



## Raw Material Inventory Control Using the Economic Order Quantity Model

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### ABSTRACT

*This study examines raw material inventory control using a secondary analysis of published wood-demand and cost data from PT Jatisari Furniture Work. The dataset covers November 2018 to February 2020 and reports demand of 272.28 cubic metres, an ordering-cost input of IDR 1,427,500, and a holding-cost input of IDR 34,082 per cubic metre. The analysis reproduces the economic order quantity calculation, checks the cost components, and distinguishes the continuous model solution from an implementable ordering schedule. Under a common 16-month cost basis, the calculated order quantity is 151.0248 cubic metres, with ordering and cycle-stock holding costs of IDR 2,573,614.34 each. Including the reported safety stock of 0.1868 cubic metres gives a modeled relevant inventory cost of IDR 5,153,595.20. These results depend on treating the published cost allocations as model parameters. The reported safety stock also relies on monthly dispersion and does not establish a verified daily service level. The analysis provides a reproducible cost benchmark, while identifying the cost definitions and demand observations needed before operational adoption. Actual cost savings and stockout prevention cannot be established from this calculation alone.*

**Keywords:** inventory control; raw materials; economic order quantity; safety stock; inventory costs

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### INTRODUCTION

Raw material inventory decisions determine how much a manufacturer orders and how much stock it carries between deliveries. The economic order quantity (EOQ) model addresses the balance between order-related expenditure and the cost of holding cycle stock. Its usefulness depends on the assumptions attached to demand and replenishment. Alnahhal et al. (2024) identify practical requirements, including supplier constraints and disruptions, that can alter the classical solution.

Furniture manufacturing provides a relevant setting for examining this balance. Sutrisna et al. (2021) report wood purchases, usage, and inventory costs at PT Jatisari Furniture Work in Tasikmalaya. A separate furniture study by Rizzal Maulana Ardhanariswara et al. (2024) evaluates EOQ and just-in-time policies at Persada Kusen. These are distinct cases. The

present analysis uses the Jatisari dataset and does not treat the Persada Kusen study as its data source.

An optimal quantity within a deterministic model is only one part of an inventory policy. Procurement simulations account for supplier disruptions and market changes (D. Gallego-García et al., 2021; S. Gallego-García & García-García, 2020). Dynamic inventory models also connect safety stock to changing demand (Di Nardo et al., 2020). These approaches explain why a numerical EOQ should be accompanied by an explicit statement of its operating conditions.

This study asks whether the published Jatisari inputs reproduce the stated EOQ and inventory cost, and what those results imply for ordering and safety stock. It is a secondary numerical analysis of an existing case. Its contribution is to make the calculation reproducible and delimit the operational conclusions supported by the available data.

### METHODS

The analysis uses the published tables and calculations of Sutrisna et al. (2021), covering November 2018 to February 2020. No new company interviews, observations, or experiments were conducted. The reported aggregate demand and cost inputs were checked against that article, and the EOQ calculations were repeated at full numerical precision before rounding the displayed results.

Table 1 specifies the inputs and their interpretation. The 480-day denominator follows the source's convention of 30 days per month. It is a modeling convention rather than a count of calendar or operating days. The ordering-cost input is a published monthly average, whereas the holding-cost input is derived from an allocation of storage expenditure. Their use as marginal EOQ cost parameters therefore remains conditional.

**Table 1. Published inputs and their use in the EOQ benchmark**

| Input           | Value                     | Interpretation                                    |
|-----------------|---------------------------|---------------------------------------------------|
| Demand D        | 272.28 m <sup>3</sup>     | Total reported wood usage over 16 months          |
| Ordering cost S | IDR 1,427,500             | Monthly average adopted as the cost per order     |
| Holding cost H  | IDR 34,082/m <sup>3</sup> | Published allocation adopted per 16-month horizon |
| Modeled horizon | 480 days                  | 16 months × 30 days; source convention            |
| Safety stock B  | 0.1868 m <sup>3</sup>     | Published buffer; monthly dispersion basis        |
| Lead time L     | 1 day                     | Value assumed in the published ROP calculation    |

Source: Sutrisna et al. (2021). The cost interpretation is an analytical assumption; daily demand variation was not measured in this reanalysis.

