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## Control of Notebook Inventory Using an Integrated ABC, EOQ, and ROP Approach for Seasonal Demand Planning in the 2026 Academic Year at PT Senyum Media Utama

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### Abstract

This study aims to analyze and optimize notebook inventory control at PT Senyum Media Utama in order to anticipate the demand surge during the 2026 new academic year period (May–August). The current inventory policy relies heavily on experience-based decisions, which may result in overstock or stock shortages during seasonal fluctuations. Therefore, this research proposes a more systematic and quantitative approach by integrating ABC analysis, Economic Order Quantity (EOQ), Safety Stock, and Reorder Point (ROP). Inventory performance is evaluated based on total inventory cost efficiency and the establishment of quantitative reorder thresholds under a specified service level. Demand forecasting is conducted using monthly historical data from 2022 to 2024, with model validation through a train-test split approach. The results show that 9 Category A notebook products account for 70.02% of total annual inventory investment, highlighting their critical importance.

Based on model assumptions, the EOQ method reduces projected total inventory costs from IDR 4,511,172 to IDR 3,664,004, resulting in an efficiency improvement of approximately 19%. In addition, Safety Stock and ROP calculations generate measurable reorder thresholds to support inventory availability and reduce stockout risk during peak demand, targeting a 95% service level. However, these findings are model-based and depend on assumptions such as constant holding costs, stable lead times, and the selected service level. Since the framework has not yet been implemented, further validation through real-world application or simulation is required. Future research is recommended to incorporate stochastic demand and lead time variability, as well as cross-company comparisons, to enhance the robustness and generalizability of the proposed approach.

#### KEYWORDS

inventory control, abc analysis, eoq, reorder point, cost efficiency.

### Introduction

PT Senyum Media Utama is a major local office stationery retailer in Jember Regency, playing a significant role in supplying school and office needs within the region (Badan Pusat Statistik Kabupaten Jember, 2024; Dinas Perindustrian dan Perdagangan Kabupaten Jember, 2023). Internal sales records from September 2024 to August 2025 indicate that average notebook sales during the May–August period are approximately 32% higher than in other months, clearly reflecting a strong seasonal demand surge associated with the new academic year cycle (Aryati et al., 2020; RKB Pekalongan, 2023). This recurring pattern highlights the critical need for a more structured, data-driven, and responsive inventory control system that is capable of aligning stock availability with fluctuating demand levels. At present, however, inventory decisions are largely based on managerial judgment and past experience, without the support of formal

quantitative models or systematic analytical tools. As a result, inventory planning tends to be reactive rather than proactive, potentially leading to inefficiencies in both cost management and service performance (Kompasiana, 2022). Based on internal interviews with inventory staff, this judgment-based approach has contributed to several operational inefficiencies, including instances of overstock during low-demand periods and the need for urgent replenishment orders when demand unexpectedly increases. These conditions not only elevate holding and ordering costs but also disrupt operational stability and reduce planning accuracy (Dinas Perindustrian dan Perdagangan Kabupaten Jember, 2023; Kompas TV, 2023). Furthermore, the absence of a formal stockout Key Performance Indicator (KPI) tracking system limits the company's ability to quantitatively evaluate service levels and identify gaps in inventory performance. Although previous studies have shown that methods such as ABC analysis, Economic Order Quantity (EOQ), and Reorder Point (ROP) can significantly enhance inventory efficiency and decision-making accuracy, most of these approaches are implemented in isolation and do not fully address the complexities of seasonal demand (Ong et al., 2020; Sudarma, 2023). Therefore, this study proposes an integrated ABC-EOQ-ROP framework tailored specifically for seasonal retail inventory planning. By combining product prioritization, cost optimization, and service level-based reorder policies, the proposed framework is expected to provide a more comprehensive and systematic solution for improving cost efficiency, enhancing service level reliability, and reducing the risk of both overstock and stockout conditions during peak academic demand periods (Kompasiana, 2024; RKB Pekalongan, 2023).

