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EVALUATING THE ACCURACY OF HOLT'S DOUBLE EXPONENTIAL SMOOTHING AND ARIMA IN FORECASTING GROSS REGIONAL DOMESTIC PRODUCT (2025-2029)

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ABSTRACT

Batang Regency has experienced continuous economic growth in recent years, making information on changes in Gross Regional Domestic Product (GRDP) essential for supporting regional development planning. Reliable forecasting methods are needed to provide an overview of future economic conditions based on observed trends. Previous studies have applied either Holt's Double Exponential Smoothing (DES) or Autoregressive Integrated Moving Average (ARIMA) models for economic forecasting; however, comparative evidence regarding the performance of these methods on Batang Regency's GRDP data remains limited. Therefore, this study aims to compare the forecasting performance of both methods and generate GRDP forecasts for the period 2025–2029. This study utilized annual GRDP data at constant prices from 2010 to 2024, which showed an increasing trend and nonstationary characteristics. The analysis procedure included descriptive analysis, stationarity testing using the Augmented Dickey–Fuller (ADF) test, model estimation, and forecast accuracy evaluation using Mean Absolute Percentage Error (MAPE). The ADF test indicated that the series became stationary after first-order differencing, and several ARIMA models were evaluated using the Akaike Information Criterion (AIC), resulting in ARIMA(1,1,1) being selected as the best-performing model. However, in terms of forecasting accuracy, Holt's DES outperformed ARIMA by producing a lower MAPE value of 2.15%, compared to 8.87% for ARIMA(1,1,1). Forecasts generated by both methods indicate that Batang Regency's GRDP is expected to continue increasing during the period 2025–2029. These findings demonstrate that Holt's DES provides more accurate forecasts for the GRDP data used in this study and contribute empirical evidence regarding the comparative performance of classical time series forecasting methods for regional economic planning. The results may serve as a reference for policymakers in formulating more targeted and sustainable development strategies.

Keywords: *ARIMA, Batang regency, Holt's DES, forecasting, Gross Regional Domestic Product.*

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INTRODUCTION

GRDP is a fundamental indicator to measure the economic performance of a region, as it reflects the total value added generated by all economic activities within a specific area (Badan Pusat Statistik, 2025). Besides providing an overview of regional economic growth, GRDP also gives several insights into the structure and contribution of primary, secondary, and tertiary sectors (Ratag et al., 2025). A solid grasp of GRDP dynamics enables policymakers to evaluate regional resources utilization and formulate strategies based on sectoral contributions (Dalimunthe, 2017).

The highlights of Batang Regency's economic structure are the significant role of the manufacturing and agricultural sectors in supporting regional economic growth. The data published by Badan Pusat Statistik (BPS) Indonesia indicates that the manufacturing sector has consistently remained one of the largest contributors to Batang Regency's GRDP (BPS Kabupaten Batang, 2024), while agriculture continues to provide a substantial share of regional value added (Badan Pusat Statistik, 2025). The development of the Batang Integrated Industrial Zone has further strengthened economic growth by attracting large-scale investments and increasing employment opportunities, reinforcing the importance of accurate economic forecasting for regional planning (Kementerian Koordinator Bidang Perekonomian Republik Indonesia, 2024). These conditions reinforce the importance of accurate economic forecasting to support effective regional planning and policymaking.

GRDP forecasting plays a crucial role in regional development planning, as the results inform budgeting, policy formulation, and the efficient allocation of resources (Dalimunthe, 2017). Reliable projections allow local governments to anticipate future economic conditions and design appropriate development strategies. Several studies have demonstrated that time series forecasting methods can provide accurate predictions of regional economic indicators and support evidence-based policymaking (Syaharani, 2023). However, forecasting economic data remains challenging due to annual fluctuations and structural changes, making medium-term forecasts particularly important (Montgomery et al., 2015). In addition, Jansen et al. (2016) in the International Journal of Forecasting emphasize that statistical forecasting models such as ARIMA and exponential smoothing methods remain highly effective for macroeconomic time series such as GDP, and are widely used as benchmark models in economic forecasting studies.

