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Implementation of Material Requirements Planning for Raw Material Inventory Control in Home Industry Palangka Raya

Tito Setianto[1*], Luluk Tri Harinie[2], Achmad Syamsudin[3], Jonathan Giovanni[4]

setiantotito933@gmail.com[1]*

Universitas Palangka Raya[1*,2,3,4], Jl. Yos Sudarso, Kota Palangka Raya, Kalimantan Tengah, Indonesia

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ABSTRACT

This study aims to analyze the efficiency of raw material inventory control in a home-based cake production industry in Palangka Raya through the application of the MRP method. The main issue faced is inefficiency in inventory management, leading to an accumulation of raw materials and increased storage costs. Therefore, a method is needed to optimize raw material orders so that they align more closely with production needs. This study employs a quantitative descriptive approach, using demand forecasting techniques with the Linear Regression method, which has been proven to have a lower error value compared to other methods. The MRP analysis is conducted using the LFL, EOQ, and POQ techniques. The findings indicate that the POQ method results in the lowest total inventory cost of Rp3,969,500, making it more efficient than the LFL and EOQ methods. These results demonstrate that the implementation of MRP can enhance the efficiency of raw material inventory management, reduce storage costs, and minimize the risk of overstocking. This study contributes by providing an MRP-based solution for home industries and small-medium enterprises (SMEs) to optimize inventory management. Furthermore, it serves as a reference for future research in the fields of inventory control and supply chain management.

Keywords : Inventory control; Material Requirement Planning (MRP); Lot Sizing; Forecasting; Cost Efficiency

ABSTRAK

Penelitian ini memiliki tujuan menganalisis efisiensi pengendalian persediaan bahan baku terhadap industri rumahan pembuatan kue di Palangka Raya dengan penerapan metode MRP. Permasalahan utama terkait dengan ketidakefisienan dalam pengelolaan persediaan, yang mengakibatkan penumpukan persediaan bahan baku serta peningkatan biaya penyimpanan. Dengan demikian, dibutuhkan metode yang bisa memaksimalkan jumlah pemesanan bahan baku supaya lebih relevan dengan kebutuhan produksi. Penelitian ini mempergunakan pendekatan deskriptif kuantitatif dengan teknik peramalan permintaan mempergunakan metode Linear Regression, yang terbukti mempunyai nilai error lebih kecil dibandingkan metode lainnya. Analisis MRP dilakukan dengan menerapkan teknik Lot untuk Lot (LFL), Kuantitas Pemesanan Ekonomis (EOQ), dan Kuantitas Pemesanan Berkala (POQ). Temuan penelitian memperlihatkan bahwasanya metode POQ

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memberi total biaya persediaan paling rendah sebesar Rp3.969.500, lebih efisien dibandingkan dengan metode LFL dan EOQ. Temuan ini membuktikan bahwa penerapan MRP dapat meningkatkan efisiensi pengelolaan persediaan bahan baku, menekan biaya penyimpanan, serta meminimalkan risiko kelebihan stok. Kontribusi penelitian ini adalah memberikan solusi berbasis MRP bagi home industry/UMKM dalam mengoptimalkan manajemen persediaan serta menjadi referensi bagi penelitian selanjutnya di bidang inventory control dan supply chain management.

Kata Kunci **: *Pengendalian persediaan; Material Requirement Planning (MRP); Lot Sizing; Peramalan; Efisiensi Biaya***

INTRODUCTION

Currently, competition in the home industry, also known as the MSME (Micro, Small, and Medium Enterprises) sector in Indonesia, is becoming increasingly intense. According to data from the Indonesian Chamber of Commerce and Industry (KADIN), the number of MSMEs has increased to 66 million units, reflecting a growth rate of 1.52% compared to the previous year's 65 million units (Fauzan, 2025).

This competition drives each industry to manage its resources more efficiently to enhance productivity and profitability while overcoming various challenges to achieve more effective business operations. Consequently, raw material inventory control is of paramount importance. Inventory generally includes products or materials required by a company at different stages of production and distribution (Simbolon, 2021). The production process cannot function effectively if raw materials are insufficient, and the distribution process may also be disrupted if inventory levels are inadequate.

