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The Use of Simple Exponential Smoothing in Predicting Economic Growth Trends

Adelia Nurul Khotimah[1], Syaharuddin[2], Vera Mandailina[3]
[1,2,3]Mathematic Education, Universitas Muhammadiyah Mataram
adelianurulkhotimah04@gmail.com

Abstract: This research is important because economic growth is a key indicator in assessing a country's macroeconomic performance, and accurate prediction of its growth trend is necessary for medium- and long-term economic policy planning. Therefore, the purpose of this study is to analyze the effectiveness of the *Simple Exponential Smoothing* (SES) method in predicting Indonesia's economic growth trend. This research is an experiment to forecast economic growth for the next five years based on actual data for the period 2015-2024. The data is obtained from the Central Bureau of Statistics (BPS). The results show that the SES method is able to describe the trend of economic growth quite stably, with a Mean Absolute Percentage Error (MAPE) value of 5.82%, which indicates a good level of accuracy in the context of macroeconomic forecasting. The implication of the results of this study is that the SES method can be used as a simple but reliable tool for the government and policy makers in projecting national economic growth and in developing development strategies that are more adaptive to changes in economic dynamics.

Keywords: Economic Growth, Forecasting, Simple Exponential Smoothing.

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A. INTRODUCTION

Economic growth trend prediction is an attempt to estimate the direction and level of economic growth of a country or region in the future, based on analysis of available economic data and information (Tilova & Darsyah, 2018). The approaches used in this prediction include econometric models, time series analysis, and the use of leading, coincident, and lagging indicators, each of which provides an overview of current economic conditions and future projections (Tilova & Darsyah, 2018). In addition, macroeconomic factors, such as fiscal and monetary policies, energy price fluctuations, as well as the influence of global factors, play an important role in influencing economic growth projections. Structural modeling approaches, which identify cause-and-effect relationships between economic sectors, as well as qualitative approaches involving analysis of market sentiment and political stability, also contribute to forecasting economic trends (Pongdatu et al., 2020). However, forecasting economic growth trends faces significant challenges, including global uncertainty, dynamic policy changes, and potential data inaccuracies, which can affect the results. Nonetheless, with the use of the right approach, these predictions can contribute significantly to decision-making in various sectors.

To predict economic growth trends, there are various forecasting methods that are commonly used, including econometric models, time series models, moving average methods, and exponential smoothing methods (Nugraheni et al., 2022). In time series models, techniques such as ARIMA and GARCH are used to analyze time series data, while moving average methods are applied to data that tends to be stable (Fahrudin & Sumitra, 2020). One method

that is often used in simple forecasting is Simple Exponential Smoothing (SES), which gives greater weight to recent data and produces projections of future values based on historical data with the formula y^t+1=αyt+(1−α)y^t\hat{y}_{t+1} = \alpha y_t + (1 - \alpha) \hat{y}_t, where α\alpha is a smoothing parameter that regulates the magnitude of the influence of recent data on predictions. The advantage of SES lies in its simplicity, so this method is very suitable for data that does not show a clear seasonal pattern or trend (Nor et al., 2018). However, this method is less effective for data that has a trend or seasonal pattern, so other methods such as Holt's Linear Trend or Holt-Winters Seasonal are more appropriate for use in these conditions.

The results of the study show that there are various methods that can be applied to predict economic growth trends, with each method having its advantages and limitations (Romaita et al., 2020). Econometric models, which are used to model the relationship between economic variables, are effective for analyzing complex data with many interrelated variables, although they require complete data and are highly dependent on the assumptions made in the model (Hayami et al., 2021). Time series models, such as ARIMA and GARCH, can be used to analyze historical data and handle stationary or volatile patterns in economic data, but require fairly long data to produce valid predictions. The moving average method, which is simple and easy to apply, is effective for relatively stable data, but cannot handle large fluctuations in the data. Meanwhile, Simple Exponential Smoothing (SES), which gives more weight to recent data, is suitable for data that does not show clear seasonal patterns or trends, although it is less effective for data with complex seasonal patterns or trends (Aminudin & Handoko, 2019). Overall, the selection of the appropriate forecasting method is highly dependent on the characteristics of the data being analyzed, where each method has advantages and limitations that need to be considered in the context of economic growth forecasting.