The deterministic benchmark assumes a single material with constant demand, replenishment upon receipt of an order, a fixed cost for each order, and a holding cost proportional to average stock. Shortages and quantity discounts are excluded. Demand D and holding cost H are expressed for the same 16-month horizon. The relevant inventory cost C comprises ordering expenditure and cycle-stock holding expenditure; purchase expenditure is excluded because a constant unit purchase price would not change the minimizing quantity.

$$C(Q) = \frac{DS}{Q} + \frac{HQ}{2} \quad (1)$$

Here,  $Q$  is the order quantity in cubic metres,  $D$  is demand in cubic metres per horizon,  $S$  is the cost per order, and  $H$  is the holding cost per cubic metre per horizon. Differentiating  $C$  with respect to  $Q$  and setting the derivative to zero gives the EOQ. The positive second derivative establishes the minimum for positive  $D$ ,  $S$ ,  $H$ , and  $Q$ .

$$Q^* = \sqrt{\frac{2DS}{H}}, \quad C''(Q) = \frac{2DS}{Q^3} > 0 \quad (2)$$

For a fixed safety-stock quantity  $B$ , the additional holding cost is  $HB$ . This term changes the modeled cost but does not change the optimizing  $Q$ . Order frequency  $D/Q$  is a continuous rate over the horizon; its rounded value is not, by itself, an optimized finite-horizon schedule.

$$C(Q, B) = \frac{DS}{Q} + H\left(\frac{Q}{2} + B\right) \quad (3)$$

Reorder point is evaluated separately from order quantity. With mean daily demand  $d$  and a fixed lead time  $L$ , expected lead-time demand is  $dL$ . Under independent daily demand with standard deviation  $\sigma$  and a normal approximation, a cycle-service buffer uses  $z\sigma\sqrt{L}$ . The standard deviation must refer to the relevant demand interval; a monthly standard deviation cannot be substituted as a daily value without an appropriate demand model.

$$ROP = dL + B, \quad B = z\sigma\sqrt{L} \quad (4)$$

The reported safety stock is reproduced as a source-based scenario, not estimated anew from daily observations. Contemporary safety-stock and inventory models distinguish service targets from other performance measures and explicitly represent uncertainty (Di Nardo et al., 2020; Giacomelli et al., 2024). The analysis therefore does not infer a measured service level from the selected normal quantile alone.

## RESULT AND DISCUSSION

The common-horizon calculation gives an EOQ of 151.0248424 m<sup>3</sup>, reported as 151.0248 m<sup>3</sup>. Table 2 separates the cost components and reproduces the total using the source's rounded safety stock of 0.1868 m<sup>3</sup>. Ordering expenditure and cycle-stock holding expenditure are equal at the continuous optimum, which provides a direct arithmetic check.

$$Q^* = \sqrt{\frac{2 \times 272.28 \times 1,427,500}{34,082}} \approx 151.0248 \text{ m}^3 \quad (5)$$

**Table 2. Recalculated order quantity and relevant inventory costs**

| Measure                       | Calculation     | Result                  |
|-------------------------------|-----------------|-------------------------|
| Economic order quantity       | Equation (2)    | 151.0248 m <sup>3</sup> |
| Continuous order frequency    | D/Q*            | 1.8028822               |
| Ordering cost                 | DS/Q*           | IDR 2,573,614.34        |
| Cycle-stock holding cost      | HQ*/2           | IDR 2,573,614.34        |
| Buffer holding cost           | 34,082 × 0.1868 | IDR 6,366.52            |
| Total relevant inventory cost | Equation (3)    | IDR 5,153,595.20        |

Note. Author calculations using Table 1. Costs cover the modeled 16-month horizon and exclude material purchase expenditure. The source-based buffer is held fixed.

The resulting relevant inventory cost is IDR 5,153,595.20. This includes IDR 6,366.52 for the reported buffer, in addition to IDR 5,147,228.68 for ordering and cycle stock. Calculations retain the unrounded EOQ internally. If the product  $1.65 \times 0.1132$  is instead retained as 0.18678 m<sup>3</sup>, the total becomes IDR 5,153,594.51. The IDR 0.69 difference is a rounding choice; it does not change the economic interpretation.

The order-frequency ratio is 1.8028822 over the 16-month horizon. At 0.56725 m<sup>3</sup> per modeled day, an EOQ-sized lot covers approximately 266.24 days of average demand. Rounding the frequency to two and then dividing 480 by two gives 240 days, which corresponds to a different equal-lot policy. Two lots of 136.14 m<sup>3</sup> would exactly cover the reported demand under zero opening and closing cycle stock. Their modeled cost, with the same buffer, is IDR 5,181,328.26. This comparison illustrates why a continuous frequency and an integer schedule must be distinguished; it does not establish an executable purchasing plan.