To meet raw material needs efficiently and at a lower cost, companies can implement raw material inventory control methods. Inventory control is the process of managing stock, which includes planning material preparation at all stages—from raw materials to work-in-progress items and finished products—organizing activities, evaluating performance, and making improvements to the inventory management system (Purnomo & Riani, 2018).

Companies can implement the MRP method to optimize raw material inventory control and ensure efficient supply fulfillment. MRP is a system designed to manage the materials required in the production process. By implementing MRP, companies can optimize warehouse space utilization while minimizing the risk of material shortages. MRP serves as a tool to plan raw material requirements while considering the necessary production lead time. The primary objectives of implementing the MRP system are to reduce inventory levels, minimize production or delivery delays, and create more realistic commitments while enhancing operational efficiency (Utama et al., 2019).

Many businesses and industries, including home-based enterprises, often face challenges in managing raw material stock due to the absence of effective inventory control methods. In home-based cake production, such as the Midi Cake business in Palangka Raya, this can lead to excessive stock accumulation or overstocking, as raw material orders are frequently based on rough estimates rather than accurate calculations, resulting in increased operational costs.

Based on internal records from Cakesters Bakery, an analysis of raw material procurement and usage between December 2023 and November 2024 reveals notable inefficiencies. During this period, a total of 5,037 kilograms of raw materials were purchased, while actual usage amounted to only 2,934 kilograms, indicating a surplus of approximately 2,103 kilograms. This discrepancy suggests stockpiling that could increase storage costs. Among the twelve months observed, May demonstrated the most efficient inventory management, with a raw material purchase of 313 kilograms and actual usage of 284 kilograms, resulting in the smallest difference of just 29 kilograms compared to the other eleven months. This minimal gap indicates an optimal alignment between procurement and production needs. The condition in May serves as a benchmark for efficient inventory control that should be reflected across the other months. In contrast, April recorded the lowest raw material usage with, only 79 kilograms, reflecting a period of reduced sales or production activity. These monthly fluctuations highlight the importance of implementing a more systematic and responsive inventory control approach to better match procurement with actual production demand.

This home industry is located in Palangka Raya, Central Kalimantan, and focuses on producing Midi Cake as the subject of this study. The primary raw materials for Midi Cake include flour, cornstarch, powdered milk, eggs, sugar, cake emulsifier (SP), margarine, fresh cream vanilla, lotus spread, and lotus biscuit. The main issue faced by this home industry is inefficient raw material inventory management, leading to excess inventory each month. To address this issue, the implementation of the MRP system can help in calculating and managing raw material stock more effectively. This study also applies lot-sizing techniques to determine optimal order quantities (Ambarwati & Supardi, 2020), using the EOQ, POQ, and LFL methods.

The Lot-for-Lot (LFL) method is an inventory management strategy that specifies order quantities exactly in accordance with demand requirements for each specific period (Ramdani et al., 2024). Meanwhile, the Economic Order Quantity (EOQ) and Period Order Quantity (POQ) methods are used to determine the optimal order quantity and frequency, with the aim of minimizing inventory costs. EOQ generates the most economical order quantity, while POQ determines the ordering interval based on demand over multiple periods (Risky et al., 2017).

Previous research has demonstrated that the MRP method can optimize raw material procurement costs at NR Brownies Bakery (Cipta et al., 2023). Based on calculations using the EOQ and POQ methods, the study found that both techniques resulted in minimal costs for various raw materials. These findings align with research that revealed that MRP significantly reduces raw material inventory costs in MSME-scale bread production, with the EOQ technique achieving cost savings of up to 88% compared to other methods (Santoso & Suseno, 2024).

Considering the existing issues and findings from previous studies, this research aims to analyze the efficiency of raw material inventory control at Cakesters Bakery and evaluate the application of the MRP method in improving inventory control efficiency. It is expected that this study will contribute to Cakesters Bakery in making informed decisions regarding raw material inventory management and serve as a reference for future research in inventory control and supply chain management.

