

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

Rio Fauzi<sup>1</sup>, Mohammad Givi Efgivia<sup>2</sup>

<sup>1</sup>Information Engineering, Prof. Dr. Hamka Muhammdiyah University, Jakarta, Indonesia

<sup>2</sup>Information Technology System, Prof. Dr. Hamka Muhammdiyah University, Jakarta, Indonesia

Email address: <sup>1</sup>2103015101@uhamka.ac.id, <sup>2</sup>mgivi@uhamka.ac.id

**Abstract**— Forecasting the growth of Micro, Small, and Medium Enterprises (MSMEs) is crucial for supporting economic development, especially at the regional level. This study aims to forecast the number of MSMEs in Tangerang Regency using the Simple Moving Average (SMA) method, combined with a Business Intelligence (BI)-based visualization approach. The SMA-3 model was selected for its ability to provide a smoother and more stable long-term trend compared to shorter-period models. Forecasting was conducted using historical data from 2018 to 2023, with projections extending to 2028. Evaluation using Mean Absolute Error (MAE) and Mean Squared Error (MSE) shows that SMA-2 offers lower short-term errors, while SMA-3 is better suited for long-term forecasting. The results suggest a continued increase in MSMEs, with the number projected to reach 43,392 by 2028. Data visualization techniques were employed to transform numerical outputs into accessible visual insights, supporting data-driven decision-making. This research provides valuable input for local governments and stakeholders to anticipate future trends and plan strategic support for MSME development. This research can serve as a reference for future development of forecasting tools integrated with Business Intelligence platforms.

**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 benefits [3] 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. LITERATURE REVIEW

### 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 3period 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 realization. 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 nontechnical 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.

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 Moving Average (MA)**

This study applies the Moving Average method, specifically the 3-year Simple Moving Average (SMA-3), to forecast the number of Micro, Small, and Medium Enterprises (MSMEs) in Tangerang Regency from 2024 to 2028. The 3-year window was selected to smooth out short-term fluctuations while maintaining responsiveness to recent changes.

The formula used in this method is:

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

Where:

$SMA_t$  is the forecasted value for year  $t$ ,

$Y_{t-1}, Y_t, Y_{t+1}$  are the MSME counts for the three preceding years.

The forecast process starts by using the actual MSME data from 2021, 2022, and 2023 to estimate the 2024 value. Each subsequent year's forecast uses the three most recent values — including forecasted ones — for the calculation.

The resulting predictions are as follows:

Year	Forecasted MSME
2024	37.616
2025	41.515
2026	46.714
2027	41.948
2028	43.392

These forecasts show a moderated upward trend. The spike in 2023 causes a ripple effect in the early forecasts, which is gradually smoothed out in the following years. This behavior is typical of the SMA method, which tends to reduce the impact of extreme values over time.

As visualized in Power BI dashboards, this trend projection provides stakeholders with a clearer understanding of expected MSME growth and supports proactive planning for infrastructure, funding, and training programs.

**C. Backtesting and Error Evaluation**

To evaluate the accuracy of the Moving Average method, a backtesting approach was conducted by comparing predicted values with actual data from previous years. Both 2-year and 3-year Simple Moving Average (SMA-2 and SMA-3) models were tested to determine their effectiveness in forecasting the number of MSMEs.

**Forecast Accuracy Table**

Year	Actual	SMA-2 Forecast	SMA-3 Forecast
2021	25.918	9.442,00	6.911,67
2022	25.918	19.906,50	14.934,00
2023	61.011	25.918,00	21.910,33

**Error Metrics**

Method	MAE	MSE
SMA-2	17.193	513,036,150
SMA-3	23.030	670,250,366

**Mean Absolute Error (MAE):**

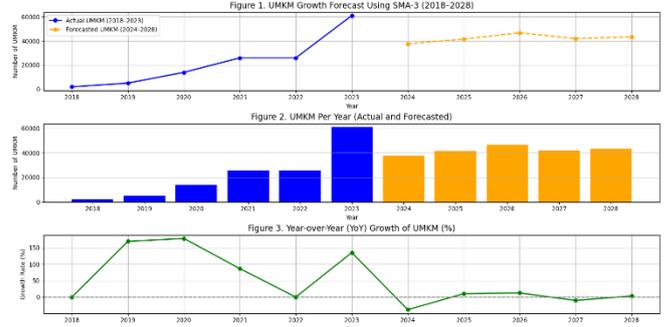
$$MAE = \frac{19.006,33 + 10.984,00 + 39.100,67}{3} = 23.030$$

**Mean Squared Error (MSE):**

$$MSE = \frac{(19.006,33^2 + 10.984,00^2 + 39.100,67^2)}{3} = 670.250.410$$

The evaluation results show that the Simple Moving Average (SMA) model effectively captures general trends but struggles with accuracy during periods of rapid growth. This suggests that SMA is more suitable for datasets with stable or gradually changing patterns, and less effective in identifying sudden structural shifts or outliers. For instance, the sharp increase in UMKM numbers in 2023 could not be fully anticipated by either SMA-2 or SMA-3, resulting in higher error values.