## Method

This study adopts a quantitative analytical research design to systematically evaluate and optimize inventory control policies for seasonal notebook products. The analysis relies on secondary data, including historical sales records, ordering costs, holding costs, and lead time information obtained from company databases. The unit of analysis is defined at the SKU-month level, encompassing 31 active notebook SKUs and their corresponding monthly sales observations, allowing for a detailed and disaggregated assessment of inventory behavior across products and time (Hafni Sahir, 2022). To ensure alignment with current inventory conditions, ABC classification is conducted using sales data from September 2024 to August 2025, thereby reflecting the most recent inventory value structure and enabling prioritization of high-impact items. In parallel, demand forecasting is performed using 36 months of historical data from January 2022 to December 2024, providing a sufficient time horizon to capture underlying demand patterns, including trend movements and recurring seasonality linked to the academic calendar cycle (Sari et al., 2022).

Furthermore, Economic Order Quantity (EOQ), Safety Stock, and Reorder Point (ROP) are calculated specifically for Category A notebook products, which represent the most critical items in terms of both inventory investment and demand intensity. These calculations are deliberately focused on the peak demand period of the new academic year from May to August, where the risk of stock imbalances is highest. The EOQ model is used to determine optimal order quantities that minimize the trade-off between ordering and holding costs (Busola et al., 2020). Safety Stock is established to buffer against uncertainties in demand and lead time variability (Gani et al., 2022). In addition, the ROP calculation defines precise reorder thresholds that trigger replenishment decisions at the appropriate time to maintain a targeted

service level (Fole et al., 2024). By integrating forecasting results with inventory optimization models and service level considerations, this approach offers a comprehensive and data-driven framework that enhances cost efficiency, improves inventory availability, and strengthens the company's ability to respond proactively to seasonal demand fluctuations (Hamidah et al., 2022).

### ABC Method Analysis

In the ABC method analysis, products are classified into three main categories based on the Pareto principle. ABC classification is based on cumulative annual investment value thresholds rather than fixed item proportions. In the retail industry, a commonly applied approach is the classification of various product items using ABC analysis by considering multiple criteria (Megawati et al., 2021). The process of classifying inventory items into classes A, B, and C in the ABC analysis is carried out through the following stages:

1. Calculating the annual rupiah volume by multiplying the annual usage volume by the unit price.
2. Ranking inventory items based on their annual rupiah volume from the highest to the lowest value.
3. Calculating the cumulative annual rupiah volume.
4. Computing the cumulative percentage value.
5. Category A represents approximately the top 70% cumulative value, Category B the next 20%, and Category C the remaining 10%.

### EOQ Method Analysis

The EOQ calculation focuses on the forecasted demand for category A notebook products during the peak new academic year period (May–August), as this period contributes the highest and most dominant demand for inventory planning. According to Heizer et al., 2017 dan Heizer et al., 2020 the EOQ formula used in this study is expressed as follows:

$$EOQ = \sqrt{\frac{2(D)(S)}{H}}$$

$$Ordering\ Frequency = \frac{Average\ Annual\ Demand}{EOQ}$$

Where:

D = Demand quantity (units) within one period (one year)

S = Ordering cost per order

H = Holding cost per unit

The components of ordering and holding costs are obtained directly from the company. Meanwhile, demand data are not solely based on historical data; demand forecasting is conducted to estimate future demand. Forecasting is a crucial stage in inventory management systems, as its results serve as the basis for determining inventory requirements. In this study, demand forecasting for Category A notebook products is conducted using monthly historical sales data from the past three years (January 2022 to December 2024).

### ROP Method Analysis

Prior to applying the Reorder Point (ROP) method, safety stock is first determined to establish an appropriate buffer inventory level that ensures continuity in sales operations despite uncertainties in demand and lead time. Safety stock serves as a protective mechanism against variability, reducing the risk of stockouts that may occur due to demand fluctuations or delays in replenishment (Rofiq et al., 2020). By incorporating safety stock into the inventory system, the company is better positioned to maintain service level targets and avoid disruptions during critical selling periods. The calculation of safety stock and ROP in this study is specifically focused on the forecasted demand for Category A notebook products during the peak new academic year period (May–August), which represents the highest and most dominant demand cycle in the company's inventory planning. This targeted approach ensures

that inventory parameters are aligned with periods of maximum demand intensity, where the consequences of stockouts are most significant. As a result, the integration of safety stock and ROP not only improves the accuracy of reorder decisions but also enhances the company's ability to respond proactively to seasonal demand surges while maintaining a desired service level. According to Shenoy & Rosas (2017), when lead time is constant while demand fluctuates, safety stock can be calculated using the following formula:

$$SS = Z \times \sigma d \times \sqrt{L}$$

Where:

