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Inventory Control Analysis Of Plain Helm Products At The Online Distribution Warehouse Of Pt Y

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Abstract

Inventory control in online distribution warehouses presents challenges in maintaining product availability, particularly when products consist of multiple variants with different demand patterns. Differences in demand among variants may lead to inventory imbalances and stock shortages, highlighting the need for appropriate inventory control policies. This study aims to evaluate inventory control practices for Plain Helm products at the online distribution warehouse of PT Y and determine the recommended order quantity, safety stock, and reorder point. This study employed a descriptive quantitative approach using historical demand and inventory data from January to December 2025, supported by interviews and observations to identify the company's existing replenishment practices. The analysis involved 11 color variants with a total annual demand of 139,089 units. Based on an ordering cost of IDR 500,000 per transaction and an annual holding cost of IDR 25,000 per unit, the combined Economic Order Quantity (EOQ) was calculated at approximately 2,359 units per order. This quantity was allocated proportionally among the 11 variants according to their respective annual demand. Furthermore, using an assumed service level of 95% and a lead time of two working days, the calculated safety stock ranged from 17 to 33 units per variant, while the Reorder Point (ROP) ranged from 90 to 128 units. These findings provide quantitative references for determining order quantities, maintaining buffer inventory, and establishing replenishment triggers. The results may support more structured inventory planning by considering demand variations and the warehouse's operational conditions.

Keywords: inventory control; Economic Order Quantity; safety stock; reorder point; online distribution warehouse

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INTRODUCTION

Inventory management is an essential component of supply chain operations because it ensures product availability while controlling the cost associated with inventory holding and replasment. Insufficient inventory may result in unfulfilled customer demand and lost sales opportunities, whereas excessive inventory can increase storage and holding costs. Therefore, effective inventory control requires companies to consider demand patterns,ordering cost, holding cosdt, and repleshiment lead times when determining inventory policies.

These challenges are particularly relevant to online distribution warehouses, where product availability must be maintained across multiple product variants. Each variant may have different demand characteristics, resulting in different inventory requirements. Consequently, inventory policies based solely on uniform replenishment quantities may not adequately reflect variations in demand across products. Appropriate inventory planning is therefore necessary to maintain stock availability and reduce the risk of inventory shortages.

PT Y manages Plain Helm products through an online distribution warehouse that serves customer orders from marketplace platforms. Based on the company's inventory records for 2025, the products consisted of 11 color variants with a combined annual demand of 139,089 units. The warehouse generally replenishes approximately 100 units per variant when additional stock is required. However, replenishment is adjusted according to stock availability and sales requirements, meaning that orders are not necessarily placed for all variants simultaneously. The company also recorded inventory shortages in several variants and periods during the observation year. These conditions indicate the importance of evaluating inventory control practices to determine whether replenishment quantities and stock levels are appropriate for the demand characteristics of each variant.

In online retail environments, purchasing channels may influence sales concentration and inventory requirements. Jain and Tan (2022) found that differences between mobile and personal computer shopping channels can affect sales concentration and inventory decisions. This finding highlights the importance of considering product-level demand patterns when managing inventory in online distribution operations.

One approach to determining an appropriate order quantity is the Economic Order Quantity (EOQ) method, which balances ordering and holding costs. Alnahhal et al. (2024) reviewed the role of EOQ in inventory decision-making, particularly under changing supply chain conditions. In addition to determining order quantities, companies need to maintain sufficient buffer inventory to address demand and supply uncertainty. Safety stock serves this purpose, while the Reorder Point (ROP) determines when

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replenishment should be initiated. Gonçalves et al. (2020) reviewed various safety-stock models and highlighted the relevance of demand variability, lead time, and service level in determining safety-stock requirements.

Although EOQ, safety stock, and ROP are established inventory control methods, their application needs to consider the actual ordering-cost structure and demand characteristics of the products being managed. In the context of PT Y's online distribution warehouse, differences in demand among the 11 color variants and the occurrence of inventory shortages provide a basis for evaluating the existing replenishment practices and calculating more structured inventory references.

Therefore, this study aims to evaluate inventory control practices for Plain Helm products at the online distribution warehouse of PT Y. Specifically, this study calculates the recommended order quantity using the EOQ method, determines the required safety stock for each color variant, and calculates the reorder point for each variant. The results are expected to provide quantitative references for improving inventory planning and supporting more structured replenishment decisions.