**D. Business Intelligence Visualization**



As part of the Business Intelligence (BI) approach, the forecasting results were visualized to enhance interpretation and support decision-making. Although no specialized BI software such as Power BI was used, the visualizations were created using BI principles by presenting historical and predicted data in an informative and intuitive format. Three primary visualizations were developed:

Figure 1. UMKM Growth Forecast Using SMA-3 (2018–2028) This line chart displays the actual growth of MSMEs (UMKM) from 2018 to 2023, represented by a solid blue line, and predicted values for 2024 to 2028 using the 3-Year Simple Moving Average (SMA-3), shown with a dashed orange line. The graph highlights a sharp increase in 2023, followed by a more stable and slightly fluctuating trend. This visualization enables readers to understand long-term patterns and the impact of recent spikes on future projections.

Figure 2. UMKM Per Year (Actual and Forecasted) This bar chart illustrates the total number of UMKMs per year, where blue bars represent actual values (2018–2023) and orange bars represent predicted values (2024–2028). It offers a clear year-by-year comparison and supports quick visual evaluation of annual growth.

Figure 3. Year-over-Year (YoY) Growth of UMKM (%) This line chart shows the percentage growth rate of UMKMs from year to year. A significant drop is observed in the projected growth rate for 2024, which is a direct result of the exceptionally high value in 2023. This visualization allows users to assess volatility, identify significant changes, and develop strategic responses accordingly. By presenting forecasting results in a visual form, this study bridges the gap between numerical analysis and actionable insights. The approach ensures that the findings are accessible not only to analysts but also to policymakers, practitioners, and business stakeholders. This aligns with the core objective of Business Intelligence: transforming data into informed decisions.

**E. Discussion and Analysis**

The results of the forecasting process using the Simple Moving Average (SMA) method revealed both the strengths and limitations of the model. While SMA is a straightforward and

widely used technique for trend analysis, its effectiveness is highly dependent on the nature of the data. In this study, the 3-Year Simple Moving Average (SMA-3) was chosen over SMA-2 for long-term forecasting due to its smoother trend line and lower sensitivity to short-term fluctuations.

The evaluation results (MAE and MSE) indicated that SMA-2 produced lower error values in short-term prediction. However, SMA-3 provided a more consistent and stable trend for multi-year forecasting, which aligns better with the research objective of projecting UMKM development up to 2028.

The forecast results showed that the number of UMKMs in Tangerang Regency is expected to continue growing moderately after a significant spike in 2023. The projected figures—from 37,616 in 2024 to 43,392 in 2028—suggest that the MSME sector is entering a phase of sustained growth, though at a slower pace than the sharp increase seen previously.

However, the spike in 2023 created a challenge for the SMA method, which inherently lags behind sudden changes. This was evident in the relatively high errors during that year. The model's limitations in handling such outliers reinforce that SMA is better suited for relatively stable or gradually evolving datasets. Future research may consider more adaptive methods like exponential smoothing or machine learning models for improved accuracy during dynamic periods.

From a policy perspective, these findings emphasize the importance of data-driven decision-making. Local governments and stakeholders should anticipate continued UMKM growth and ensure that appropriate infrastructure, training, and financial support are sustained to accommodate this development. Business Intelligence-based visualizations used in this study have also proven effective in simplifying complex trends, making the forecast results accessible and actionable for various decision-makers.

## V. CONCLUSION

This study aimed to forecast the number of Micro, Small, and Medium Enterprises (MSMEs) in Tangerang Regency using the Simple Moving Average (SMA) method as part of a Business Intelligence approach. The SMA-3 model was selected for long-term forecasting due to its ability to smooth out short-term fluctuations and present a clearer trend pattern.

Based on historical data from 2018 to 2023, the forecasting results predicted a consistent increase in MSMEs from 2024 to 2028, ranging from 37,616 to 43,392 units. Although the SMA-2 model yielded lower short-term errors (MAE and MSE), the SMA-3 model provided a more stable projection suitable for strategic planning.

The evaluation process demonstrated that while SMA methods effectively identify general trends, they may be less accurate in capturing sudden changes, such as the sharp spike in 2023. Despite this, the overall forecast trend supports a positive outlook for MSME growth in the region.

The use of Business Intelligence visualization has proven helpful in communicating the results in a clear and actionable way. These findings are expected to assist policymakers, regional planners, and business stakeholders in making informed decisions to support the sustainable development of MSMEs in Tangerang Regency.

