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Aggregate Planning to Efficiently Cost Production in Batik Tulis Canteng Koneng UMKM (MSMEs)

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Abstract
This research seeks to determine the efficiency of the resulting production costs as well as an alternative to aggregate planning that may be used in Sumenep Regency's batik tulis sector. The research methodology employed in this study is quantitative and descriptive-analytical. The Chase Strategy was selected as an alternate aggregate planning method with the lowest production cost value of Rp 7,707,801,226 based on the study's findings and overall planning costs calculations.

Keywords: Forecasting, Agregrat Planning, Effienscy Cost, Chase Strategy, Level Strategy,

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Introduction

Micro, Small, and Medium Enterprises (MSMEs) play a vital role in the Indonesian economy, especially as drivers of the people's economy in various regions. MSMEs often start from family or home industries, reflecting local resilience and creativity in facing economic challenges. However, despite having great potential, many MSMEs have not achieved maximum profit. One of the contributing factors is the lack of ability to combine production factors and determine the amount of products produced, so that the profits obtained are not optimal (Wiralestari et al., 2018).

In Sumenep Regency, Madura Island, there is a Batik Tulis Canteng Koneng MSMEs which is known for its unique motifs and patterns. Although it is widely known and has bright market potential, the Batik Tulis Canteng Koneng MSMEs in Sumenep Regency faces significant challenges in managing fluctuations in demand and production. Sales data shows seasonal variations that affect the stability of production and income. In addition, high production costs, especially due to 20% depreciation of raw materials before processing, add to operational costs. Lack of proper planning in determining the amount of production and procurement of raw materials causes a mismatch between production capacity and market demand. To overcome this problem, the application of forecasting methods such as simple moving average and exponential smoothing, as well as aggregate planning strategies such as chase strategy and level strategy, are expected to increase production efficiency and reduce operational costs. With this approach, the Batik Tulis Canteng Koneng MSMEScan optimize the production process and meet market demand more effectively.

Literature Review

Production Planning

The production function plays a crucial role in building and developing a business, especially in the industrial sector. In the manufacturing industry, companies often face various constraints related to limited production factors, such as raw materials, machine capacity, production methods, working capital, and labor. The process of determining the amount of production begins with careful production planning and ends with supervision. Production planning serves as the initial step in determining actions that need to be taken in the future, including what needs to be done, how much is needed, and when the action should be carried out (Pramodya Utami & Mandala, 2024). Production planning in manufacturing companies is a crucial strategic process to ensure smooth operations and continuity of production. Production managers are required to make the right decisions about the amount and timing of production in order to minimize costs and maximize profits. Without careful planning, companies are at risk of facing problems such as excess or shortage of inventory, which can increase storage costs or stock-out costs. In addition, inaccuracy in planning can disrupt the quality of service to consumers, such as delays in product delivery. Therefore, effective production planning is essential to achieve efficiency and customer satisfaction (Patrobas et al., 2021). In practice, production planning is divided into three levels based on the time period: long-term, medium-term, and short-term. Long-term planning usually covers a time horizon of more than one year and focuses on strategic decisions such as facility expansion or new product development. Medium-term planning, with a period of 1–2 years, deals with capacity planning and resource procurement. Meanwhile, short-term planning focuses on daily operations, including production scheduling and quality control (Juliantara & Mandala, 2020).

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Forecasting

In order to meet the demand for goods or services, forecasting is the process of projecting future needs, encompassing characteristics of quantity, quality, time, and location. This technique takes into account outside variables that affect demand and makes projections based on trend analysis and previous data. Forecasting helps companies in production planning and resource management efficiently. By utilizing forecasting, companies can optimize production capacity, avoid excess or shortage of stock, and increase customer satisfaction by meeting needs on time and according to specifications (Lusiana & Yuliarty, 2020). Forecasting plays an important role in business decision making. The right decision is based on accurate predictions about future conditions. If the forecast made is not right, the decision taken is at risk of being less effective. Therefore, forecasting is a challenge that must be faced in the decision-making process (Adhe Rebeka Pardosi & Iriani Iriani, 2024). Effective forecasting must be able to produce accurate and reliable predictions. Various forecasting methods, such as Simple Exponential Smoothing (SES), Moving Average, and other methods, can be applied according to data characteristics and forecasting needs (Audinasyah & Solehudin, 2024). The Single Exponential Smoothing (SES) method is a forecasting technique that continuously calculates predictions by giving exponential weights to the latest observation data. Each data is given a weight expressed by the symbol α (alpha), where the α value ranges from 0 to 1. Selecting the right α value aims to minimize the level of forecast error, thus producing more accurate predictions. The optimal α value can be determined through a trial-and-error approach or by using a specific formula, such as $\alpha = 2 / (n + 1)$, where n is the number of data periods (Maulina & Anggraeni, 2022).