OBJECTIVES

This study aims to evaluate inventory control practices for Plain Helm products at the online distribution warehouse of PT Y. Specifically, the objectives of this study are:

1. To describe the existing inventory control practices at the online distribution warehouse of PT Y.
2. To determine the recommended order quantity using the Economic Order Quantity (EOQ) method.
3. To calculate the required safety stock for each color variant.
4. To determine the reorder point (ROP) for each color variant as a basis for replenishment decisions.

LITERATURE REVIEW

Inventory Control

Inventory control is an essential activity in inventory management that aims to maintain product availability while minimizing inventory-related costs. Effective inventory control requires companies to determine appropriate stock levels and replenishment policies based on demand, ordering costs, holding costs, and lead time. Inadequate inventory control may result in stock shortages or excessive inventory, both of which can affect operational efficiency.

In online distribution operations, inventory control becomes particularly important because products may consist of several variants with different demand patterns. Jain and Tan (2022) discussed the relationship between purchasing channels, sales

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concentration, and inventory management, highlighting the relevance of demand characteristics in inventory decisions. Therefore, inventory control should consider the specific demand patterns of each product variant to support appropriate replenishment decisions.

Economic Order Quantity (EOQ)

Economic Order Quantity (EOQ) is an inventory control method used to determine an economical order quantity by balancing ordering costs and holding costs. The method provides a reference for determining how much inventory should be ordered to minimize the total costs associated with these two components.

Alnahhal et al. (2024) reviewed the development and application of EOQ in inventory management, particularly in supply chains characterized by uncertainty. Their review demonstrates the continued relevance of EOQ as a basis for inventory decision-making. In addition, Saputra et al. (2024) examined the application of EOQ alongside safety stock to support inventory control optimization.

In this study, EOQ is applied to determine the combined economical order quantity based on the annual demand and ordering and holding costs of the 11 color variants. The resulting quantity is subsequently allocated proportionally according to the annual demand of each variant.

Safety Stock

Safety stock refers to additional inventory maintained to reduce the risk of stock shortages caused by fluctuations in demand during replenishment lead time. The amount of safety stock is influenced by demand variability, lead time, and the selected service level.

Gonçalves et al. (2020) reviewed operations research models and methods for safety-stock determination, emphasizing the relevance of uncertainty and the factors considered in inventory buffer calculations. Handi et al. (2026) also discussed safety stock as part of an integrated inventory control approach involving EOQ and ROP.

In this study, safety stock is calculated separately for each color variant because the standard deviation of daily demand differs among variants. A 95% service level is used as an analytical assumption to determine the corresponding safety-stock factor.

Reorder Point (ROP)

Reorder Point (ROP) is the inventory level at which a new replenishment order should be initiated. ROP considers the expected demand during lead time and the additional inventory maintained as safety stock. Its purpose is to provide a replenishment trigger before available inventory becomes insufficient to meet demand.

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The application of ROP together with EOQ and safety stock has been discussed by Saputra et al. (2024) and Handi et al. (2026) in the context of inventory control. These methods serve complementary functions: EOQ determines the order quantity, safety stock provides a buffer against demand uncertainty, and ROP establishes the inventory threshold for initiating replenishment.

In this study, ROP is calculated for each color variant based on average daily demand, a two-working-day lead time, and the calculated safety-stock level. This approach provides variant-specific replenishment thresholds for the online distribution warehouse.

RESEARCH METHODOLOGY

Research Design and Data Collection

This study employed a descriptive quantitative approach to evaluate inventory control practices for Plain Helm products at the online distribution warehouse of PT Y. The analysis used historical demand and inventory records covering the period from January to December 2025. Interviews and observations were conducted as supporting data collection techniques to obtain information regarding the warehouse's existing replenishment practices, ordering procedures, and replenishment lead time.

The unit of analysis consisted of Plain Helm products managed by the online distribution warehouse, comprising 11 color variants. The analysis focused on determining the order quantity, safety stock, and reorder point based on the demand and inventory characteristics of each variant.

Data and Calculation Parameters

The annual demand (D) recorded for the 11 variants was 139,089 units. The ordering cost (S) was IDR 500,000 per transaction, while the annual holding cost (H) was IDR 25,000 per unit per year. The replenishment lead time was reported to range from one to two working days. For the calculation, this study used two working days as the lead time (L).

A service level of 95%, corresponding to a Z value of 1.645, was adopted as an analytical assumption for determining safety stock. This service level was not a formally established policy of the company.

Inventory Control Analysis

Three inventory control methods were applied: Economic Order Quantity (EOQ), Safety Stock (SS), and Reorder Point (ROP).

