.

Makridakis, S., & S. C., W. (1989). *Forecasting Methods for Management*.

Mardiyah, R. (2016). Perbandingan Metode Double Exponential Smoothing dan Fuzzy Time Series Pada Peramalan Penjualan.

Mursidah, Yunina, Nurhasanah Desma Yuni (2021) Perbandingan Metode Exponential Smoothing dan Metode Decomposition. Vol 10, Nomor 1, ISSN : 2338-2864 p. 37-46 .

Rachman Rizal, (2018) Penerapan Metode Moving Average dan Exponential Smoothing. Vol.5 No.1 September 2018, pp. 211~220.

Makridakis, S, Wheelwright, S.C., & McGee, V.E. 1999. *Metode dan Aplikasi Peramalan*, jilid 1, edisi revisi (terj.), Alih Bahasa: Hari Suminto. Jakarta: Binarupa Aksara.

Bank BRI. (2016). Dipetik May 25, 2015, dari <http://bri.co.id/ar>