Cost definitions are a larger source of uncertainty than numerical rounding. Sutrisna et al. (2021) report IDR 22,840,000 in ordering expenditure over 16 months and IDR 9,280,000 in storage expenditure. The former becomes IDR 1,427,500 when divided by 16; the latter divided by reported throughput is approximately IDR 34,082.56 per m<sup>3</sup>. A throughput allocation does not directly measure the cost of holding one additional cubic metre for the entire horizon. Nor does a monthly ordering average establish that the same expense recurs for every order regardless of load size. The calculated optimum is therefore conditional on these inputs being suitable proxies.

The baseline also excludes price-dependent purchasing and quantity discounts. Alejo-Reyes et al. (2023) optimize order allocation when nonlinear discounts and demand are included, while price-dependent EOQ formulations allow the demand function to change with the selling decision (San-José et al., 2021). Such models cannot be transferred to this case without the relevant price and order data. Likewise, a large timber order could require a different transport arrangement or exceed storage capacity; these constraints have not been quantified here.

The source reports a one-day lead time and safety stock of 0.1868 m<sup>3</sup>. Combining those values with the 480-day convention gives a reorder point of 0.75405 m<sup>3</sup>. This is a reproduction of the reported scenario. The dispersion used in the buffer calculation is based on 16 monthly observations and does not measure daily variability. Consequently,

the calculation does not demonstrate 95% daily cycle-service performance. Safety-stock strategies should be compared using their actual demand and replenishment assumptions (Demiray Kırmızı et al., 2024), while seasonal replenishment requires explicit treatment of time-varying demand and delivery opportunities (Alnahhal et al., 2021).

Demand forecasts and supplier performance also affect the required buffer. Tadayonrad and Ndiaye (2023) discuss inventory decisions that account for seasonality and supply-chain reliability. Arbabian and Rikhtehgar Berenji (2023) model demand together with uncertain supplier capacity, and Barrera-Sánchez and García-Cáceres (2025) consider stochastic demand with deterministic lead time in a multiproduct setting. These studies support testing replenishment assumptions separately from the EOQ calculation. The Jatisari aggregate demand cannot reveal daily shortage exposure or forecast error.

More elaborate models require more observations. Kalaichelvan et al. (2024) combine fuzzy modeling and machine learning for a pharmaceutical inventory problem; Patriarca et al. (2020) include deterioration and uncertain demand in an EOQ formulation. These studies provide methodological alternatives when parameter uncertainty or product condition matters, but their sector-specific results are not evidence of savings for timber inventory. Lei et al. (2024) likewise examine mathematical and dynamic approaches to manufacturing inventories. The present deterministic calculation remains useful as a transparent comparison point for such extensions.

Operational adoption would require staff to record order dates, quantities received, daily material usage, and stock balances. Pan et al. (2022) show experimentally that cognitive load can affect EOQ decisions and learning, which supports keeping the calculation and its inputs understandable. A trial policy should be assessed against the existing policy using consistent cost definitions and observed stockouts. No such before-and-after evaluation is available in this secondary analysis.

The environmental implications are also unmeasured. Becerra et al. (2022) review the integration of sustainability into inventory models; Giacomelli et al. (2024) explicitly distinguish economic and emission objectives. Santos et al. (2024) examine trade-offs involving holding costs, energy use, and shortage risk across storage facilities. The current monetary objective contains no timber-waste or emissions measure, so a lower modeled inventory cost cannot be interpreted as demonstrated environmental improvement.

## CONCLUSION

The published Jatisari inputs produce a conditional EOQ of 151.0248 m<sup>3</sup> and a relevant inventory cost of IDR 5,153,595.20 when the reported safety stock of 0.1868 m<sup>3</sup> is included. This is a reproducible model result, not an observed saving. The cost allocations must first be validated as ordering and holding parameters on a common time basis. The continuous frequency of 1.8029 orders also requires a separate scheduling decision. A defensible buffer and reorder policy require demand variability measured over lead time; the monthly dispersion in the source does not verify the claimed daily service level. Company adoption should follow cost validation and monitoring of actual replenishment and stockout performance.

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