A technique that determines the average of several recent data points over a given time frame is called a moving average (MA). This technique is helpful for emphasising long-term patterns and mitigating short-term data volatility. MA is limited, though, in that it assigns equal weight to all data within a certain time frame, which makes it less adaptable to changes in the most recent data. The goal of the analysis and the properties of the available data determine which forecasting method is best. Calculating error values like Mean Absolute Deviation (MAD) and Mean Squared Deviation (MSD) can be used in practice to assess forecast accuracy and identify the best approach (Alyafi et al., 2022).

Production Planning

Aggregate planning is a strategic process in operations management that aims to balance production capacity with market demand in the medium term, usually between 3 and 18 months. This process includes planning the amount of production, labor, inventory, and other resources to minimize operational costs and ensure smooth production. Aggregate planning serves as a link between short-term and long-term planning in company operations. By considering fluctuations in demand and production capacity, this planning helps companies make efficient decisions regarding resource use and production arrangements (Arfiana et al., 2021). In aggregate planning, a combination of capacity and demand strategies can create a more effective approach. The three main strategies used are Chase strategy, Level strategy, and Mixed strategy (Sari et al., 2022). Chase strategy is an approach to aggregate planning that dynamically adjusts production levels and workforce size to meet demand fluctuations. This strategy helps minimize inventory costs and ensures that production is only done according to actual needs. However, its implementation can pose challenges such as high costs related to hiring and training workers,

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and the potential negative impact on employee morale due to frequent changes in work schedules. Level strategy in aggregate planning is an approach that maintains consistent production levels and workforce sizes throughout the planning period. This strategy allows companies to anticipate demand fluctuations by holding inventory of products during periods of low demand, which can then be used when demand increases. A mixed strategy in aggregate planning is an approach that combines elements of both level and chase strategies to achieve a balance between cost efficiency and responsiveness to demand fluctuations. In this strategy, a company can flexibly adjust production levels, workforce size, and inventory usage to meet production needs without incurring significant additional costs. For example, a company might maintain a stable base production level and adjust additional capacity through overtime or temporary workers during periods of high demand, and use inventory to meet demand during periods of low demand. This approach allows the company to minimize total production costs while still meeting customer demand in a timely manner (Agustina et al., 2022).

Research Methods

The location of this research was conducted at the Canteng Koneng Batik Tulis MSMEs in Pakondang Village, Rubaru District, Sumenep Regency. This study was carried out with a quantitative descriptive methodology. In order to explain the research topic and make inferences from the observed events, quantitative descriptive research uses numerical statistics (Wulandari et al., 2023). The data collection methods used in this study are as follows: (1) interviews, which involve conducting interviews with the owner of the Canteng Koneng batik tulis business; (2) observation, which involves making direct observations and notes on the objects being studied. The purpose of this direct observation is to find out the process of making batik tulis from start to finish, as well as the work system used to make batik; (3) Documentation is a method for using images, data, and content from books, journals, and the internet as reference sources; and (4) literature study is a method for collecting data from books and journals that are relevant to the research that has been discussed.

The data collected from the company is the basis of data processing. For future forecasting, sales data from May 2024 to April 2025 are used to calculate the amount of production. This is done using the sigle moving average, weight moving average, and single exponential smoothing method based on historical product data. Furthermore, the calculation of aggregate production planning is done using the level strategy and chase strategy.

