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Prediction of the Number of UMKM in Tangerang Regency Using the Moving Average Method: A Business Intelligence Approach

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Abstract**—** *Accurate MSME prediction plays a critical role in data-driven planning, especially when supported by Business Intelligence (BI) tools. Micro, Small, and Medium Enterprises (MSMEs) are vital to the economic growth of Tangerang Regency, Indonesia, requiring accurate forecasting tools for strategic planning. This study applies the Simple Moving Average (SMA) method with a 3-year window to forecast MSME numbers using historical data from 2018 to 2023. The model predicts approximately 37,616 MSMEs in 2024. Despite its simplicity, the SMA method yielded a high Mean Absolute Error (MAE) of 23,030 and Mean Squared Error (MSE) of 627 million due to sharp growth spikes, particularly in 2023. To improve accessibility and interpretability, the forecast results were visualized using Power BI dashboards. These included trend graphs, KPI metrics (MAE and MSE), and year-on-year comparisons to support transparent decision-making. While SMA is suitable for short-term and stable trends, it lacks responsiveness to volatility. Future research should consider advanced models such as ARIMA or machine learning for better accuracy. This study demonstrates the synergy of statistical forecasting and Business Intelligence (BI) tools in guiding regional MSME policy.*

Keywords**—** *MSME prediction, Business Intelligence, Moving Average.*

I. INTRODUCTION

1. Background

Micro, Small, and Medium Enterprises (MSMEs) play a pivotal role in the economic growth of Tangerang Regency, contributing significantly to job creation and community welfare. In recent years, research has increasingly emphasized the integration of BI frameworks with forecasting and operational planning tools in SMEs. According to [1], BI empowers SMEs to enhance competitiveness by converting raw data into actionable insights, particularly through predictive analytics and performance dashboards.[2]proposed the strategic integration of Big Data Analytics and BI to increase resilience in SME supply chains, highlighting the bene[3]fits of BI in mitigating disruptions and improving efficiency. Similarly, [4]demonstrated that BI combined with organizational learning can significantly boost SME innovation and customer responsiveness . However, the lack of accurate predictive tools for MSME growth hinders strategic planning by local governments and stakeholders. This study addresses this gap by implementing the Moving Average method integrated with Business Intelligence (BI) to forecast MSME numbers, leveraging historical data from 2018–2024 obtained from the Tangerang Regency Cooperative and SME Office. Prior research has applied Moving Average for time-series predictions, such as consumer price indices[5]and unemployment rates. [6]developed a dashboard using Microsoft Power BI to assist in decision-making for Micro and Small Enterprises (UMK) in Indonesia. The dashboard visualizes various metrics, including the number of businesses, workers, income, and expenditure. Although the study doesn't incorporate Moving Average forecasting, it demonstrates the application of BI tools in the MSME context. [7]analyzed the role of MSME growth in reducing unemployment amidst high poverty levels in Indonesia.

II. LITERATUR RIVIEW

2.1 MSME Prediction

The prediction of Micro, Small, and Medium Enterprises (MSMEs) is essential for regional economic planning and decision-making. Accurate forecasting can guide resource allocation, policy formulation, and entrepreneurial development. [8]proposed a *Simple Seasonal Time Series Analysis* model to forecast Indian MSME growth for 2020, highlighting the importance of basic time-series forecasting in resource-limited regions. The study demonstrated how even simple seasonal models can reveal macroeconomic trends and support development planning. [9]applied the *Single Moving Average (SMA)* and *Single Exponential Smoothing* methods to forecast pharmaceutical demand in Jombang Regency. Although the context was medical inventory, their approach provided valuable insight into the use of SMA in short-term planning with minimal error, confirming the method's relevance for forecasting with limited data and stable trends. [3]demonstrated the role of Business Intelligence (BI) using Power BI dashboards to support MSME data visualization in Jember Regency. Their findings confirmed that visual analytics enhanced decision-making accuracy and MSME productivity evaluation In addition, [10]employed SMA for forecasting the Consumer Price Index in West Java, illustrating that even a 3-period SMA can yield low MAPE values, making it suitable for datasets with upward trends. [11]conducted a bibliometric review of BI integration in organizational decision-making. They emphasized the underutilization of BI in strategic sectors such as MSMEs, and called for increased adoption of BI tools to support forecasting and planning.

