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Forecasting Inflation Movements in East Java Province Using the Auto-Regressive Integrated Moving Average (ARIMA) Approach

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ABSTRACT

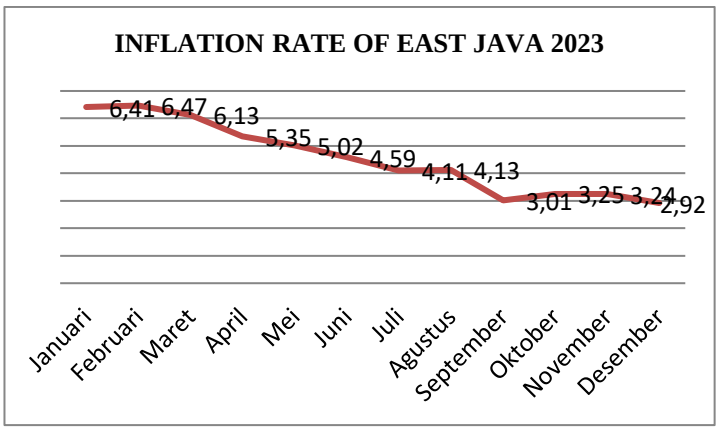
East Java is the province with the largest population in Indonesia. In addition, East Java's economic growth rate is the highest on the island of Java. The economic growth needs to be supported by other economic indicators. One of the most important macroeconomic indicators is inflation. This study discusses the inflation forecasting for East Java towards the end of 2024. Financial forecasting is crucial as it serves as the basis for government decision-making. The forecasting technique used in this study is ARIMA. The tests indicated that inflation in East Java will decrease towards the end of the year. In December, East Java will experience deflation of -1.75%. Meanwhile, in January and February 2025, the inflation rates were -2.07 and -2.39, respectively. Therefore, the East Java government must implement policies to anticipate this situation.

INTRODUCTION

Forecasting on the economic condition of a country is essential. These are necessary for formulating policies to be implemented, thereby assisting the government in maintaining financial stability in the future. Inflation is a key economic indicator alongside economic growth (Prasasti & Slamet, 2020). Inflation serves as a benchmark for the economic condition of a country. It reflects the public's ability to meet their needs and is a key consideration for investors in making investment decisions (Marpaung et al., 2022). Accurate inflation forecasting is critical at both national and regional levels. Indonesia has a vast territory and a large population, which leads to varying inflation conditions in different regions.

One of Indonesia's provinces requiring in-depth inflation monitoring is East Java, one of the most populous regions, which has made significant economic contributions. Known for its diverse economic base, including agriculture, manufacturing, and services, East Java plays a key role in the national economic performance. However, like many other provinces, East Java faces price fluctuations,

supply chain disruptions, and regional disparities that may affect inflation rates differently from national trends. This underscores the importance of using advanced statistical methods to forecast inflation accurately and provide insights that policymakers can act upon.



Source: Data processed using Eviews, 2024

Figure 1: Inflation Movement in East Java 2023

Inflation movements in East Java during 2023 remained under control. At the beginning of the year, inflation spiked to a relatively high level of 6.41%. However, inflation in East Java continued to decline by the end of the year. Low inflation supports economic stability in a region. The movement of inflation is a significant concern for the government as policymakers, enabling them to make informed decisions in the future amidst various possible scenarios.

The ARIMA model is one of the most widely used statistical techniques in time series forecasting, including inflation forecasting. It is highly effective in analyzing univariate time series data, such as monthly or quarterly inflation rates, by capturing past values and errors to predict future trends (Marpaung et al., 2022). The ARIMA model can be adapted to address specific characteristics of inflation data in a region, such as trends, seasonality, and cyclical patterns, making it an ideal tool for forecasting inflation in East Java.