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RESEARCH METHOD

This study employs a case study method with a descriptive quantitative approach. A descriptive quantitative approach involves collecting, processing, analyzing, and presenting data in numerical form objectively, to explain phenomena based on data and identify patterns and trends that can be used for decision-making (Pangaribuan & Yugopuspito, 2022). Descriptive quantitative research also aims to describe, analyze, and explain a phenomenon as it is, with conclusions drawn based on measurable numerical data (Nurhabiba et al., 2023). This approach is applied to examine the raw material inventory control system for Midi Cake production by implementing the MRP method and demand forecasting to improve raw material management efficiency and forecast future sales at Cakesters Bakery.

The study was conducted at Cakesters Bakery, a home industry located on Sisingamangaraja Street, Menteng Subdistrict, Jekan Raya District, Palangka Raya City, Central Kalimantan. The research variables include independent variables such as Midi Cake demand data, raw material data, lead time, storage costs, and ordering costs. The dependent variable is the efficiency of raw material inventory management. The data collection techniques used in this study include observation, interviews, and literature review. Observations were conducted to gain direct insights into the production process and raw material management. Meanwhile, interviews aim to gather information regarding the ordering process and inventory control of raw materials. The literature review is utilized to strengthen the theoretical foundation of the study and ensure the relevance of the applied methods (Sahir, 2021; Sundari et al., 2024). The collected data consists of primary data from observations and interviews with the owner of Cakesters Bakery, as well as secondary data from literature, MRP-related journals, raw material transaction records, and sales data. The unit of analysis in this study includes the amount of raw materials used in production and the inventory control methods implemented at Cakesters Bakery. The sample consists of Midi Cake demand data from the past 12 months, which serves as the basis for demand forecasting and MRP calculations for the 13th month.

Data analysis techniques involve demand forecasting using the Linear Regression and Moving Average (MA) methods. The best forecasting method is selected based on the Mean Absolute Deviation (MAD), Mean Absolute Percentage Error (MAPE), and Mean Squared Error (MSE) values. Following the forecasting stage, MRP calculations are carried out to determine the optimal ordering quantity and timing. In implementing MRP, three lot sizing techniques are applied: Lot-for-Lot (LFL), Economic Order Quantity (EOQ), and Periodic Order Quantity (POQ).

The first technique is the Lot-for-Lot (LFL) method. The LFL technique is a simple and easily understandable method. This technique aims to minimize storage costs by ordering materials only when needed. In each period, the order quantity is adjusted to meet the net requirements, ensuring that no excess inventory is stored (Ambarwati & Supardi, 2020). In the LFL method, the order quantity matches actual demand, preventing stockpiling. Consequently, the costs incurred are only related to ordering costs. This method assumes that suppliers, whether internal or external, do not impose specific lot size constraints, allowing flexibility in order quantities.

The second technique utilized is the Economic Order Quantity (EOQ) method. EOQ represents the optimal purchase quantity that minimizes total inventory costs. EOQ calculations consider various factors related to inventory costs (Pradana & Jakaria, 2020).

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The formula used for MRP calculations based on the EOQ technique is as follows (Martono, 2018):

$$\mathbf{EOQ} = \sqrt{\frac{\mathbf{2AO}}{\mathbf{S}}} \quad (\mathbf{1})$$

where A represents the total inventory requirement (units/year), O represents the ordering cost per unit, and S represents the inventory holding cost per unit.

The third technique is the Periodic Order Quantity (POQ) method. POQ is a technique aimed at determining the ordering time interval to make it more organized and efficient (Zain, 2021). The formula used for the calculation of MRP using the POQ technique is as follows (Martono, 2018):