1. Economic Order Quantity (EOQ)

EOQ was used to determine the economical order quantity by balancing ordering costs and annual holding costs. The calculation used the following formula:

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$$EOQ = \frac{\sqrt{2DS}}{H}$$

Where:

- D = Annual demand (units)
- S = Ordering cost per transaction (IDR)
- H = Annual holding cost per unit (IDR)

The EOQ was calculated using the combined annual demand and ordering cost for all 11 variants. The resulting combined order quantity was then allocated proportionally to each variant based on its share of annual demand. Thus, the allocated quantities did not represent independently calculated EOQ values for each variant.

2. Safety Stock (SS)

Safety stock was calculated to determine the additional inventory required to provide a buffer against fluctuations in demand during the replenishment lead time. The formula used was:

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

Where:

- Z = Service-level factor
- σd = Standard deviation of daily demand
- L = Lead time (working days)

3. Reorder Point (ROP)

ROP was calculated to determine the inventory level at which replenishment should be initiated. The formula was:

$$ROP = (d \times L) + SS$$

Where:

- d = Average daily demand (units)
- L = Lead time (working days)
- SS = Safety stock (units)

The calculated inventory quantities were rounded up to whole units where necessary to provide practical inventory references.

RESULTS

Actual Inventory Control Practices

The inventory control practices at the online distribution warehouse of PT Y are primarily based on stock availability and sales requirements. The warehouse manages Plain Helm products consisting of 11 color variants. When additional inventory is required, the company generally replenishes approximately 100 units for each variant. However, replenishment is not necessarily carried out simultaneously for all variants, as ordering decisions depend on the availability of existing stock and sales requirements.

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Based on the company's inventory records for 2025, inventory shortages occurred in several variants and periods throughout the year. These conditions indicate that product availability varied across the 11 color variants. The existing replenishment practices and recorded shortages provide the basis for evaluating inventory requirements using the Economic Order Quantity (EOQ), Safety Stock, and Reorder Point (ROP) methods.

DISCUSSION

Actual Inventory Control Practices

The inventory control practices at the online distribution warehouse of PT Y are primarily determined by stock availability and sales requirements. Based on interviews and observations, the company generally replenishes approximately 100 units for each color variant when additional stock is required. However, replenishment is not necessarily carried out simultaneously for all variants, as ordering decisions depend on the remaining inventory and sales requirements of each variant.

Demand variability is an important consideration in inventory management, particularly in online retail environments where purchasing patterns may differ across products and sales channels. Jain and Tan (2022) discuss the relationship between purchasing channels, sales concentration, and inventory management, emphasizing the importance of considering product-level demand patterns when making inventory decisions. In addition, accurate demand information plays an important role in inventory planning because it helps companies anticipate inventory requirements and make more informed replenishment decisions (Babai et al., 2026; Seyedan et al., 2023).

These practices indicate that inventory replenishment at PT Y is still primarily based on operational considerations and routine stock monitoring. The company adjusts its purchasing decisions according to product availability in the warehouse rather than applying predetermined order quantities and replenishment thresholds calculated using inventory control methods.

Based on the company's historical inventory records for January–December 2025, the combined annual demand for the 11 Plain Helm color variants reached 139,089 units. The records also indicate that inventory shortages occurred in several variants and periods. These conditions suggest that the existing replenishment practices still face challenges in maintaining product availability, particularly because each color variant has different demand characteristics.

Considering these conditions, an inventory control analysis is necessary to establish more systematic references for determining order quantities, safety stock levels, and reorder timing. Therefore, this study applies the Economic Order Quantity (EOQ), Safety Stock, and Reorder Point (ROP) methods to evaluate inventory requirements and develop inventory control recommendations for each Plain Helm color variant.

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Economic Order Quantity

The EOQ method provides a quantitative basis for determining economical order quantities by balancing ordering costs and inventory holding costs. Alnahhal et al. (2024) discuss the relevance of EOQ in inventory decision-making under changing supply-chain conditions. Furthermore, Teunter et al. (2025) examine EOQ-based approaches in stochastic inventory control, highlighting the importance of determining appropriate order quantities under demand uncertainty.

In this study, the EOQ method is applied to determine the economical order quantity for Plain Helm products using the combined annual demand of 139,089 units, an ordering cost of IDR 500,000 per transaction, and an annual holding cost of IDR 25,000 per unit. Based on these parameters, the calculated EOQ is approximately 2,359 units per combined order. This result represents the recommended order quantity for the total demand of the 11 color variants, rather than an independent EOQ for each variant.