This paper explores the application of the ARIMA technique to forecast inflation rates in East Java, providing insights into the potential benefits and challenges of using this model for regional economic forecasting. Using historical inflation data from the region, we aim to develop a reliable forecasting model to help local policymakers and business actors better anticipate future inflationary pressures. Through this study, we seek to contribute to developing research on regional inflation forecasting in Indonesia and demonstrate the practical utility of the ARIMA model in addressing local economic challenges.

LITERATURE REVIEW

Inflation is a key concept in economics. The inflation rate refers to the percentage change in the average price level of goods and services in an economy over a specific period, typically one year (Prayogi, 2022). Various theories and models are used to explain Inflation, as this phenomenon is highly complex and influenced by various factors. Below is an in-depth explanation of the theories of Inflation.

Structural Inflation occurs due to changes in a country's economic structure, such as changes in the labour market, technological advancements, or demographic shifts (Christianingrum & Syafri, 2019). For example, an ageing population or increasing demand for healthcare services can lead to long-term inflationary pressures in specific sectors. In developing countries like Indonesia, structural changes such as urbanization and industrialization can contribute to sectoral Inflation (Ayuningtyas, 2019).

Structural inflation models are based on economic theories and attempt to model the underlying causes of Inflation, such as monetary policy, fiscal policy, and supply-side factors (Christianingrum & Syafri, 2019). These models often use simultaneous equations to capture the relationship between Inflation and other macroeconomic variables (e.g., interest rates, unemployment, money supply). One popular example is the Phillips Curve, which shows an inverse relationship between Inflation and unemployment, although this relationship has been questioned in the context of stagflation (Rugman, 1996). Structural models are helpful for long-term forecasting because they consider broader economic factors that influence Inflation (Kondo Lembang, 2017). However, these models are more complex and require detailed data on many variables, making them less flexible for short-term forecasting than time series models like ARIMA (Nurjannah, 2024).

Demand-pull Inflation occurs when aggregate demand in the economy exceeds aggregate supply. This situation usually arises during periods of rapid economic growth, where consumer spending, business investment, and government expenditure increase, pushing prices upward (Prasasti & Slamet, 2020). Economists argue that Inflation can be managed by controlling demand-side factors, such as reducing public spending or raising interest rates to curb borrowing (Salim, Fadilla, and Purnamasari, 2021). Cost-Push Inflation occurs when production costs rise, causing businesses to increase the prices of goods and services. This type of Inflation can be caused by wage increases, rising raw material costs, or supply chain disruptions (Prayogi, 2022). A historical example of cost-push Inflation includes oil price shocks, which caused significant increases in production costs across various industries, driving Inflation.

Forecasting Inflation in developing countries like Indonesia can be very challenging due to factors such as volatile commodity prices, political instability, and rapid structural changes in the economy (Hartati, 2017). However, studies have shown

that the ARIMA model remains highly effective in forecasting Inflation in these regions. For example, a study by Rachman et al. (2023) that applied ARIMA to forecast Inflation in Indonesia found that this model provided reliable predictions, particularly for short-term forecasting, despite the complex economic environment in the country.

In the case of East Java, regional Inflation is influenced by local and national factors. Economic activities such as agriculture, manufacturing, regional government policies, and broader national trends such as fuel price adjustments and food price fluctuations all contribute to inflationary pressures. Local studies using ARIMA have shown that this model is effective in capturing the dynamics of regional Inflation, especially when considering seasonal factors and local economic shocks (Marpaung et al., 2022)

METHOD

This study is a quantitative research. The data used in this study is secondary data obtained from Badan Pusat Statistik (BPS). The population and sample in this study are the monthly inflation rates in Indonesia from 2022 to 2024, totalling 34 observations. The data analysis model employed in this study is the Auto-Regressive Integrated Moving Average (ARIMA) model. The testing was conducted with the help of the EViews 12 program. ARIMA is a statistical model commonly used for time series forecasting. This model is very effective for univariate time series data, where the main goal is to predict future values based on past observations. With the ARIMA model, it is expected to provide accurate forecasting.