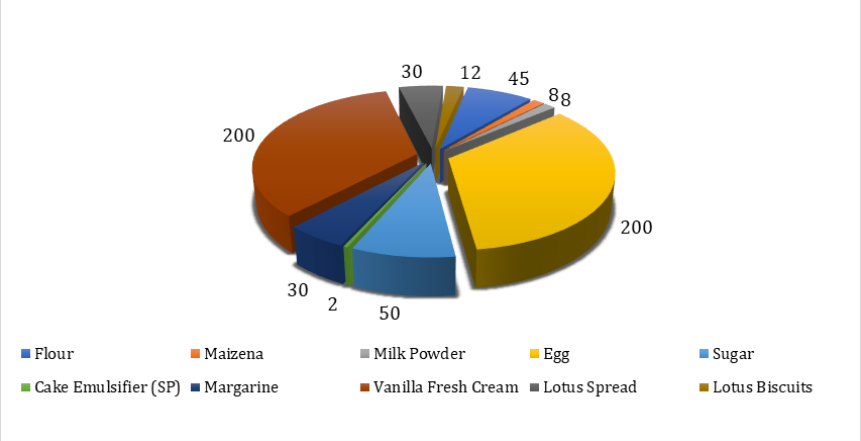
$$\mathbf{POQ} = \frac{\mathbf{EOQ}}{\mathbf{Average\ Demand\ per\ Period}} \quad (\mathbf{2})$$

where EOQ represents the Economic Order Quantity, which is the optimal order quantity that minimizes total inventory costs, and Average Demand per Period represents the average quantity of raw materials required in each period based on historical demand data.

Finally, data processing is carried out using Minitab version 22.1 for demand forecasting and Microsoft Excel for MRP analysis. The results of this analysis are expected to provide recommendations regarding optimal inventory control strategies to enhance operational efficiency at Cakesters Bakery.

RESULTS AND DISCUSSION

The data collected in this study include information on the composition of raw materials, inventory costs, and other related expenses, such as storage and ordering costs. However, the data have limitations due to the lack of complete internal records and interview results, which may affect the completeness of the MRP calculations. The composition of raw materials used in the production of Midi Cake is presented in Figure 1.



Source: Midi Cake Raw Material Data, 2025

Figure 1. Composition of Raw Materials for Midi Cake Production (grams)

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Figure 1 illustrates the composition of raw materials required to produce a single unit of Midi Cake at the Cakesters Bakery home industry. The total weight of raw materials used amounts to 585 grams (0.585 kg). The chart shows that the primary ingredients are eggs and vanilla fresh cream, each contributing 200 grams. Other significant ingredients include 50 grams of sugar, 45 grams of flour, and 30 grams of margarine. Smaller quantities of additional components, such as cake emulsifier (SP), milk powder, cornstarch, lotus biscuits, and lotus spread are also included

At Cakesters Bakery, the store owner procures raw materials directly at the beginning of each month, with a purchase frequency of once per month. This process does not require lead time, as the ordered raw materials are generally available immediately upon request. Furthermore, storage and ordering costs incurred during the production process of Midi Cake are identified. This analysis will be conducted through MRP calculations to evaluate inventory management efficiency. Ordering costs refer to expenses associated with the procurement of goods or materials by the company. Meanwhile, storage costs represent expenses incurred due to the storage of goods in the warehouse (Ramadhona & Puspitasari, 2016). The details of storage and ordering costs for Midi Cake raw materials over one month are presented in Table 1.

Table 1. List of Storage and Ordering Costs for Midi Cake Raw Materials

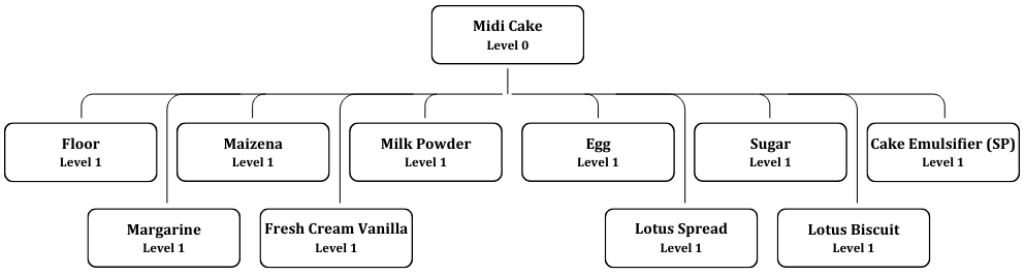
No	Cost Type	Description	Cost (Rp)
1	Storage Cost	Electricity	Rp25.000
2	Ordering Cost	Transportation	Rp100.000

Source: Midi Cake Raw Material Storage and Ordering Cost Data, 2025

Table 1 shows that the monthly storage cost is Rp25,000, attributed to electricity usage for raw material storage. Additionally, the monthly ordering cost amounts to Rp100,000, which is spent on transportation to procure the raw materials.