Among time series forecasting techniques, Holt's DES and ARIMA are widely favored for their ability to accurately capture trend patterns in economic data. A study conducted by Syaharani (2023) applied Holt's DES method to forecast GRDP of Jombang regency, resulting in the method which can follow long-term trend patterns well and provide a low error rate, making it suitable for use in regional economic planning analysis. Similar results were reported by Artiyati and Utari (2024), who implemented Holt's DES for forecasting the GRDP of South Tangerang City and demonstrated its suitability for medium-term economic projections. In contrast, Hayati and Agustina (2024) applied the ARIMA model to forecast the GRDP of the mining and quarrying sector in South Kalimantan and showed that ARIMA could model economic time series with satisfactory accuracy. Those results also demonstrate that time series-based forecasting models can provide a fairly accurate picture of a region's economic growth prospects. Wibowo et. al. (2025) compared ARIMA and Holt's DES methods in forecasting gold prices in Indonesia and found that the Holt's DES method produced a lower forecasting error. Likewise, Muzakir and Yahya (2025) reported that forecasting performance depends on the characteristics of the underlying data. These findings indicate that both methods can effectively forecast economic variables; however, their relative performance may vary across different datasets and economic contexts. Empirical studies comparing these methods have reported mixed results, indicating that no single method consistently outperforms the other across different contexts.

Despite extensive research on Holt's DES and ARIMA, comparative studies focusing on regional GRDP forecasting remain limited, particularly at the local level. Most existing studies concentrate on population forecasting or commodity prices, leaving a research gap in evaluating the effectiveness of these methods for forecasting regional economic output. Therefore, a systematic comparison of Holt's DES and ARIMA for forecasting the GRDP of Batang Regency is necessary to determine the most suitable method for medium-term economic forecasting.

This study aims to analyze the historical trend of Batang Regency's GRDP and, to apply ARIMA and Holt's Linear Exponential Smoothing, also commonly referred to Holt's DES methods to forecast GRDP for the period of 2025–2029. Furthermore, this research compares the forecasting accuracy of both methods using appropriate error measures to identify the most reliable model. The findings are expected to provide empirical insights that support regional development planning and contribute to the methodological literature on economic forecasting at the regional level.

MATERIALS AND METHODS

Research Data

The data used in this study are secondary data in the form of GRDP of Batang Regency at constant prices. The data were obtained from official publications of BPS Indonesia of Batang Regency. The data contains annual observations for several years prior to 2025 and used as the basis for model estimation and forecasting. The use of constant-price GRDP data aims to capture real economic growth without being affected by price changes or inflation.

Research Steps

The research was conducted through several systematic steps to ensure a structured forecasting process. First, the GRDP data were collected from official statistical source. Second, the data were explored through descriptive analysis and visualization to identify general patterns. Third, stationarity testing was conducted using the ADF test to examine wether the time series is stationarity was achieved (Hyndman & Athanasopoulos, 2018; Montgomery et al., 2015).

Fourth, two forecasting methods were applied, namely Holt's DES and ARIMA. Holt's DES is suitable for data with trend components and is widely used in economic forecasting due to its simplicity and effectiveness (Hyndman & Athanasopoulos, 2018). ARIMA modeling follows the Box-Jenkins methodology, which includes model identification, parameter estimation, and diagnostic checking (Montgomery et al., 2015).

Fifth, forecast performance was evaluated using MAPE, a commonly used accuracy measure in time series forecasting (Hyndman & Athanasopoulos, 2018). Finally, the model with the lowest MAPE was selected as the best forecasting model, and future GRDP values for 2025-2029 were generated. The overall research workflow is illustrated in Figure 1.