SS = Safety stock

Z = Service level

σd = Standard deviation of daily demand

L = Lead time

The ROP method determines the reorder point at which a replenishment order must be placed once inventory reaches this level. According to Shenoy & Rosas (2017), the ROP formula under conditions of constant lead time and fluctuating demand is as follows:

$$ROP = (\bar{d} \times L) + SS$$

Where:

ROP = Reorder Point

d = Average daily demand

L = Lead time

SS = Safety stock

#### Comparison of Total Inventory Costs

The comparison of total inventory costs is conducted to evaluate the differences between the company's existing inventory policy and the costs calculated using the Economic Order Quantity (EOQ) method, which consist of ordering costs and holding costs (Soraya et al., 2022; Sukendar et al., 2023). This comparison provides a quantitative basis for assessing whether the current policy is economically efficient or whether it results in excessive costs due to suboptimal order quantities. By explicitly separating and analyzing these cost components, the study is able to identify potential inefficiencies in the company's inventory practices and highlight opportunities for cost optimization through a more systematic approach (Nadhifa et al., 2022). According to Heizer et al. (2020), decision-making that focuses on minimizing total inventory costs enables companies to achieve an optimal balance between ordering frequency and inventory holding levels. Such a balance is essential to avoid both overstock conditions, which increase holding costs, and frequent small orders, which raise ordering costs. Therefore, the application of the EOQ model in this study not only serves as a cost-minimization tool but also as a decision-support mechanism that enhances the overall efficiency and rationality of inventory management policies.

## Result and Discussion

#### ABC Method Calculation

This analysis uses sales data from September 2024 to August 2025. PT Senyum Media Utama has 31 types of notebook products to be classified using the ABC method. Based on Table 1 and the detailed calculations presented in Appendix 1, the following results are obtained:

- Group A consists of 9 items (29.03% of total items) with an annual rupiah volume of IDR 495,281,000, representing 70.02% of the total annual rupiah volume.
- Group B consists of 8 items (25.81% of total items) with an annual rupiah volume of IDR 141,611,000, accounting for 20.02% of the total annual rupiah volume.

- Group C consists of 14 items (45.16% of total items) with an annual rupiah volume of only IDR 70,436,500, contributing 9.96% of the total annual rupiah volume.

#### EOQ Method Calculation

The EOQ calculation in this study is conducted to determine the optimal order quantity for category A notebook products during the 2026 new academic year period. According to Rofiq et al. (2020) dan Silaen et al. (2024) the EOQ method requires three main components: demand data, ordering costs, and holding costs. Based on the collected data, ordering and holding costs are obtained directly from PT Senyum Media Utama.

Table 1. ABC Classification of Notebook Inventory

Notebook Group	Number of Items	Percentage (%)	Investment Value (IDR)	Percentage (%)
A	9	29.03	495,281,000	70.02
B	8	25.81	141,611,000	20.02
C	14	45.16	70,436,500	9.96
Total	31	100	707,328,500	100

Source: Processed data, 2025

Table 2. EOQ Calculation Results

No	Product Name	EOQ	Ordering Frequency
1	Sidu Kraft 40V	1.424	9
2	Sidu 38V	1.347	8
3	Sidu 58V	793	8
4	Big Boss Boxy 50V	599	6
5	Big Boss Boxy 36V	926	7
6	Okey 38V	623	4
7	Sidu Strimin SQ5	805	5
8	Sidu 32V	956	5
9	Okey Boxy 50V	422	5