2.2 Business Intelligence

Business Intelligence (BI) has become a vital strategy in enhancing data-driven decision-making, especially in organizational and public sector contexts. [12] conducted a bibliometric study analyzing over 2,400 BI publications and

found rising trends in predictive analytics and performance monitoring as BI grows beyond reporting tools. Similarly, [13] proposed a unified research model after reviewing 35 years of BI studies, highlighting the importance of integrating BI processes with value realizati. In a practical application, [14] developed a roadmap for BI implementation in higher education using Power BI, proving its role in institutional goal alignment. In Indonesia, [15] Implementing data governance and integration tools ensures data accuracy and consistency, forming the foundation for reliable BI insights. As explored in this study through the use of Power BI dashboards to visualize MSME forecasts in Tangerang Regency.

2.3 Moving Average

The Moving Average (MA) method is a fundamental technique in time-series forecasting, renowned for its simplicity and effectiveness in smoothing out short-term fluctuations to highlight longer-term trends. Among its variants, the Simple Moving Average (SMA) is frequently employed due to its straightforward computation and interpretability, making it suitable for datasets with gradual trends.

In the context of demand forecasting, [16]introduced the Cumulative Weighted Moving Average (CWMA) technique, which assigns progressively increasing weights to more recent data points. Their study demonstrated that CWMA outperforms traditional MA methods in forecasting spare parts demand within the automotive industry, achieving lower Mean Squared Error (MSE) values.

Similarly, [17] applied the Weighted Moving Average (WMA) model to forecast apparel production in the fashion industry. Their findings indicated that accurate demand forecasting using WMA significantly enhances resource optimization and production planning, leading to improved operational efficiency.

In a healthcare setting, [18] compared the efficacy of SMA and Single Exponential Smoothing (SES) methods in forecasting drug requirements in Jombang Regency, Indonesia. The study concluded that SMA provided reliable predictions with minimal error, highlighting its applicability in managing pharmaceutical inventories.

These studies underscore the versatility of MA methods across various industries, including automotive, fashion, and healthcare. Their simplicity and adaptability make them particularly valuable for forecasting in contexts with limited data availability. In this research, the SMA method is employed to predict the growth of Micro, Small, and Medium Enterprises (MSMEs) in Tangerang Regency, Indonesia. Given its proven effectiveness in similar forecasting scenarios, SMA serves as a practical tool for policymakers and stakeholders aiming to make informed decisions based on trend analysis.

III. METHODOLOGY

This study utilizes a descriptive quantitative approach through time-series forecasting to predict the number of Micro, Small, and Medium Enterprises (MSMEs) in Tangerang Regency. The methodology integrates statistical forecasting techniques with Business Intelligence (BI) tools to provide actionable visual insights for regional development strategies.

A. Research Flow

The research methodology is structured as follows:
Problem Identification: Understanding the need for MSME growth forecasting to support regional economic planning.
Data Collection: Historical MSME data (2018–2023) obtained from the Department of Cooperatives and MSMEs in Tangerang Regency.
Data Preprocessing: Includes data cleaning, handling missing values, and normalization using Python and Microsoft Excel.
Model Implementation: Applying the Moving Average technique to forecast future MSME counts.
Model Evaluation: Accuracy measured using Mean Absolute Error (MAE) and Mean Squared Error (MSE).
Result Visualization: Forecast outputs are visualized using Power BI dashboards.

B. Forecasting Model: Moving Average

The forecasting process involves the Moving Average method, which is commonly used for smoothing short-term fluctuations in time-series data. Three types of Moving Average were considered:
Simple Moving Average (SMA): Calculates the unweighted mean of previous data points.
Weighted Moving Average (WMA): Assigns higher weights to more recent data, capturing recent trends better.
Exponential Moving Average (EMA): Similar to WMA but uses exponential weights, giving even more emphasis to the latest data points.