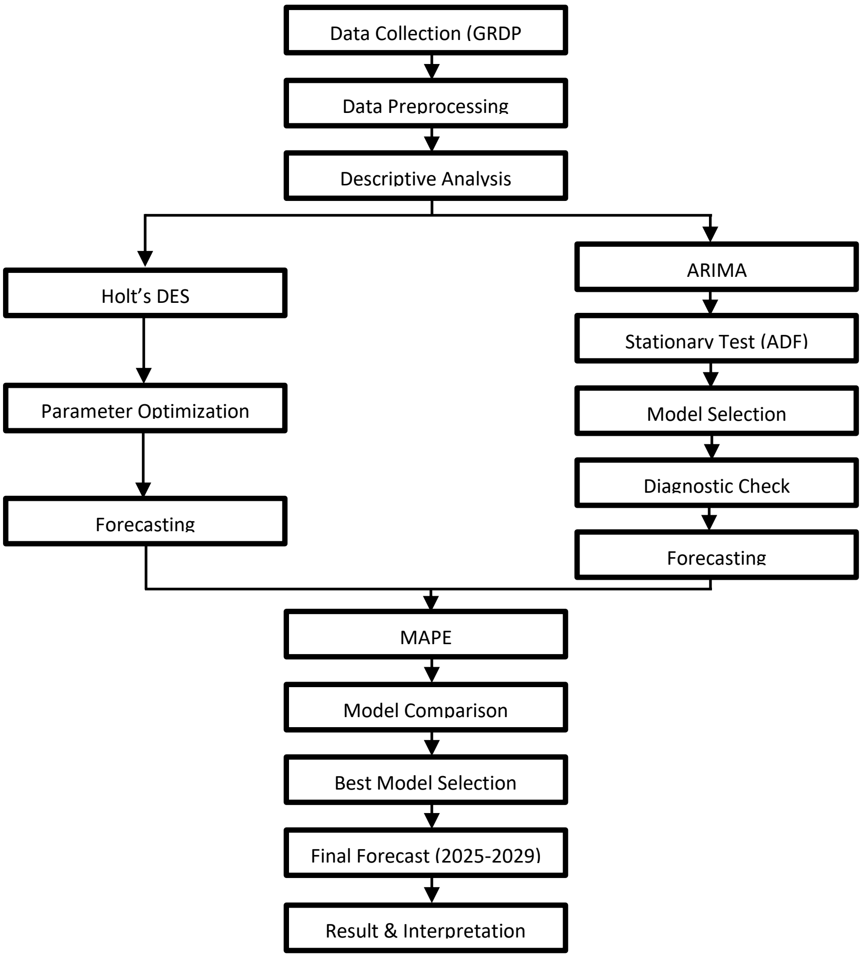

Figure 1. Research Workflow

The research process begins with data collection, followed by preprocessing and exploratory data analysis. Next, stationary testing is conducted to ensure the suitability of time series modeling. After that, two forecasting approaches (Holt's DES and ARIMA) are implemented. The result of both models is then compared using MAPE as the evaluation metric. The model with best performance is selected for final forecasting and interpretation.

Data Analysis

Data Stationary Test

First, the stationarity of the GRDP time series data is examined. It is necessary to ensure the statistical properties of the data, such as mean and variance, remain constant over time. The ADF test is also applied to determine whether the data contains a unit root. If the data are found to be non-stationary, differencing is performed until stationarity is achieved (Khoiri, 2023).

Holt's Double Exponential Smoothing Holt (Holt's DES)

This method is used to forecast GRDP data that exhibits a trend pattern, which estimates two components simultaneously, namely the level and the trend of the data. The smoothing parameters are determined by minimizing forecasting errors. Holt's DES is chosen to be applied due to its simplicity and effectiveness in capturing upward trend movements in a time series data (Hyndman & Athanasopoulos, 2018).

Based on Abdy et al. (2023), the formulas of the Holt's DES method are given as follows:

$$L_t = aY_t + (1-a)(L_{t-1} + T_{t-1}) \tag{1}$$

$$T_t = b(L_t - L_{t-1}) + (1-b)T_{t-1} \tag{2}$$

$$F_{t+m} = L + mT_t \tag{3}$$

where Y_t, L_t, and T_t represent the actual data observed, the level smoothing value, and the trend smoothing value at the period of t, respectively. The parameter a and b denote the level and trend smoothing parameter respectively. Further, F_{t+m} indicates the forecast value for period $t+m$, where m refers to the number of periods ahead to be forecasted. Since the forecasts were generated sequentially from one year to the next, a one-step-ahead forecasting horizon ($m = 1$) was employed in this study. The parameters a and b lie within the interval (0,1). According to Tarigan (2023), variations in parameter values indicate that larger values of a and b enable the model to respond more rapidly to recent changes in the data. In this study, the optimal values of a and b were determined through a trial-and-error procedure by testing several parameter combinations and selecting the combination that produced the lowest MAPE value. The selected parameter combination was subsequently used to generate forecast and evaluate forecasting accuracy.

Autoregressive Integrated Moving Average (ARIMA) Modeling

The ARIMA model is employed as an alternative forecasting method. The modeling process follows the Box-Jenkins procedure, which consists of model identification, parameter estimation, and diagnostic checking. The identification process involves determining the appropriate orders of autoregressive (AR), differencing (I), and moving average (MA) components based on autocorrelation and partial autocorrelation functions. Parameter estimation is conducted to obtain the best-fitting model for the GRDP data.

In general, the ARIMA model is written using the notation ARIMA(p,d,q), where the p denotes the order of the autoregressive component, d represents the degree of differencing required to achieve stationarity, and q indicates the order of the moving average component. In general, the ARIMA model is written using the notation ARIMA(p,d,q), where p denotes the order of the autoregressive component, d represents the degree of differencing required to achieve stationarity, and q indicates the order of the moving average component. The combination of these three components enables the ARIMA model to capture the underlying patterns in time series data, including short-term dependencies and long-term structures (Hyndman & Athanasopoulos, 2018). ARIMA has also been widely applied in economic forecasting because of its ability to model temporal dynamics and produce reliable projections of macroeconomic indicators such as Gross Domestic Product (Jijo, 2025).