Previous research results on the Simple Exponential Smoothing (SES) method show that this method is effective when applied to forecasting data that is stable or does not show clear seasonal patterns and trends (Rosdianawati & Surjanto, 2023). SES is widely chosen because of its simplicity and ability to provide accurate projections on data with relatively small fluctuations, such as in forecasting consumer goods sales. Several studies comparing SES with other methods, such as ARIMA or regression, have found that although SES is simpler, in some cases this method is more effective, especially for short-term forecasting with limited data. The study also highlighted the importance of selecting the α\alpha parameter in SES, where the right value greatly affects the accuracy of the forecast results, so various optimization methods are often applied to determine the optimal α\alpha value (Sidqi & Sumitra, 2019). SES has been widely applied in various sectors, such as product demand forecasting, production, and short-term inflation prediction. However, this method has limitations when applied to data that shows significant seasonal patterns or trends, so other methods, such as Holt's Linear Trend or Holt-Winters Seasonal Method, are more suitable for handling this type of data.

The purpose of research using the Simple Exponential Smoothing (SES) method is generally to analyze and predict trends in time series data that do not show clear seasonal patterns or trends. This study aims to evaluate the level of accuracy of SES in forecasting future

values based on available historical data, with a focus on identifying the optimal α\alpha parameters to improve the accuracy of forecasting results. In addition, this study aims to compare the effectiveness of SES with other forecasting methods, such as ARIMA or moving averages, in the context of short-term forecasting on relatively stable economic or business data. The study also aims to explore the application of SES in various sectors, such as forecasting product demand or production, and to identify the limitations of this method in handling data that has more complex seasonal patterns or long-term trends. Overall, the main objective of this study is to measure the extent to which the SES method can be relied on in economic or business forecasting that does not show significant seasonal patterns or trends.

B. METHOD

Quantitative-experimental research in the context of economic growth aims to identify and measure the direct effect of a variable on economic growth using an experimental design that divides subjects into experimental and control groups. In this study, certain economic variables, such as fiscal policy or infrastructure investment, are manipulated to see their impact on economic growth. Quantitative data, such as GDP, inflation, and unemployment rates, are collected to test the causal relationship between these factors, using inferential statistical techniques and econometric models for analysis. For example, research can test the effect of tax reduction policies or increased government spending on the rate of economic growth. The results of this study provide useful insights for policymakers to design more effective policies in encouraging economic growth based on empirical evidence obtained from the experiment. The general formula for multiple linear regression is as follows:

Simple Economic Model Without Government:

$$Y = \mathrm{C} + I \quad (1)$$

Simple Economic Model With Government

If the government sector is included, the formula will be expanded to:

$$Y = \mathrm{C} + I + G \quad (2)$$

Simple Economic Model With Foreign Sector (Open Economy)

If the economy also involves international trade (exports and imports), the formula would be:

$$Y = \mathrm{C} + I + G + (X - M) \quad (3)$$

Types of economic growth data consist of quantitative and qualitative data. Quantitative data includes indicators such as Gross Domestic Product (GDP), inflation, unemployment rate, investment, international trade, and per capita income that can be measured numerically to analyze economic conditions. While qualitative data provides insight into factors that affect the economy, such as government policies and political stability. The main sources of economic growth data include the Central Bureau of Statistics (BPS), the World Bank, the International Monetary Fund (IMF),OECD, and Bank Indonesia, which provides information on GDP, inflation, fiscal policy, and other economic sector data. In addition, corporate financial reports and special surveys conducted by research institutions or market research companies are also important sources of information for understanding the impact of policies and the

contribution of economic sectors to growth. Data from these various sources are used to analyze the economy and design policies that can support economic growth.