In this study, the Simple Moving Average (SMA) was selected due to its simplicity and suitability for annual data with relatively linear growth. It is also easier to interpret by non-technical stakeholders.

C. Window Size and Configuration

The SMA model in this research uses a window size of 3 years, meaning the average of the three most recent years is used to predict the value for the next year. This size was chosen to balance between responsiveness to recent changes and smoothing of random fluctuations.

$$SMA_t = \frac{Y_{t-1} + Y_{t-2} + Y_{t-3}}{3}$$

SMA_t = Predicted MSME count in year t
$Y_{t-1}, Y_{t-2}, Y_{t-3}$ = Actual MSME counts from the three preceding years

D. Stationarity and Seasonality Check

Before applying the forecasting model, a stationarity check was conducted to assess whether the data mean and variance are consistent over time. Since the available data is yearly (not monthly or quarterly), seasonality was not present in this dataset.

Visual inspection of the trend indicates a general increase in MSMEs with a steep jump in 2023.

Due to the short time horizon (6 data points), formal statistical tests like Augmented Dickey-Fuller (ADF) were not applied, as they require a larger sample size.

The data is assumed to be non-stationary but is handled by the smoothing nature of the Moving Average model.

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Future research with monthly or quarterly data is recommended to explore seasonal decomposition and use of more advanced models like SARIMA if seasonality is significant.

E. Business Intelligence Integration

To enhance insight delivery and stakeholder accessibility, BI tools were employed. The implementation includes:
Extract: Retrieving data from government sources and reports.
Transform: Cleaning and formatting data using Python and Excel.
Load: Importing the final dataset into Power BI for visualization.

BI dashboards feature line charts of actual vs forecasted values, Year-on-Year comparisons, and KPIs such as MAE and MSE. These visuals are designed to facilitate understanding and support for decision-makers.

IV. Results and Discussion

A. Dataset Overview

The data used in this study consists of the number of registered MSMEs in Tangerang Regency for the period 2018–2023. This dataset was sourced from regional government reports and is summarized in the following table:

Year	MSME Count
2018	1,851
2019	4,989
2020	13,895
2021	25,918
2022	25,918
2023	61,011

The data illustrates a consistent upward trend in MSME growth, with significant acceleration between 2020 and 2023. This trend aligns with national efforts to empower MSMEs post-pandemic through digitalization and government support programs.

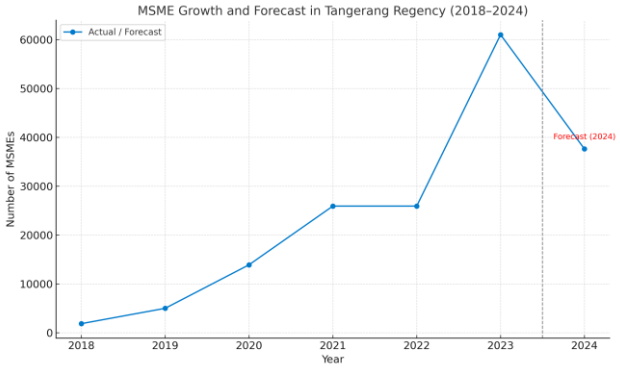
B. Forecasting Using Simple Moving Average (SMA)

The forecast for 2024 was conducted using the Simple Moving Average method with a 3-year window. The forecasted value is calculated using the average of the MSME counts from 2021, 2022, and 2023:

$$SMA_{2024} = \frac{(25{,}918+25{,}918+61{,}011)}{3} = \frac{112{,}847}{3} = 37{,}615.67$$

Thus, the forecasted number of MSMEs in 2024 is approximately 37,616. While this value is lower than the 2023 figure, it reflects the smoothing nature of SMA, which moderates sharp fluctuations by averaging them with previous years.