To accommodate differences in demand among the color variants, the combined EOQ is subsequently allocated proportionally according to the annual demand of each variant. Black Gloss receives the largest indicative allocation of 275 units because it has the highest annual demand of 16,240 units. Meanwhile, Gunmetal Gloss receives the smallest allocation of 156 units, corresponding to its annual demand of 9,218 units.

Compared with the company's actual replenishment practice of approximately 100 units per variant, the EOQ calculation provides an alternative quantitative reference for determining order quantities. However, the implementation of this allocation should also consider operational conditions, including production availability, storage capacity, and the timing of replenishment for each variant.

This consideration is consistent with Vicente et al. (2025), who discuss the role of uncertainty and inventory review policies in multi-echelon inventory planning. Their discussion highlights that inventory planning needs to account for demand characteristics and replenishment conditions when determining appropriate stock levels.

Overall, the findings indicate that EOQ can support more systematic order-quantity planning by considering total demand and inventory-related costs. Nevertheless, the combined EOQ should not be interpreted as a requirement to order all 11 variants simultaneously.

Safety Stock

Table 1. Calculated safety stock by color variant

Color Variant	Daily demand SD (units)	Safety Stock (Units)
Black Gloss	8.16	19
Black Doff	7.03	17
White Gloss	8.18	20

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Grey Gloss	7.59	18
Grey Doff	11.72	28
Eazy Green	13.94	33
Pink Gloss	12.74	30
Dark Teil Gloss	11.86	28
Dark Teil Doff	11.95	28
Gunmet Doff	12.17	29
Gunmet Gloss	11.64	28

Safety stock is maintained to anticipate fluctuations in demand during the replenishment lead time. In this study, safety stock is calculated using a 95% service-level assumption, a Z value of 1.645, and a lead time of two working days. The calculation is performed separately for each color variant because the standard deviation of daily demand differs among variants.

The results show that the required safety stock ranges from 17 to 33 units. Eazy Green has the highest safety stock requirement of 33 units, corresponding to the largest daily-demand standard deviation of 13.94 units. In contrast, Black Doff has the lowest safety stock requirement of 17 units, with a daily-demand standard deviation of 7.03 units.

These differences indicate that safety stock requirements are influenced by the variability of demand for each variant. Variants with greater fluctuations in daily demand require larger buffer inventories to anticipate uncertainty during replenishment lead time.

The results are consistent with the discussion by Gonçalves et al. (2020), which emphasizes the role of demand variability, lead time, and service level in determining safety stock. Similarly, Handi et al. (2026) demonstrate the use of safety stock as part of an integrated inventory control approach.

In relation to the actual inventory practices at PT Y, the calculated safety stock provides a specific inventory buffer reference for each color variant. The company can use these values as a basis for maintaining additional inventory to anticipate demand fluctuations. However, the calculated safety stock does not guarantee the elimination of stockouts because actual inventory availability may also be affected by production delays and changes in demand.

Reorder Point

Table 2. Calculated reorder point by color variant

No.	Variasi Helm	Rata-rata Permintaan/Hari	Safety Stock (Unit)	ROP (Unit)
1	Black Gloss	54,23	19	128

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2	Black Doff	53,82	17	124
3	White Gloss	51,68	20	123
4	Gorila Gloss	53,45	18	125
5	Gorila Doff	46,89	28	122
6	Eazy Green	38,71	33	110
7	Pink Gloss	35,23	30	101
8	Dark Teil Gloss	34,23	28	97
9	Dark Teil Doff	33,20	28	95
10	Gunmet Doff	31,46	29	92
11	Gunmet Gloss	30,75	28	89

Replenishment decisions require coordination between inventory monitoring and ordering policies. Prak et al. (2015) discuss periodic review and continuous ordering policies, highlighting the importance of determining the appropriate timing for inventory replenishment based on the inventory system being applied. In addition, variant-specific reorder thresholds allow inventory monitoring to account for differences in demand patterns and replenishment requirements. This is particularly relevant in inventory systems involving multiple products with different demand characteristics (Vicente et al., 2025).

In this study, the Reorder Point (ROP) method is applied to determine the inventory level at which a new replenishment order should be initiated. The calculation considers average daily demand during lead time and the required safety stock. Accordingly, the ROP for each Plain Helm color variant is calculated using average daily demand, a two-working-day lead time, and the corresponding safety stock.

The calculation results indicate that the ROP ranges from 90 to 128 units. Black Gloss has the highest reorder point of 128 units, based on an average daily demand of 54.23 units and safety stock of 19 units. Meanwhile, Gunmetal Gloss has the lowest reorder point of 90 units, with an average daily demand of 30.75 units and safety stock of 28 units.