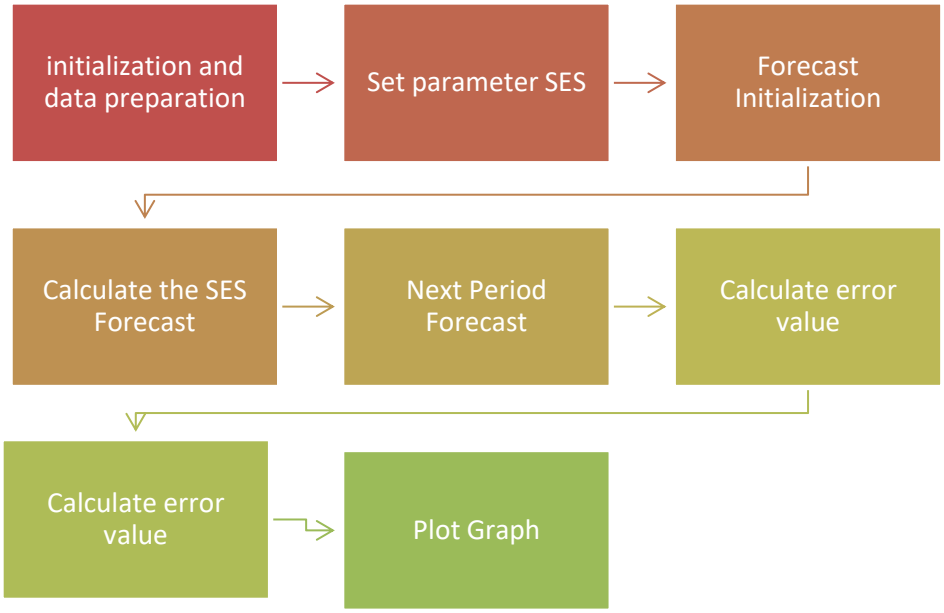

Figure 1. Algoritma Simple Exponential Smoothing (SES)

Figure 1 shows the flowchart depicting the stages of the Simple Exponential Smoothing (SES) method process for forecasting time series data. The process begins with initialization and data preparation, such as loading data from a source (e.g. Excel) and separating it into years and growth values. Next, the smoothing parameter value (alpha) is determined and the initial forecast is initialized. After that, the SES forecast is calculated for the entire period based on historical data, followed by the forecast for the next period. The next step is to calculate the error value to evaluate the accuracy of the model using indicators such as MSE and MAPE. Finally, the forecast results are displayed and visualized in graphical form to make it easier to analyze and compare with actual data.

C. RESULTS AND DISCUSSION

1. Data Description

The data analyzed is annual data on economic growth in percent from 2015 to 2024. This data is analyzed using the Simple Exponential Smoothing (SES) method with a smoothing parameter of $\alpha = 0.5$ through MATLAB software. The forecasting results show a gradual increase in economic growth from 2.0150% in 2015 to 2.0220% in 2024, reflecting a stable upward trend without major fluctuations. In terms of descriptive statistics, the average growth value during the period was 2.0184%, with a minimum value of 2.0150% and a maximum of 2.0220%. The difference between the highest and lowest values (range) is only 0.0070%, indicating data stability. Model SES yang digunakan memiliki tingkat akurasi yang sangat baik, dengan nilai Mean Squared Error (MSE) sebesar 3,2610 and Mean Absolute Percentage Error (MAPE) is only 0.09%, which means the prediction error is very small. Overall, this data

illustrates a trend of economic growth that has consistently increased from year to year with a high level of stability and forecast accuracy.

2. Forecasting Results and Decision Making

Table 1. Forecasting Results and Decision Making

Year	SES (%) Forecast
2015	2.0150
2016	2.0150
2017	2.0155
2018	2.0162
2019	2.0171
2020	2.0181
2021	2.0190
2022	2.0200
2023	2.0210
2024	2.0220

The forecasting results table using the Simple Exponential Smoothing (SES) method shows a stable and gradually increasing annual economic growth trend from 2015 to 2024. The forecast value starts from 2.0150% in 2015 and remains at the same figure in 2016, then increases slowly each year until it reaches 2.0220% in 2024. The average growth during this period is 2.0184%, with a minimum value of 2.0150% and a maximum of 2.0220%, and a very small difference or range of 0.0070%. The very small and consistent annual increase pattern reflects a conservative and stable economic growth projection, without any major fluctuations. This shows that the SES method has succeeded in capturing the characteristics of data that tend to be linear and non-volatile, making it suitable for forecasting moderate long-term economic trends.