As shown in Figure 1, the line chart illustrates the trend of MSME growth in Tangerang Regency from 2018 to 2023, along with the forecasted value for 2024. The sharp increase in 2023 and the moderated forecast in 2024 highlight the smoothing effect of the SMA method



MSME Growth Trend and Forecast Using SMA (2018–2024)

C. Backtesting and Error Evaluation

To evaluate the model's predictive performance, a backtesting approach was conducted by applying SMA to earlier periods and comparing forecasts with actual values.

Year	Actual	Forecast (SMA)	Absolute Error
2021	25,918	6,911.67	19,006.33
2022	25,918	14,934.00	10,984.00
2023	61,011	21,910.33	39,100.67

Mean Absolute Error (MAE):

$$MAE = \frac{19{,}006.33+10{,}984.00+39{,}100.67}{3} = 23{,}030.$$

Mean Squared Error (MSE):

$$MSE = \frac{(19{,}006.33^2+10{,}984.00^2+39{,}100.67^2)}{3} = 627{,}397{,}646$$

The evaluation results show that the SMA model provides a general trend but has high errors in periods of rapid growth. This indicates that SMA is better suited for stable or gradually changing data and less effective in capturing structural jumps or shocks.

D. Business Intelligence Visualization

The forecast results were visualized using Power BI, allowing dynamic and interactive exploration of trends. The dashboard includes:
Line chart: Comparison of actual vs. predicted MSME counts over time
KPI cards: Real-time display of MAE, MSE, and forecasted value
Growth rate chart: Year-on-year percentage changes
Filter tools: To adjust views by year, accuracy level, or growth phase

The BI dashboard ensures that results are accessible not only to technical analysts but also to policymakers, helping them make informed decisions quickly.

E. Discussion and Analysis

The prediction result for 2024 indicates an estimated MSME count of 37,616, suggesting a continued increase, albeit

more moderated than the spike seen in 2023. The high MAE and MSE values indicate that SMA, while easy to apply and interpret, may underestimate sudden spikes or fail to capture complex economic effects.

Despite its limitations, SMA serves as a practical baseline model, especially when historical data is limited and interpretability is prioritized. However, for more accurate forecasting in future studies, it is recommended to explore:

- ARIMA models, which account for trends and seasonality
- Machine learning techniques such as Support Vector Regression (SVR) or Prophet
- Inclusion of exogenous variables (e.g., government grants, macroeconomic indicators)

This study also shows how the integration of forecasting and BI can enhance transparency, communication, and stakeholder involvement in regional development planning.

V. CONSLUSION

This study successfully implemented the Simple Moving Average (SMA) method to forecast the number of Micro, Small, and Medium Enterprises (MSMEs) in Tangerang Regency, with the support of Business Intelligence (BI) tools for data visualization and communication. By utilizing annual historical data from 2018 to 2023, the forecasting model predicted that the number of MSMEs in 2024 will reach approximately 37,616 units. The research process involved key stages such as data preprocessing, forecasting model application, performance evaluation using MAE and MSE, and visual presentation through Power BI.

The results indicate that the SMA method is a practical and easy-to-implement tool for short-term trend forecasting. However, it demonstrates significant prediction error when data patterns exhibit sharp growth, such as in 2023. The high MAE and MSE values highlight the limitations of SMA in handling non-linear changes or unexpected surges. Nevertheless, the integration of BI platforms such as Python, Excel, and Power BI proved effective in enhancing the interpretability and accessibility of the forecasting results. Power BI dashboards allowed for dynamic exploration of trends and metrics, making insights more actionable for stakeholders, especially policymakers.

For future research, it is recommended to explore more sophisticated forecasting models such as ARIMA, Exponential Smoothing, or Machine Learning-based algorithms that can better capture non-linear dynamics and external variables. Additionally, incorporating more granular data (e.g., monthly or quarterly MSME registration) and contextual factors (e.g., government support, inflation, investment trends) can significantly improve forecast accuracy. The approach demonstrated in this study can serve as a replicable framework for other regional governments aiming to implement data-driven strategies for MSME development.

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