In a more comprehensive formulation, the ARIMA(p,d,q) model is commonly expressed as

$$\phi_p(B)(1-B)^d Z_t = \mu' + \theta_q(B)\varepsilon_t \tag{4}$$

While the complete form of the ARIMA(p,d,q) model can be written as follows

$$(1 - \phi_1 B - \phi_2 B^2 - \cdots - \phi_p B^p)(1-B)^d Z_t = \mu + (1 + \theta_1 B + \theta_2 B^2 + \cdots + \theta_q B^q)\varepsilon \tag{5}$$

which explicitly clarifies all of AR and MA components. After the differencing process is performed up to the order of d, let

$$Y_t = (1-B)^d Z_t \tag{6}$$

Then, the ARMA model for Y_t becomes

$$Y_t = \mu + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \cdots + \phi_p Y_{t-p} + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \cdots + \theta_q \varepsilon_{t-q} + \varepsilon_t \tag{7}$$

Forecast Accuracy Evaluation

Both Holt's DES and ARIMA models are used to generate GRDP forecasts for the period of 2025-2029. Forecast performance is evaluated using the MAPE, which is a widely used accuracy measure in forecasting evaluation (Hyndman & Athanasopoulos, 2018). MAPE is defined as:

$$MAPE = \frac{1}{n}\sum_{t=1}^{n}\left|\frac{Y_t - \widehat{Y}_t}{Y_t}\right| \times 100\% \tag{8}$$

where Y_t and $\widehat{Y}_t$ represent the actual and forecasted values at time t and n is the number of observations. The model with the smallest MAPE values is considered the most accurate and reliable.

RESULTS AND DISCUSSION

Descriptive Analysis of GRDP Data

Following the data collection and preprocessing stages described in the research methodology, a descriptive analysis was conducted to identify the characteristics of Batang Regency's GRDP data from 2024 before applying the forecasting models. The time series plot of the GRDP data is presented in Figure 2.

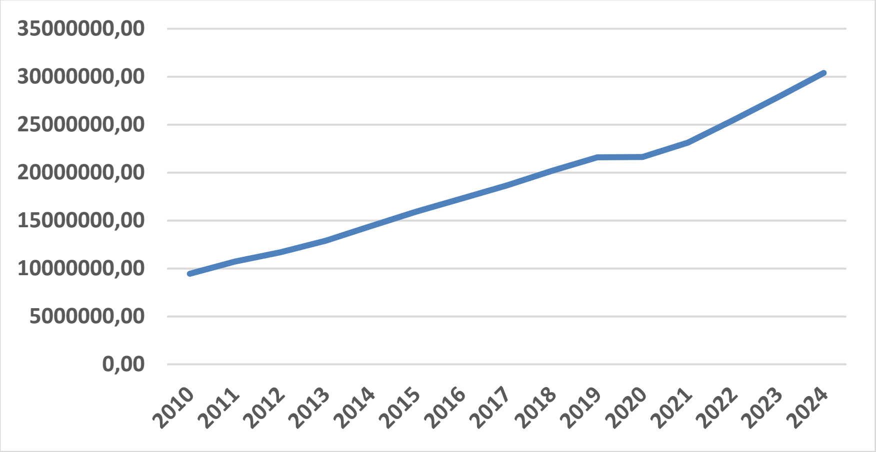

Figure 2. Time Series Plot of GRDP (in IDR) of Batang Regency From 2010 to 2024

Figure 2 shows an increasing trend in Batang Regency's GRDP throughout the observation period. The values increase gradually in the early years and rise more rapidly in the later years. A relatively stable movement is observed around 2019-2020 before the upward trend continues. This pattern indicates that the series is dominated by a trend component without a clear seasonal pattern. Therefore, forecasting approaches capable of capturing trend behavior, namely Holt's DES and ARIMA, were subsequently applied in accordance with the research framework.

Forecasting Result Using Holt's DES

Following the forecasting procedure described in the research methodology, Holt's DES was applied to the GRDP data of Batang Regency. The implementation results for each stage, including parameter optimization, initialization, forecasting, and accuracy evaluation are presented in the following subsections.

1. Parameter Optimization Result (a and b)

   Following the parameter optimization procedure described in the research methodology, several combinations of a and b were evaluated using a trial-and-error approach. A total of 81 parameter combinations were tested, and the combination that produced the lowest MAPE value was selected. The best performance was achieved when $a = 0.9$ and $b = 0.9$, resulting in a MAPE value of 0.57%. This MAPE value was obtained by comparing the fitted values generated by Holt's DES with the actual GRDP observation over the entire historical dataset (2010-2024). Therefore, the parameter combination $a = 0.9$ and $b = 0.9$ was selected for the subsequent forecasting process.