ARIMA combines three main components to capture various patterns in the data and generate accurate forecasts. This is because the data used in the ARIMA method consists of historical data using a time series approach. The ARIMA method is used for short-term predictions. This is because its accuracy tends to decrease when used for long-term predictions. The predictions obtained for long-term periods tend to be constant, whereas for short-term predictions, the accuracy of the forecasted values is generally higher. An assumption used in this model is that the time series data generated is stationary. This means that the mean and variance of the data are constant. However, in reality, many time series data are non-stationary. If the mean of the generated data is non-stationary, differencing is applied, and if the variance is non-stationary, a transformation is performed.

ARIMA is a forecasting method that uses time series data through regression. The components of ARIMA are divided into three components. Autoregressive (AR) is a form of regression, but instead of linking independent variables, it connects the previous values of the time series at various time lags. In other words, an Autoregressive model will predict a value as a function of the previous values of a specific time series. The Moving Average (MA) is obtained by summing and averaging

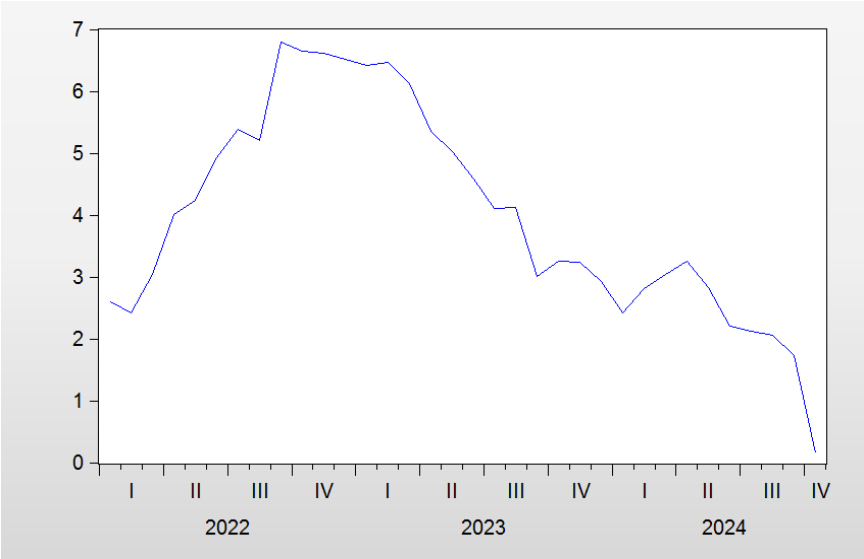
the values over a specified number of periods, then eliminating the oldest value and adding a new value.

The Autoregressive Moving Average (ARMA) model combines AR and MA models. The general form of the ARMA model is (p, q), where *p* is the order of the AR component and *q* is the order of the MA component. The Autoregressive Integrated Moving Average (ARIMA) model combines the AR, MA, and differencing (denoted by *d*) processes. Therefore, the general form of the ARIMA model is (p, d, q), where *p* is the order of the AR component, *d* is the degree of differencing, and *q* is the order of the MA component.

RESULT AND DISCUSSION

Result

Inflation is an economic indicator that reflects a country's or region's economic condition.The movement of inflation from month to month is of particular concern to the government as policymakers. In addition, inflation also affects investment levels, consumer spending, unemployment, and various other macroeconomic variables. The inflation data consists of monthly inflation data from January 2022 to October 2024. The data was processed using Eviews. The inflation movement from January 2022 to October 2024 is shown as follows:



Source: Data processed using Eviews, 2024

Figure 2: Inflation Movement East Java 2022-2024

Inflation in East Java experienced significant fluctuations in 2022. In 2023, East Java's inflation tended to decline significantly. The inflation trend 2024 continued to decrease in line with national inflation trends. The inflation data was tested for stationarity before proceeding to the ARIMA estimation stage. The testing using