Product Structure Determination

The product structure is used to describe the arrangement of raw materials that make up the final product. In this study, the product structure of the Midi Cake is designed to provide an understanding of the components required in the production process and to support Material Requirements Planning (MRP), as illustrated in Figure 2.



Source: Processed Primary Data, 2025

Figure 2. Product Structure of Midi Cake

Once the product structure of the Midi Cake is established, the next step is to create the Bill of Materials (BOM). The BOM is a comprehensive list that includes all raw materials,

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components, sub-assemblies, and assemblies required to manufacture a unit of the product. Additionally, the BOM outlines the relationships between the product and its components, specifying material types, required quantities, and hierarchical levels. Typically, this list is presented in the form of a product structure tree to facilitate a clearer understanding of the material hierarchy and composition (Novitasari, 2022). In other words, the BOM details every essential element, from raw material components to their sources, necessary for producing the final product. The BOM is presented in Table 2 below:

Tabel 2. Bill of Material (BOM)

Material level	Raw Material	Quantity (Kg)	Source
-	Midi Cake	-	Production
1	Flour	0,045	Buy
1	Maizena	0,008	Buy
1	Milk Powder	0,008	Buy
1	Egg	0,200	Buy
1	Sugar	0,053	Buy
1	Cake Emulsifier (SP)	0,003	Buy
1	Margarine	0,030	Buy
1	Vanilla Fresh Cream	0,200	Buy
1	Lotus Spread	0,030	Buy
1	Lotus Biscuits	0,12	Buy

Source: Processed Primary Data, 2025

Table 2 presents the Bill of Materials (BOM) for one unit of Midi Cake. All components listed are at Material Level 1, indicating that they are directly used in the final product without intermediate subassemblies. The table details the name of each raw material, the quantity required in kilograms (Kg), and the sourcing method—either purchased ("Buy") or produced internally ("Production"). The primary raw materials contributing the largest quantities are eggs and vanilla fresh cream, each at 0.200 Kg. This BOM serves as a fundamental reference for production planning and inventory control processes, particularly in Material Requirements Planning (MRP) analysis.

Demand Data

Demand data represents the total sales of the Midi Cake product from December 2023 to November 2024. This data is used to generate a demand plot and analyze sales trends to assist in raw material inventory planning, as shown in Table 3.

Table 3. Midi Cake Demand Data (December 2023 – November 2024)

Period	Quantity Demand (Unit)
December	356
January	286
February	357
March	446
April	135
May	486
June	480
July	609
August	577
September	416
October	443
November	425

Source: Midi Cake Demand Data (December 2023 – November 2024)

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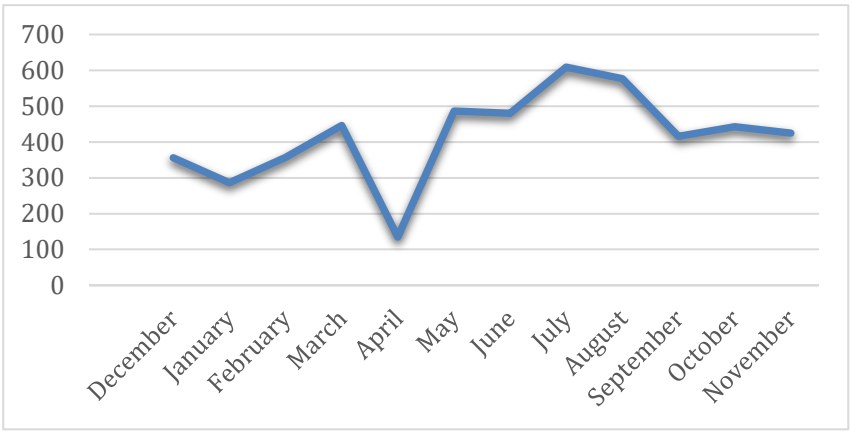
Table 3 presents the monthly demand data for Midi Cake from December 2023 to November 2024. The data show significant variation across the months. The highest recorded demand occurred in July (609 units), followed by August (577 units), while the lowest demand was observed in April (135 units). Such fluctuations suggest a possible seasonal or periodic pattern in customer purchasing behavior. This table provides essential input for analyzing demand trends and forecasting future needs using statistical tools. Based on the demand table, the demand pattern for the Midi Cake product can be analyzed using Minitab 22.1 software, as illustrated in Figure 3.