## REFERENCES

- K. Ragazou, I. Passas, A. Garefalakis, and C. Zopounidis, "Business intelligence model empowering SMEs to make better decisions and enhance their competitive advantage," *Discover Analytics*, vol. 1, no. 1, Feb. 2023, doi: 10.1007/s44257-022-00002-3.
- I. M. Saleh and M. T. Sadeghi, "Strategic Integration of Big Data Analytics and Business Intelligence for Enhancing Supply Chain Resilience in SMEs," 2024. [Online]. Available: <https://www.ijsemjournal.com/ORCIDiD:https://orcid.org/0009-0003-9829-697x>
- F. N. Arifin, A. A. Cahyarani, M. Arifur Furqon, and O. Juwita, "Small Medium Enterprise Data Visualization Analysis as Strategic Business Development," in *E3S Web of Conferences*, EDP Sciences, Nov. 2023. doi: 10.1051/e3sconf/202344802018.
- W. D. Anjaningrum, N. Azizah, and N. Suryadi, "Spurring SMEs' performance through business intelligence, organizational and network learning, customer value anticipation, and innovation - Empirical evidence of the creative economy sector in East Java, Indonesia," *Heliyon*, vol. 10, no. 7, Apr. 2024, doi: 10.1016/j.heliyon.2024.e27998.
- A. Nurfadilah et al., "Penerapan Metode Moving Average untuk Prediksi Indeks Harga Konsumen Application of Moving Average Method for Consumer Price Index Prediction," vol. 21, no. 1, 2022.
- [B. Lailatul Nafiisa, Y. Novealita, W. Putri, and Q. Ayunin, "Dashboard Visualisasi Data UMK Sebagai Alat Pengambilan Keputusan Menggunakan Microsoft Power BI," vol. 17, no. 2, pp. 86–105, 2022, [Online]. Available: <https://akuntansi.pnp.ac.id/jam>
- S. Sunaryono, T. Apriani, and F. Ekobelawati, "Analyzing the Impact: The Role of MSME Growth in Reducing Unemployment Amidst High Levels of Poverty," *AJARCODE (Asian Journal of Applied Research for Community Development and Empowerment)*, pp. 166–175, Jun. 2024, doi: 10.29165/ajarcde.v8i2.417.
- sRajamohan S-Rajamohan and A. Sathish Research Scholar, "Simple Seasonal Time Series Analysis Forecasting Model-Indian MSME In 2020 A. Sathish Simple Seasonal Time Series Analysis Forecasting Model-Indian Msme In 2020," 2019. [Online]. Available: <https://www.researchgate.net/publication/343602570>
- A. Restyana, L. Savitri, N. F. Laili, and N. Probosiwi, "Analysis of Drug Forecasting with Single Moving Average and Single Exponential Smoothing Approach (Case Study in Jombang Regency 2017-2019)," in *Journal of Physics: Conference Series*, IOP Publishing Ltd, May 2021. doi: 10.1088/1742-6596/1899/1/012100.
- A. Nurfadilah et al., "Penerapan Metode Moving Average untuk Prediksi Indeks Harga Konsumen Application of Moving Average Method for Consumer Price Index Prediction," vol. 21, no. 1, 2022.
- S. Mekimah, R. Zighed, K. Mili, and I. Bengana, "Business intelligence in organizational decision-making: a bibliometric analysis of research trends and gaps (2014–2024)," Dec. 01, 2024, Springer Nature. doi: 10.1007/s43621-024-00692-7.
- S. Mekimah, R. Zighed, K. Mili, and I. Bengana, "Business intelligence in organizational decision-making: a bibliometric analysis of research trends and gaps (2014–2024)," Dec. 01, 2024, Springer Nature. doi: 10.1007/s43621-024-00692-7.
- Y. Talaoui and M. Kohtamäki, "35 years of research on business intelligence process: a synthesis of a fragmented literature," 2020, Emerald Group Holdings Ltd. doi: 10.1108/MRR-07-2020-0386.
- R. Sequeira, A. Reis, P. Alves, and F. Branco, "Roadmap for Implementing Business Intelligence Systems in Higher Education Institutions: Systematic Literature Review †," Apr. 01, 2024, Multidisciplinary Digital Publishing Institute (MDPI). doi: 10.3390/info15040208.
- K. Nayyar, "Business Intelligence Challenges and How to Handle Them," *International Journal of Computer Trends and Technology*, vol. 71, no. 5, pp. 37–39, May 2023, doi: 10.14445/22312803/ijctt-v71i5p106.
- H. A. Abdelwali1 and M. H. Abdelati2, "Enhancing Time Series Forecasting with the Advanced Cumulative Weighted Moving Average Technique Introduction and Literature Review," 2024, [Online]. Available: [www.ijasi.org](http://www.ijasi.org)
- A. Augusta, M. Chukwuma, J. Nsikan, and O. Onayemi, "Application of a Weighted Moving Average Forecasting Model for Apparel Production Planning and Resource Optimization in the Fashion Industry," *Journal of Southwest Jiaotong University*, vol. 59, no. 4, 2024, doi: 10.35741/issn.0258-2724.59.4.31.
- A. Restyana, L. Savitri, N. F. Laili, and N. Probosiwi, "Analysis of Drug Forecasting with Single Moving Average and Single Exponential Smoothing Approach (Case Study in Jombang Regency 2017-2019)," in *Journal of Physics: Conference Series*, IOP Publishing Ltd, May 2021. doi: 10.1088/1742-6596/1899/1/012100.