Source: Processed data, 2025

Table 3. Safety Stock Calculation Results

No	Product Name	SS
1	Sidu Kraft 40V	1.039
2	Sidu 38V	729
3	Sidu 58V	378
4	Big Boss Boxy 50V	144
5	Big Boss Boxy 36V	330
6	Okey 38V	153
7	Sidu Strimin SQ5	309
8	Sidu 32V	95
9	Okey Boxy 50V	109

Source: Processed data, 2025

Table 4. ROP Calculation Results

No	Product Name	ROP
1	Sidu Kraft 40V	1.599
2	Sidu 38V	1.185
3	Sidu 58V	632
4	Big Boss Boxy 50V	304
5	Big Boss Boxy 36V	601
6	Okey 38V	247
7	Sidu Strimin SQ5	475
8	Sidu 32V	299
9	Okey Boxy 50V	192

Source: Processed data, 2025

**Table 5.** Comparison of Total Inventory Costs Between Company Policy and EOQ Method

No	Product Name	Company Policy (IDR)	EOQ Method (IDR)	Difference (IDR)	Percentage
1	Sidu Kraft 40V	837,968	602,526	235,442	28%
2	Sidu 38V	653,534	518,416	135,118	21%
3	Sidu 58V	599,571	491,090	108,481	18%
4	Big Boss Boxy 50V	334,196	316,461	17,734	5%
5	Big Boss Boxy 36V	521,719	406,330	115,389	22%
6	Okey 38V	338,303	267,151	71,153	21%
7	Sidu Strimin SQ5	468,651	433,704	34,948	7%
8	Sidu 32V	335,646	325,962	9,685	3%
9	Okey Boxy 50V	421,583	302,363	119,219	28%
Total		4,511,172	3,664,004	847,168	19%

Source: Processed data, 2025

The ordering cost consists of telephone communication expenses amounting to IDR 1,950 and goods receiving labor costs of IDR 30,000, resulting in a total ordering cost of IDR 31,950 per order transaction. These costs are variable per order and are assumed to be uniform across notebook products, as the company applies the same administrative and receiving procedures regardless of supplier or product type. Transportation costs and supplier fees are excluded because the company applies an FOB destination agreement, under which delivery costs are borne by the supplier.

The holding cost rate is determined at 15.64% (0.1564) per year of the acquisition cost. This percentage is calculated by dividing the total annual warehouse-related costs by the maximum warehouse capacity valued at IDR 3,000,000,000.

The resulting rate represents the annual proportion of storage costs allocated to inventory value and is used to calculate the holding cost per unit by multiplying the acquisition cost per notebook unit by 15.64% (0.1564), thereby reflecting the annual storage expense assigned to each product based on its purchase value (Pleños, 2022). According to Hyndman & Athanasopoulos (2021) Since the EOQ model requires future demand estimation, demand forecasting is conducted using the Holt-Winters Exponential Smoothing Multiplicative method with a seasonal length of 12 months (Paramu, 2018; Reza Hoshmand, 2010). Forecast validation is performed using a train-test split approach, where data from 2022-2023 are used for model training and 2024 data are used for testing. Forecast accuracy is evaluated using Mean Absolute Percentage Error (MAPE) (Makridakis et al., 2020; Makridakis, Hyndman, et al., 2020) For the Sidu Kraft 40V product, parameter initialization is set as follows:  $L_1$  equals the first actual observation,  $T_1 = 0$ , and  $S_1 = 1$ . Parameter optimization using Excel Solver produces  $\alpha = 0.765$ ,  $\beta = 0.272$ , and  $\gamma = 0.694$ . The model yields a MAPE value of 27%, which is lower than the seasonal naïve model (34%), indicating improved predictive performance. The estimated components for the subsequent period are  $L_2 = 348.526$ ,  $T_2 = 24.323$ , and  $S_2 = 1.055$ . (Suryawan et al., 2024)

After obtaining the forecasting results, EOQ calculations are conducted using demand data for the new academic year period (May-August) for nine category A notebook products, as this group has the highest investment value and dominant demand. An example calculation for the Sidu Kraft 40V product is presented below (see table 2).