2. Initialization of the Initial Level Value (L_t)
   Following the initialization stage, the initial level value was obtained as $L_1 = 9447328.38$, corresponding to the first GRDP observation in the dataset.
3. Initialization of the Trend Component (T_t)
   Following the initialization stage, the initial trend value was calculated as:
   $$T_1 = \frac{(X_2 - X_1) + (X_4 - X_3)}{2} = 1{,}235{,}515.225$$
   This value represents the estimated initial trend of the GRDP series and was subsequently used in the forecasting process.
4. Forecasting Result for the Training and Testing Periods
   Using the initialized level and trend values together with the optimal smoothing parameters ($a = 0.9$ and $b = 0.9$), the level and trend components were recursively updated for each observation period. The resulting estimates were then used to generate forecast values for both the training and testing datasets. The forecasting results are presented in Table 1.

Table 1. Projected GRDP Values From 2011 to 2024 for Training and Testing Data

Training Data		**Testing Data**	
Year	**GRDP (F_{t+m})**	**Year**	**GRDP (F_{t+m})**
2011	10682843.61	2022	24179898.60
2012	11981015.61	2023	27501748.24
2013	12744448.66	2024	30349453.00
2014	13912057.15		
2015	15800667.32		
2016	17426944.78		
2017	18704593.02		
2018	20041756.38		
2019	21654665.53		
2020	23024738.85		
2021	22057090.59		

Table 1 presents the forecasted GRDP values obtained using Holt's DES for both the training and testing periods. The forecast values show a generally increasing pattern over time, reflecting the upward trend observed in the historical GRDP data. The projected values for testing period (2022-2024) were subsequently used to evaluate forecasting accuracy using MAPE.

5. Forecast Accuracy Evaluation for the testing Period
   The forecasting accuracy of Holt's DES was evaluated using testing data for the period 2022-2024. The actual, forecast, and Absolute Percentage Error (APE) values for each testing observation are presented in Table 2.

Table 2. Actual values, Forecast Values, and APE for the Testing Period (2022-2024) Using Holt' DES

Year	**Actual GRDP**	**Forecast GRDP**	**APE (%)**
2022	25443548.01	24179898.60	4.97
2023	27889549.17	27501748.24	1.39
2024	30389480.09	30349453.00	0.1

Based on the APE values presented in Table 2, the forecasting accuracy was evaluated using Formula (8), which is calculated as $MAPE = 2.15$ %. It indicates that the forecasts generated by Holt's DES are relatively close to the actual GRDP values. According to commonly used forecasting accuracy criteria, a MAPE value below 10% indicates high forecasting accuracy. Therefore, Holt's DES can be considered effective for forecasting the GRDP of Batang Regency's during the testing period.

6. Forecasted GRDP Values for 2025-2029
   Using the optimal smoothing parameters ($a = 0.9$ and $b = 0.9$), future GRDP values were forecasted for the period 2025-2029. The forecasts were generated based on the estimated level and trend components obtained from the historical GRDP data. The forecasting results are presented in Table 3.

Table 3. Projected GRDP Forecast Results of Batang Regency From 2025 to 2029

Year	Forecasted (Million IDR)
2025	32916583.25
2026	35447689.11
2027	37978794.98
2028	40509900.85
2029	43041006.71

As shown in Table 3, the forecasted GRDP values exhibit a continuous upward trend throughout the forecast horizon. The projected GRDP increases from 32916583.25 million IDR in 2025 to 43041006.71 million IDR in 2029, indicating sustained economic growth in Batang Regency according to the Holt's DES model.

To provide a clearer visualization of historical forecasted GRDP values, the forecasting results are presented graphically in Figure 3.