The differences in ROP values demonstrate that each color variant requires a different replenishment threshold. Variants with higher average daily demand generally require replenishment to be initiated at higher inventory levels to maintain sufficient stock during the lead time.

Compared with the company's current practice, which relies on stock availability and operational judgment, the calculated ROP provides a more measurable reference for determining when replenishment should begin. For example, when the inventory level of Black Gloss reaches approximately 128 units, the warehouse can initiate a replenishment request to anticipate demand during the two-working-day lead time.

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The ROP calculation complements the EOQ and Safety Stock methods. EOQ determines the recommended order quantity, Safety Stock establishes the additional inventory buffer to protect against demand uncertainty, and ROP determines the inventory level at which replenishment should be initiated. Therefore, these three methods provide complementary references for improving inventory planning at the online distribution warehouse of PT Y.

Proposed Inventory Control Improvements

Based on the results of the EOQ, Safety Stock, and ROP calculations, several improvements can be proposed to support inventory control at the online distribution warehouse of PT Y.

First, the company may use the combined EOQ of 2,359 units as a reference for determining order quantities. The quantity can be allocated proportionally among the 11 color variants based on their respective annual demand. This approach provides a more systematic basis for planning replenishment quantities compared with relying solely on the usual replenishment quantity of approximately 100 units per variant. The use of EOQ as a basis for determining economical order quantities is relevant to inventory decision-making because it considers the balance between ordering and holding costs (Alnahhal et al., 2024). However, its implementation should consider production availability, storage capacity, and the company's ordering arrangements.

Second, the company may establish safety-stock levels for each color variant. The calculated safety stock ranges from 17 to 33 units and can be used as a reference for maintaining buffer inventory against fluctuations in demand during replenishment lead time. Variants with higher demand variability, such as Eazy Green, require greater safety stock than variants with relatively lower demand variability. This is consistent with the role of safety stock in addressing demand and supply uncertainty in inventory management (Gonçalves et al., 2020).

Third, the company may apply the calculated ROP values as replenishment triggers. The ROP ranges from 90 to 128 units for the 11 color variants. By monitoring inventory levels against these thresholds, the warehouse can identify when replenishment requests should be initiated. This approach is in line with inventory replenishment policies that determine when new orders should be placed based on inventory conditions (Prak et al., 2015). It may help reduce the risk of delayed replenishment, particularly for variants with relatively high daily demand.

Finally, the company is encouraged to improve inventory recording and monitoring for each color variant. Records should include beginning inventory, incoming goods, outgoing goods, and ending inventory. The company may also periodically review EOQ,

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safety stock, and ROP parameters when demand patterns, ordering costs, holding costs, or lead times change.

These proposed improvements are based on the results of the inventory calculations and the observed replenishment practices. They are intended as recommendations for future inventory planning and have not been implemented or experimentally tested in the warehouse.

CONCLUSION

This study analyzed inventory control practices for Plain Helm products at the online distribution warehouse of PT Y using the Economic Order Quantity (EOQ), Safety Stock, and Reorder Point (ROP) methods. The findings indicate that the company's existing replenishment practices are primarily based on stock availability and sales requirements, with a usual replenishment quantity of approximately 100 units per variant. Replenishment decisions are made according to operational needs rather than predetermined quantitative inventory thresholds.

The EOQ calculation, based on an annual demand of 139,089 units, an ordering cost of IDR 500,000 per transaction, and an annual holding cost of IDR 25,000 per unit, resulted in a combined order quantity of approximately 2,359 units. This quantity was allocated proportionally among the 11 color variants based on their annual demand. Meanwhile, the Safety Stock calculation, using a 95% service-level assumption and a two-working-day lead time, resulted in requirements ranging from 17 to 33 units per variant. The ROP calculation produced replenishment thresholds ranging from 90 to 128 units.

The results demonstrate that EOQ, Safety Stock, and ROP provide complementary references for determining order quantities, maintaining buffer inventory, and establishing replenishment timing. Based on these findings, PT Y is recommended to consider the calculated values in its inventory planning, supported by routine stock monitoring and periodic evaluation of inventory parameters.

This study is limited to historical inventory and demand data from January to December 2025 and the assumptions applied in the calculations. Furthermore, the proposed inventory control improvements have not been implemented or tested in actual warehouse operations. Future research may examine the implementation of these methods and evaluate their effects on inventory costs and product availability.

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