Given:

D = 13,429 units

S = IDR 31,950 per order

H = IDR 423 per unit per year

$$EOQ = \sqrt{\frac{2(D)(S)}{H}}$$

$$= \sqrt{\frac{2(13.429)(Rp\ 31.950)}{Rp.423}}$$

$$= 1.424 \text{ Units}$$

$$\text{Ordering frequency} = \frac{\text{Average Annual Demand}}{EOQ} = \frac{13.429}{1.424} = 9 \text{ order per year}$$

**ROP Method Calculation**

Before calculating the Reorder Point (ROP), safety stock is determined to ensure uninterrupted sales operations. The calculation focuses on category A items using forecasted demand data for the May-August period, which represents the new academic year peak season. The safety stock calculation requires the service level (Z), demand standard deviation, and lead time. Based on company data, the desired service level is 95% ( $Z = 1.645$ ), and the lead time for all notebook products is 5 days.

An example calculation for the Sidu Kraft 40V product is as follows (see table 3).

Given:

Z = 1.645

$\sigma d = 282.511$

L = 5 days

$$SS = Z \times \sigma d \times \sqrt{L}$$

$$SS = 1,645 \times 282,511 \times \sqrt{5}$$

$$SS = 1,645 \times 282,511 \times 2,236$$

$$SS = 1.039 \text{ Units}$$

The ROP calculation is also focused on category A items using forecasted demand data for the May-August period. An example calculation for the Sidu Kraft 40V product is presented below (see table 4).

Given:

d = 112 units/day

L = 5 days

SS = 1,039 units

$$ROP = (\bar{d} \times L) + SS$$

$$ROP = (112 \times 5) + 1.039$$

$$ROP = 1.599 \text{ Units}$$

**Comparison of Total Inventory Costs**

Table 5 presents a comparison of total inventory costs between the company's existing inventory policy and the EOQ method for category A notebook products. The comparison highlights differences in ordering and holding costs for each product and demonstrates the potential cost savings achieved through the implementation of the EOQ method.

Based on Table 5, the total inventory cost under the company's existing policy for category A products amounts to IDR 4,511,172, which is higher than the total inventory cost calculated using the EOQ method at IDR 3,664,004. This indicates a cost saving of 19%. These results demonstrate that the EOQ method is capable of providing significant inventory cost savings compared to the company's previous inventory policy.

## Conclusion

This study proposes an integrated framework that combines ABC classification, Economic Order Quantity (EOQ), and Reorder Point (ROP) methodologies to support more effective seasonal notebook inventory planning. The integration of these approaches enables the development of a structured, data-driven inventory control system in which ABC analysis is used to prioritize high-value and high-impact items, EOQ determines the optimal order quantity that minimizes the trade-off between ordering and holding costs, and ROP establishes precise reorder thresholds based on demand patterns and lead time considerations. By aligning product prioritization with cost optimization and replenishment timing, the framework provides a more comprehensive basis for inventory decision-making compared to conventional experience-based approaches. In this study, inventory control effectiveness is evaluated using two primary indicators: (1) the reduction of total inventory cost and (2) the establishment of reorder points that achieve a 95% service level, thereby reducing the likelihood of stockouts during peak demand periods. The application of the EOQ model demonstrates a projected

cost efficiency improvement, with an estimated 19% reduction in total inventory cost compared to the company's existing, less optimized inventory policy. In addition, the integration of ROP ensures that replenishment decisions are triggered at appropriate inventory levels, improving responsiveness to demand fluctuations and supporting more consistent service performance. Despite these promising analytical outcomes, the results remain theoretical and model-based, as they rely on assumptions such as stable demand patterns, constant holding cost rates, and fixed lead times. Consequently, the extent to which the proposed framework can deliver actual operational improvements particularly in reducing stockouts, stabilizing service levels, and enhancing responsiveness to demand variability cannot be fully confirmed without empirical validation. Therefore, future research is recommended to extend this study by incorporating multi-company comparisons to improve generalizability, applying stochastic modeling of demand and lead time to better reflect real-world uncertainty, and conducting before-and-after Key Performance Indicator (KPI) evaluations following implementation. Such extensions would provide stronger empirical evidence on the effectiveness and practical applicability of the integrated ABC-EOQ-ROP framework in diverse operational settings.

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