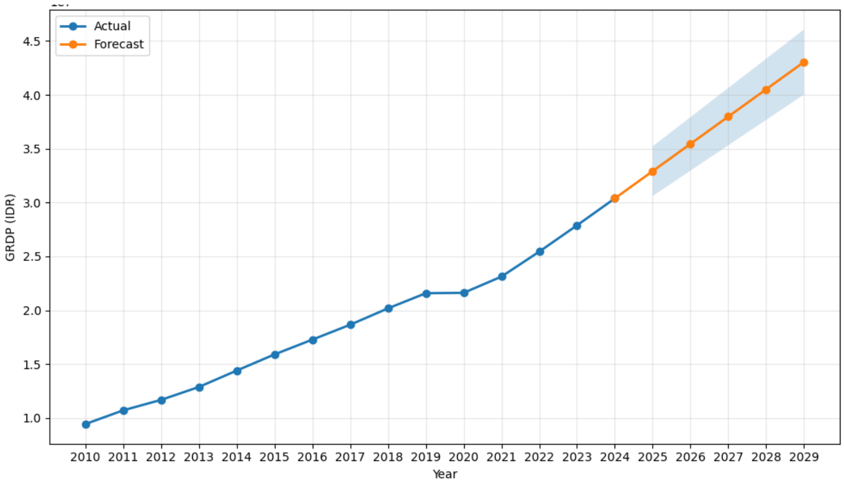

Figure 3. GRDP Actual and Forecast Data (in million IDR) Using Holt's DES

Figure 3 illustrates the historical GRDP values from 2010 to 2024 and the forecasted values for 2025-2029 obtained using Holt's DES. The forecast line continues the upward trend observed in the historical data, indicating that the model successfully captures the long-term growth pattern of Batang Regency's economy. This finding consistent with the forecasting accuracy obtained during the testing period, where the model achieved a MAPE value of 2.15 %.

Forecasting Result Using ARIMA

In this study, the ADF test was applied to Batang Regency's GRDP data (2010-2024) to check the stationarity. The null hypothesis (H_0) assumes the data is nonstationary, while the alternative (H_1) assumes it is stationary. Using a 5% significance level, H_0 is rejected if the p-value < 0.05, indicating the data is stationary, otherwise, the data is nonstationary and requires differencing. Thus, the ADF test results are presented in the following table

Table 4. ADF Test Results

Data	*p*-value	Description
Before differencing	0.99872	Non-stationary
Differencing 1	0.00002	Stationary

Based on the Table 4, the GRDP data before differencing produced a *p-value* of 0.99872 (> 0.05), indicating that the series was non-stationary. After applying first-order differencing, the *p-value* decreased to 0.00002 (< 0.05), indicating that the transformed series had become stationary.

Since stationarity was achieved after the first differencing process, additional differencing was not required. In ARIMA modeling, the differencing order is generally selected as the minimum transformation needed to achieve stationarity in order to preserve the original information contained in the data and avoid over-differencing.

After obtaining stationary data, the next step was identifying the appropriate ARIMA model. Several candidate models were estimated and compared using the AIC, where a lower AIC value indicates a better balance between model fit and model complexity. The candidate models and their corresponding AIC values are shown in Table 5.

Table 5. Model and Resulting AIC Score

Model	**AIC Score**
ARIMA(0,1,0)	442.014
ARIMA(0,1,1)	439.815
ARIMA(0,1,2)	442.226
ARIMA(1,1,0)	459.470
ARIMA(1,1,1)	420.122
ARIMA(1,1,2)	423.581
ARIMA(2,1,0)	452.900
ARIMA(2,1,1)	421.881
ARIMA(2,1,2)	425.434

Based on the AIC comparison, ARIMA(1,1,1) was selected as the best model because it produced the lowest AIC value among all candidate models. After selecting the optimal model, diagnostic checking was conducted to evaluate whether the residuals satisfied the white noise assumption. The residual series of ARIMA(1,1,1) fluctuated randomly around zero without a clear systematic pattern. In addition, the Ljung–Box test produced a p-value of 0.09 (>0.05), indicating that there was no significant autocorrelation remaining in the residuals. This result was also supported by the residual ACF plot, where all autocorrelation coefficients remained within the significance bounds. Therefore, the residuals can be considered to satisfy the white noise assumption, indicating that ARIMA(1,1,1) adequately captured the temporal structure of the GRDP data and is appropriate for forecasting.

Before forecasting, the GRDP data were divided into training and testing sets. Approximately 80% of the observations (2010-2021) were used as training to fit the ARIMA model, while the remaining 20% (2022-2024) were reserved as testing data to evaluate forecasting performance. Model accuracy was assessed using MAPE. The data partition used in this study is presented in Table 6.

Table 6. Training and Testing Data for ARIMA$(\mathbf{0},\mathbf{4},\mathbf{2})$

Training Data		**Testing Data**	
Year	**GRDP**	**Year**	**GRDP**
2010	9447328.38	2022	25443548.01
2011	10719485.00	2023	27889549.17
2012	11687587.71	2024	30389480.09
2013	12886461.55		
2014	14408439.19		
2015	15908510.08		
2016	17279827.39		
2017	18661966.98		
2018	20180576.47		
2019	21585719.48		
2020	21621362.81		
2021	23125755.99		

After fitting the ARIMA(1,1,1) model to the training data, forecasts were generated for the testing period. The forecasted values are presented in Table 7 to allow comparison between the forecast model and the actual testing data.