ARIMA begins with a stationarity test. This is aimed at determining whether the data is stationary or not. The selection of the best model also plays a significant role in forecasting accuracy. The stationarity test used was the Dickey-Fuller test. The data at the level was non-stationary, so testing was continued using first differencing and second differencing. The results of the Dickey-Fuller test using second differencing are as follows:

Table 1: Dicky Fuller test

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.185223	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

Source: Data processed using Eviews, 2024

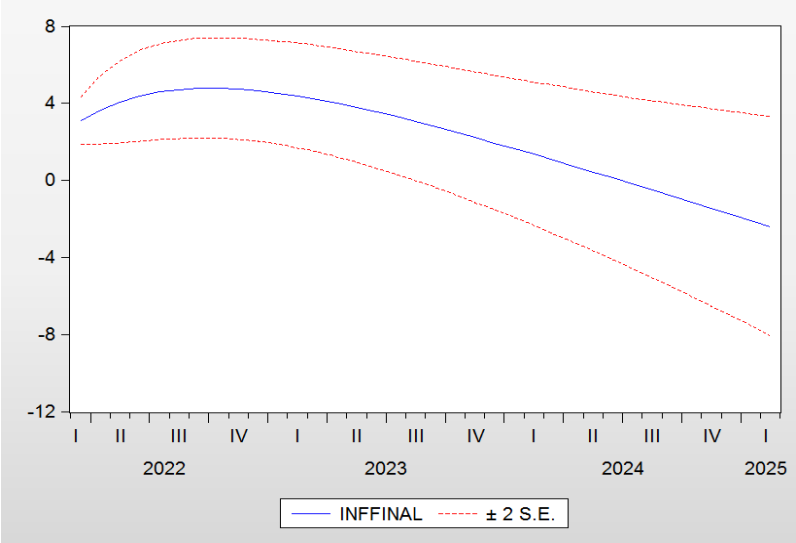
Estimation can be done using various combinations of possible models. Different model combinations can be obtained from observations and various clinical comparisons. For example, combining AR(1) with MA(1) at the second difference level. The correlogram observation shows which combinations need to be tested. The test results are tabulated to present the most suitable outcomes. The data that passed the stationarity test was then used for estimation using the ARIMA (1,2,1) model with the observation of the correlogram to identify the best model from the estimation.

Table 2: Estimation

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.321787	0.133112	-2.417419	0.0221
AR(1)	0.850043	0.090974	9.343793	0.0000
MA(1)	-0.919273	0.120769	-7.611859	0.0000

Source: Data processed using Eviews, 2024

After the estimation test, the results are followed by a residual test. This is necessary to determine whether the model is genuinely appropriate. The residual test shows whether any residuals are statistically significant. If the residual test is passed, the process can proceed to the next stage, which is forecasting. The forecasting stage begins by extending the data range according to the number of months to be estimated. This study's estimation is for the next four months so that the range will include additional observations. The estimation was followed by forecasting inflation data for East Java. The following is the inflation projection graph for the end of 2024 to early 2025:



Source: Data processed using Eviews, 2024

Figure 3: Inflation Forecasting Graph

Estimation using ARIMA is carried out through the forecasting stage, which is then presented in a forecasting graph with forecast values approximately 2.5 above and below the estimated values. The accuracy of the estimation is also influenced by the appropriateness of the testing stages and the accuracy of model selection. The estimation results are presented in a table based on the number of months to be estimated. The forecasting results using the ARIMA (1,2,1) model are as follows:

Table 3: Inflation Forecasting Results with ARIMA

Month	Inflation
2024 Dec	-1.757916
2025 Jan	-2.075641
2025 Feb	-2.393975

Source: Data processed using Eviews, 2024

The forecasting results above indicate that in December 2024, East Java Province will experience a deflation of 1.75%. This trend will continue until the transition into 2025. Meanwhile, in January 2025, the deflation rate in East Java is 2.07%, increasing to 2.39% in February. This trend aligns with the national inflation trend, which has experienced deflation for six consecutive months. Deflation is the decrease in the prices of goods and services in a region. This phenomenon occurs due to reduced money supply, which decreases the public's purchasing power. Generally, deflation occurs due to the reduced circulation of money in the economy, as a large portion of money is held in banks. Additionally, reduced demand for goods and services, even though production remains high, also contributes to this condition.