Source: Processed Primary Data, 2025

Figure 3. Plot of Midi Cake Demand Data (December 2023 – November 2024)

The forecasting conducted in this study covers a one-month period. This approach is taken because long-term forecasts tend to yield less accurate results. The forecasting process in this study is carried out using Minitab 22.1 software. Sales forecasting plays a crucial role in planning sales strategies and business development by providing insights into potential future trends. With forecasting, businesses can anticipate risks and devise appropriate measures to optimize their operations for each product (Parlina, 2017).

Based on the analysis of historical demand data in Figure 3, significant fluctuations can be observed in April. Interviews with the store owner revealed that this fluctuation was caused by the Eid holiday. This suggests that a similar pattern is likely to occur during the Eid period in the following year. Additionally, the demand plot also exhibits a seasonal pattern, where recurring trends appear within a year, such as weekly, monthly, or quarterly cycles. These patterns are evident in the form of peaks and troughs that repeat at similar intervals. Quarterly and monthly data are typically influenced by seasonal factors due to their recurrence (Alfarisi et al., 2024).

Given the variations in demand and the presence of seasonal patterns, this study utilizes two forecasting methods: Moving Average and Linear Regression. These methods are compared based on MAD, MAPE, and MSE values, with the method yielding the smallest error being selected as the best approach. The forecasting calculations using Moving Average and Linear Regression, analyzed through Minitab 22.1, are presented in Table 4.

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Table 4. Comparison of Forecasting Error Values

Forecasting Methods	MAD	MSE	MAPE
Moving Average	118,5	20591,3	39,3
Linear Regression	85,2	11572,6	29,6

Source: Processed Primary Data, 2025

Table 4 displays a comparison of forecasting error values between the Moving Average and Linear Regression methods. Based on the forecasting calculations conducted using the Moving Average and Linear Regression methods, it was determined that the most accurate method is the Linear Regression method, as it has the smallest error measures. The evaluation results show that this method has a MAD of 85.2, an MSE of 11572.6, and a MAPE of 29.6. Following the Linear Regression method, the forecasted demand for December 2024 is estimated to be 524 units, as shown in Table 5.

Table 5. Forecasted Demand for Midi Cake in December 2024

Month	Forecasted Demand (Units)
Desember 2024	524

Source: Processed Primary Data, 2025

Table 5 shows the forecasted demand for the Midi Cake product in December 2024, which is projected to be 524 units. This forecasted figure was generated based on the results of the Linear Regression method, which was previously identified as the most accurate forecasting model due to its lower error values. The result provides a quantitative basis for planning raw material procurement and production volume to meet anticipated customer demand in that specific month.

Master Production Schedules (MPS)

The Master Production Schedule (MPS) is a plan used to regulate the production schedule. The MPS is prepared based on the forecasting results and customer demand. In this study, the MPS for the Midi Cake product is structured according to the forecasting results obtained. As shown in Table 6, a weekly MPS is established for the Midi Cake product.

Tabel 6. Weekly Master Production Schedules (MPS) December 2024

Product	Week-				Total
	1	2	3	4	
Midi Cake	131	131	131	131	524

Source: Processed Primary Data, 2025

Table 6 presents the Master Production Schedule (MPS) for the Midi Cake product in December 2024. The schedule is divided into four weekly periods, with a consistent production quantity of 131 units per week. This uniform distribution was derived from the total forecasted demand of 524 units for the month.

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Research Analysis by Comparing Lot Sizing Methods

After performing calculations using the three selected lot-sizing methods, the next step is to compare the results and select the method that yields the lowest total cost. The comparison of the three lot-sizing methods for each raw material is presented in Table 7.