Table 7. Actual Values, Forecast Values, and APE for the Testing Period (2022-2024) Using ARIMA(1,1,1)

Year	**Actual GRDP**	**Forecasted GRDP**	**APE(5)**
2022	2544354801	24704071	4.67
2023	2788954917	26406912	9.04
2024	3038948009	28284882	12.91

Based on the APE values presented in Table 7, the forecasting accuracy of the ARIMA(1,1,1) model was evaluated using Mean Absolute Percentage Error (MAPE), which was calculated as 8.87%. According to commonly used forecasting accuracy criteria, a MAPE value below 10% indicates high forecasting accuracy. Therefore, the ARIMA(1,1,1) model can be considered effective for forecasting Batang Regency's GRDP during the testing period.

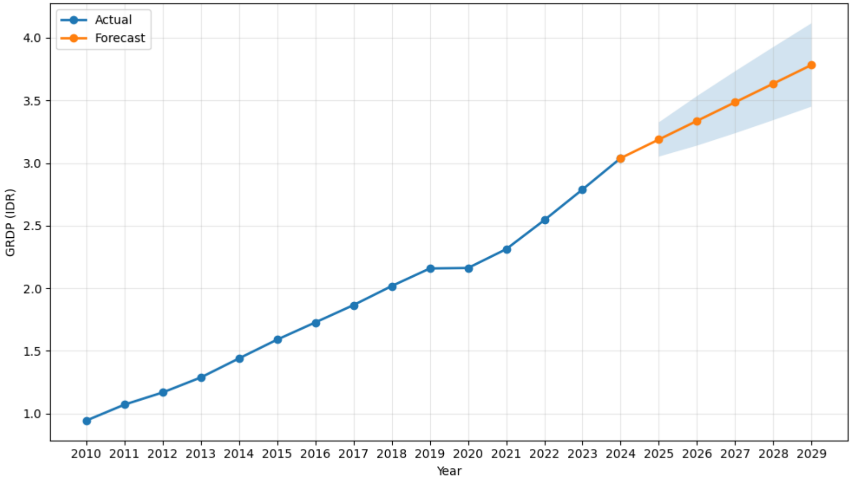

Figure 4. GRDP Actual and Forecast Data (in IDR) From 2010 to 2029 Using ARIMA(1,1,1)

Figure 4 illustrates the comparison between the actual and forecasted GRDP values. Overall, the forecasted values follow the historical upward trend reasonably well, indicating that the ARIMA(1,1,1) model is able to capture the short-term movement of the data. Although slight differences between the predicted and actual values are observed during the testing period, the obtained MAPE value of 8.87% indicates that the model provides good forecasting accuracy.

Since this study also employs Holt's DES as an alternative forecasting approach, a comparative evaluation between both methods is conducted based on forecasting accuracy. The comparison results are presented in the following discussion to determine the most appropriate model for forecasting Batang Regency's GRDP.

Comparison of Forecasting Models

To evaluate the forecasting performance of the two methods, namely Holt's DES and ARIMA, a comparison was conducted using MAPE as the accuracy measure. MAPE is used to assess the predictive accuracy of each model, where a lower value indicates better forecasting performance. The comparison result is presented in Table 8

Table 8. Comparison of Forecasting Accuracy

Model	MAPE
Holt's DES	2.15%
ARIMA	8.87%

The results indicate that Holt's DES produced a lower MAPE value than the ARIMA(1,1,1) model, suggesting better forecasting accuracy for Batang Regency's GRDP data. This result implies that the GRDP series can be modeled more effectively using an exponential smoothing approach that directly captures the trend component of the data. Although the ARIMA(1,1,1) model also achieved good forecasting performance, as indicated by a MAPE value below 10%, its accuracy was lower than that of Holt's DES. This may indicate that the upward movement of the GRDP series is more appropriately represented through smoothing-based forecasting rather than autoregressive modeling. Therefore, based on forecasting accuracy, Holt's DES was identified as the more suitable method for forecasting Batang Regency's GRDP for the period 2025–2029.

Final Model Selection

Based on the forecasting accuracy comparison, Holt's DES method is selected as the best-performing model for GRDP forecasting in Batang Regency, as it yields the lowest MAPE value (2.15%). Therefore, Holt's DES method is considered more suitable for short-term GRDP prediction in this study.

CONCLUSION

Based on the forecasting results, both Holt's DES and ARIMA methods could model the GRDP trend of Batang Regency. However, the comparison of forecasting accuracy shows that Holt's DES outperforms the ARIMA model, with a lower MAPE values of 2.15% compared to 8.87% for ARIMA(1,1,1). This indicates that Holt's DES provides more accurate short-term forecasting for GRDP data. These results indicate that Holt's DES provides more accurate short-term forecasting performance for Batang Regency's GRDP data. The findings suggest that the exponential smoothing approach is more suitable for capturing the trend characteristics of the GRDP series in this study than the ARIMA approach. Although ARIMA(1,1,1) also demonstrated good forecasting performance, Holt's DES achieved higher predictive accuracy and produced forecasts that more closely followed the observed data pattern.