People may be reluctant to buy goods and services due to boredom or spending restrictions. Economic activity slowdown also plays a role in deflation.

In contrast, inflation is a condition in which the prices of goods and services continuously rise over a period. Inflation occurs when the value of money decreases due to an increase in the money supply, causing prices of goods and services to rise. The most significant impacts of deflation are increased unemployment, slowed economic growth, and a decline in public welfare. To address deflation, people should focus on spending on basic needs, seek additional income from side jobs, and avoid high-interest debt.

Discussion

Economic growth represents the expansion of the production output of a country or region within a specific period. Sustained economic growth can bring benefits such as increased employment, higher per capita income, and more significant investment opportunities. However, economic growth can also pose challenges, particularly regarding the fair distribution of wealth and environmental impacts (Ayuningtyas, 2019). It is important to understand that inflation and economic growth are interconnected in the context of the global economy (Djawoto, 2017). An increase in economic growth can often trigger inflation due to higher demand outstripping supply, while policies aimed at controlling inflation may sometimes affect the economic growth rate (Nawawi, 2017).

Forecasting results indicate a downward trend in inflation in East Java in 2024. This is consistent with the national inflation trend, which has experienced deflation for six consecutive months. Deflation is the decline in a region's goods and services prices. This phenomenon occurs due to a reduced money supply and decreasing public purchasing power. In general, deflation happens because the circulation of money in society is reduced, as a large amount of money is stored in banks. Despite high production levels, a decline in demand for goods and services also contributes to this situation. People may be reluctant to purchase goods and services due to boredom or spending restrictions. A slowdown in economic activity also plays a role in deflation. In contrast, inflation is when the prices of goods and services increase continuously over a certain period. Inflation occurs when the currency's value decreases due to increased money supply in circulation (Prayogi, 2022). This is what causes the prices of goods and services to rise.

Inflation can be described as a continuous and widespread increase in the general price level. In this context, an increase in the price of one or two items alone cannot be classified as inflation. However, when this price rise spreads and causes other goods to rise, it can be considered inflation. For developing countries, inflation represents a serious issue because its effects on the economy are profound. It becomes a common economic problem that can lead to a decrease in citizens' real income. Inflation

can negatively affect a country's macroeconomic stability if it persists over time. From this, it is clear that inflation plays a crucial role in maintaining economic stability.

Inflation forecasting is crucial for policymakers, especially in regions like East Java, where local economic dynamics can cause significant deviations from national trends. The ARIMA model has proven to be a valuable and versatile tool for time series forecasting, offering a simple yet effective approach to predicting inflation. By examining key factors driving inflation and applying a robust statistical model, this paper aims to contribute to a better understanding of inflation trends in East Java and enhance the effectiveness of regional economic policies.

CONCLUSSION

Based on the ARIMA model forecasting results, East Java's inflation is predicted to experience deflation in December 2024. Additionally, the forecast for early 2025 also indicates deflation. This suggests a general decline in the region's goods and services prices. Deflation can negatively impact the economy, such as a decrease in public purchasing power and the potential for economic stagnation. Therefore, the government must take prompt and appropriate policy measures to address this issue. Some policies that could be considered include stimulating the economy through increased public spending, adjusting monetary policy, and providing incentives to affected sectors. With these measures, deflation can be controlled, and the economy of East Java can continue to grow steadily. The limitations of this study include the relatively small number of observations. Therefore, a suggestion for future research is to increase the number of observations to provide better forecasting.

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