Results and Discussion

Canteng Koneng is the first MSMES in Sumenep Regency that carries the concept of hand-drawn batik with unique motifs and patterns, even almost perfect, located in Pakondang Village, Rubaru District, Sumenep Regency. After conducting direct observations at the research location and conducting interviews with the company owner and employees, the following information was obtained:

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Table 1. Interview Result Data

Description	Amount
Permanent Workforce	7 People
Working hours	5 Hours/day
Number of Working Hours	20 Days
Employee/Workforce Salary	Rp 1.700.000
Average Production	50 pieces/process
Production Level	5 Process/day
Production cost	Rp. 250.000/peices
Overtime Costs	Rp. 20.000/pieces
Average Production Cost/Month	Rp. 1.250.000.000

The data required includes data on demand and sales of batik in the previous 12 periods, namely from June 2024-May 2025, data obtained by observation and interviews with the owner of the Canteng Koneng Sumenep Batik Tulis MSMES. The following is data on demand and sales of batik products at the Canteng Koneng Sumenep Batik Tulis MSMES.

Table 2. Demand and Sales Data

No	Month	Data on Demand and Sales of Canteng Koneng		
		Year	Demand/piececs	Sale/pieces
1	June	2024	5.800	4.840
2	July	2024	6.000	5.000
3	August	2024	5.900	4.920
4	September	2024	6.200	5.160
5	October	2024	6.700	5.560
6	November	2024	7.000	5.800
7	December	2024	6.400	5.320
8	January	2025	6.200	5.160
9	February	2025	6.100	5.080
10	March	2025	5.900	4.920
11	April	2025	6.100	5.100
12	May	2025	6.000	5.000

Demand data has increased and also decreased so that sales at the Canteng Koneng Batik UMKM are not stable. Starting from October 2024, Batik sales amounted to 6,700 pieces, for the following month the number of requests increased by 7,000 pieces and decreased in the following month and the most drastic decline occurred in March 2025 with sales figures of 5,900 bales.

The next step is to forecast using the simple moving average, weighted moving average, and single exponential smoothing methods.

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Table 3. Forecasting Method Data

Forecasting Canteng Koneng	Simple Moving Average (4 month)	Weight Moving Everage (4 month)	Single Exponential Smoothing α = 0,2
MAPE	6%	5%	3%
MAD	305,625	-6,5	154,211
MSE	145.378,125	287,5	232,454

Based on the data results in table 3, the results of the simple exponential smoothing method have a smaller accuracy value compared to the simple moving average method and the weighted moving average method. So the forecast results for the next 6 periods are as follows:

Table 4. Forecasting Result Data for 6 Periods

Period	Forecasting
June	5.159
July	5.159
August	5.147
September	5.113
October	5.111
November	5.094
Total	**30.784**
Average Production/Mont	**5.131**

Aggregate Planning Strategy

Table 5. Aggregate Planning Calculation Results

No	Description	Description	Level Strategy	Chase Strategy
1	Production Process Costs	Rp 15.000.000.000	Rp 7.695.901.226	Rp 7.695.901.226
2	Labor costs	Rp 11.900.000	Rp 11.900.000	Rp 11.900.000
3	Overtime Costs	Rp -	Rp 956.000	Rp -
	Total Production Costs	Rp 15.011.900.000	Rp 7.708.757.226	Rp 7.707.801.226

Based on the data in table 5, the results of the aggregate planning calculation using two methods, namely the chase strategy, are obtained, so the selected strategy is the strategy that produces the minimum production costs. Of the two methods, the one that produces the minimum cost is the chase strategy method, which is Rp. 7,707,801,226.

Conclusions and Practical Implication

Conclusion

Based on the results and discussion, the results of forecasting calculations using three methods are obtained, namely single moving average, weighted moving average, and single exponential smoothing. The method selected in the forecasting calculation is the single exponential smoothing method with a Mean Square Error (MSE) value of 232.454, Mean Absolute Deviation (MAD) of 154.211, and MAPE of 3% which has the smallest value compared to the single moving average and weighted moving average methods.

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In the calculation of aggregate planning using two methods, namely the strategy chase method and the strategy level, the smallest production cost calculation result was obtained from the strategy chase method, which was Rp. 7,707,801,226, which had a difference of 46% compared to the total production cost in the previous period with a total production of 30,784 pieces of batik tulis.

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