This study contributes to the empirical comparison of time series forecasting methods, specifically Holt's DES and ARIMA, in modeling regional economic data. The findings highlight that simpler smoothing-based models can outperform more complex stochastic models when dealing with strongly trending and limited-size dataset.

REFERENCES

Abdy, M., Irwan, & Lukman, F. (2023). Penggunaan Metode Double Exponential Smoothing dalam Meramalkan Indeks Harga Konsumen (IHK) di Kota Makassar. *Journal of Mathematics: Theory and Applications*, *5*(2), 61–66. https://doi.org/10.31605/jomta.v5i2.2874

Artiyati, N., & Utari, D. T. (2024). Implementasi Metode Double Exponential Smoothing Dalam Peramalan Nilai PDRB Kota Tangerang Selatan Tahun 2023-2027. *Emerging Statistics and Data Science Journal*, *2*(1), 77–84.

Badan Pusat Statistik. (2025). *Produk Domestik Regional Bruto Provinsi-Provinsi di Indonesia Menurut Lapangan Usaha (2020-2024)*.

BPS Kabupaten Batang. (2024). *Lembar Fakta PDRB Lapangan Usaha Kabupaten Batang 2024*.

Dalimunthe, D. Y. (2017). Analisis Peramalan Data Produk Domestik Regional Bruto (PDRB) Sebagai Tolak Ukur Kinerja Perekonomian Provinsi Kepulauan Bangka Belitung. *Journal of Business and Economics (IJBE)*, *1*(1), 19–27.

Hayati, L. A., & Agustina, N. (2024). *Aplikasi Model ARIMA dalam Peramalan Produk Domestik Regional Bruto (PDRB) Pertambangan dan Penggalian Kalimantan Selatan (Application of ARIMA Model in Forecasting Gross Regional Domestic Product (GRDP) Mining and Quarrying in South Kalimantan)*.

Hyndman, R. J., & Athanasopoulos, George. (2018). *Forecasting: principles and practice* (3rd ed.). OTexts.

Jansen, W. J., Jin, X., & de Winter, J. M. (2016). Forecasting and nowcasting real GDP: Comparing statistical models and subjective forecasts. *International Journal of Forecasting*, *32*(2), 411–436. https://doi.org/10.1016/j.ijforecast.2015.05.008

Jijo, J. J. (2025). Modelling and Forecasting the GDP of G7 Countries Using Arima Model. *Asian Journal of Economics, Business and Accounting*, *25*(3), 295–315. https://doi.org/10.9734/ajeba/2025/v25i31711

Kementerian Koordinator Bidang Perekonomian Republik Indonesia. (2024). *Mengusung Konsep The Smart & Sustainable Industrial Estate, Kawasan Industri Terpadu Batang Menjadi Garda Terdepan Investasi Sektor Industri*. www.ekon.go.id

Khoiri, H. A. (2023). *Analisis Deret Waktu Univariat (Teori dan Pengolahan Data)* (C. P. Hendrastati, Ed.; 1st ed.). UNIPMA Press.

Montgomery, D. C., Jennings, C. L., & Kulahci, M. (2015). *Introduction to Time Series Analysis and Forecasting* (2nd ed.). Wiley.

Muzakir, N. A., & Yahya, Muh. Z. (2025). Analisis Perbandingan Model Double Exponential Smoothing dan ARIMA untuk Prediksi Harga Beras di Indonesia. *VARIANSI: Journal of Statistics and Its Application on Teaching and Research*, *7*(1), 7–20. https://doi.org/10.35580/variansiunm349

Ratag, O. S. I., Rotinsulu, T. O., & Maramis, M. Th. B. (2025). Analisis Potensi dan Daya Saing Perekonomian Kota Kotamobagu Periode 2019-2023. *Jurnal Berkala Ilmiah Efisiensi*, *25*(2), 41–46.

Syaharani, M. N. (2023). Peramalan PDRB Kabupaten Jombang pada Periode Mendatang Menggunakan Metode Double Exponential Smoothing. In *Universitas Negeri Malang* (Vol. 8).

Tarigan, V. (2023). Penerapan Metode Double Exponential Smoothing Untuk Memperediksi Jumlah Penjualan Springbed di PT. Masindo Karya Prima. *Jurnal Informasi Polinema*.

Wibowo, A. Z. A., Pratama, B. P., Aulia, M., & Kartiasih, F. (2025). Perbandingan Model ARIMA dan Holt’s Double Exponential Smoothing Untuk Peramalan Harga Emas Indonesia 2025. *Journal of Mathematics: Theory and Applications*, *7*(2), 68–84. https://doi.org/10.31605/jomta.v7i2.4934