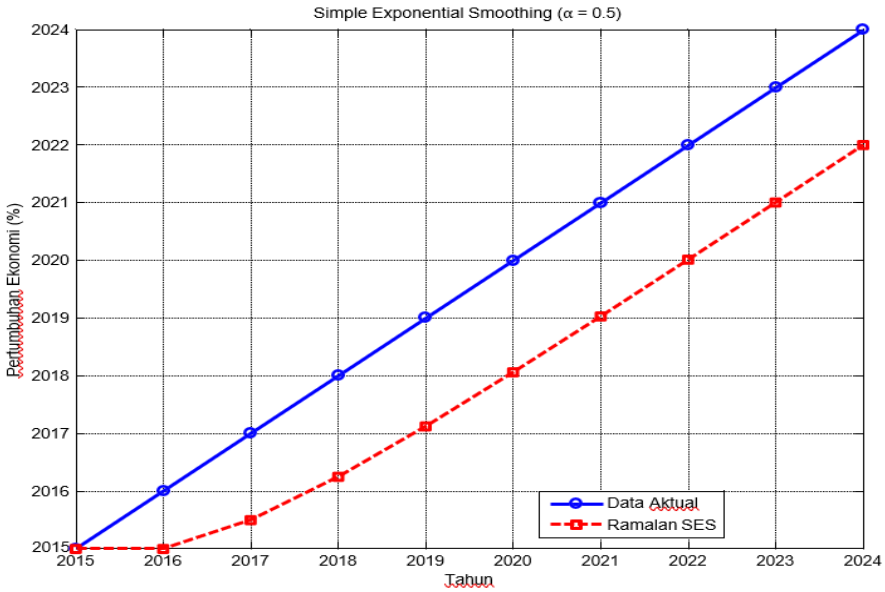

Figure 1. Examples of Images with Good Resolution

The forecasting results using the Simple Exponential Smoothing (SES) method show that economic growth has experienced a stable and gradual upward trend from 2015 to 2024. The resulting pattern is linear with a very small increase each year, reflecting that the economy is in a moderate growth phase without any significant spikes or declines. This is reinforced by the low error value, namely MSE of 3.2610 and MAPE of 0.09%, which indicates that the forecasting model has a very good and reliable level of accuracy. Interpretation of these results shows that in the medium term, economic growth tends to be stable, but not too aggressive. Therefore, the right policy should focus on strengthening the long-term economic foundation, such as increasing the productivity of the real sector, sustainable infrastructure investment, and supporting MSMEs to encourage higher economic growth. In addition, because there is no indication of major volatility in the growth trend, fiscal and monetary strategies can be directed at maintaining price stability, strengthening economic resilience, and anticipating potential global risks that can affect this stable trend. The government can also use this projection to design a long-term budget and development program that is realistic and oriented towards sustainable growth.

D. CONCLUSIONS AND SUGGESTIONS

Based on the results of the analysis using the Simple Exponential Smoothing (SES) method, it was obtained that economic growth from 2015 to 2024 showed a stable trend and increased slowly. The forecast value consistently experienced a small increase from year to year, with an average of 2.0184% and a high level of accuracy (MSE = 3.2610 and MAPE = 0.09%). This shows that the SES method is effective dalam memodelkan dan meramalkan data pertumbuhan ekonomi yang bersifat linier dan tidak fluktuatif.

Given the trend of stable but moderate growth, it is recommended that the government and policy makers focus on efforts to improve the quality of growth, including through increased productivity, sustainable investment, and strengthening domestic economic sectors such as MSMEs and the creative industry. In addition, economic forecasts should be updated periodically with more adaptive methods if there are significant changes in data patterns, so that the policies taken remain relevant and responsive to the dynamics of the developing economy.

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