Table 7. Comparison of Lot Sizing for Midi Cake Raw Materials

No.	Product	Lot Sizing		
		LFL	EOQ	POQ
1.	Flour	Rp400.000	Rp700.000	Rp500.000
2.	Maizena	Rp400.000	Rp400.000	Rp250.000
3.	Milk Powder	Rp400.000	Rp400.000	Rp250.000
4.	Egg	Rp400.000	Rp850.000	Rp400.000
5.	Sugar	Rp400.000	Rp550.000	Rp550.000
6.	Cake Emulsifier (SP)	Rp400.000	Rp286.000	Rp219.500
7.	Margarine	Rp400.000	Rp700.000	Rp500.000
8.	Vanilla Fresh Cream	Rp400.000	Rp850.000	Rp400.000
9.	Lotus Spread	Rp400.000	Rp700.000	Rp500.000
10.	Lotus Biscuits	Rp400.000	Rp325.000	Rp400.000

Source: Processed Primary Data, 2025

Referring to Table 7, it is observed that the MRP method using the LFL and POQ techniques tends to result in lower total costs for certain raw materials compared to the total costs obtained using the EOQ technique. The total costs incurred for the overall production of the Midi Cake, including total storage and ordering costs from the three lot-sizing calculations, are presented in Table 8.

Table 8. Comparison of Lot Sizing for Midi Cake Raw Materials

Cost Type	Lot Sizing		
	LFL	EOQ	POQ
Storage Cost	0	Rp2.000.000	Rp2.100.000
Ordering Cost	Rp4.000.000	Rp3.761.000	Rp1.869.500
Total Cost	Rp4.000.000	Rp5.761.000	Rp 3.969.500

Source: Processed Primary Data, 2025

Table 8 displays a comparison of lot-sizing methods for the procurement of raw materials used in the production of Midi Cake. The three methods analyzed are Lot-for-Lot (LFL), Economic Order Quantity (EOQ), and Periodic Order Quantity (POQ).

The LFL method incurs no storage cost, as materials are ordered exactly as needed, but results in the highest ordering cost (Rp4,000,000). The EOQ method strikes a balance by minimizing ordering frequency, resulting in a lower ordering cost (Rp3,761,000) but a higher storage cost (Rp2,000,000), leading to the highest total cost (Rp5,761,000). Meanwhile, the POQ method offers the most cost-efficient approach, with the lowest total cost (Rp3,969,500), due to a significantly reduced ordering cost (Rp1,869,500), despite a slightly higher storage cost (Rp2,100,000). This comparison indicates that the POQ method is the most economical lot-sizing strategy for Midi Cake production in terms of total inventory-related costs.

In addition to determining the final order quantity for each lot-sizing technique, reviewing the MRP table enables the company to identify both the timing of raw material arrivals and the weekly raw material requirements. The MRP table includes several key

elements: gross requirements, inventory, scheduled receipts, net requirements, order receipts, and order releases.

CONCLUSION

This study at Cakesters Bakery Home Industry applied the Material Requirements Planning (MRP) method to the Midi Cake product through demand forecasting for the upcoming month. The results showed that the Linear Regression technique produced the most accurate forecast based on the lowest MAD, MSE, and MAPE values. In terms of raw material planning, the cost analysis using various lot-sizing techniques revealed that LFL and POQ were the most suitable methods, with POQ yielding the lowest total cost over one month of production. Therefore, by adopting accurate forecasting methods and implementing an MRP system in raw material inventory management, Cakesters Bakery can minimize raw material shortages or excess inventory and enhance profitability. The forecasting results will serve as a reliable reference for procurement planning, while MRP provides a structured approach to inventory control and cost estimation, supporting more informed and efficient production decisions.

RECOMMENDATIONS

In this study, MRP calculations were conducted manually using Microsoft Excel, which required periodic inventory checks based on the input data. Future studies are encouraged to adopt more advanced software tools beyond Microsoft Excel such as "Quantitative Management (QM) for Windows", to enhance the precision and efficiency of inventory planning and cost analysis. A key limitation of this study is the absence of comprehensive data derived from interviews, observations, or internal company records. This limitation stems from the wide variety of cake products manufactured at Cakesters Bakery, where detailed records of raw material purchases and costs were not consistently maintained for each product. Maintaining such records across all product lines could support more robust, data-driven decision-making processes in future research and business operations.

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