

# chapter 8 the economic order quantity eoq model

Published: September 27, 2026 | Index ID: #-

---

## Introduction

---

In the world of supply chain and operations management, few concepts are as foundational as the Economic Order Quantity (EOQ) model. Often introduced in the middle chapters of a standard inventory control textbook, Chapter 8 – “The Economic Order Quantity (EOQ) Model” – serves as a bridge between theoretical principles and real world decision making. This article delves deep into the core ideas, mathematical derivations, practical applications, and common pitfalls associated with the EOQ framework, offering a comprehensive guide for students, practitioners, and anyone keen on mastering inventory optimization.

## Overview of Chapter /8

---

Chapter 8 typically follows an introductory discussion of inventory concepts, demand forecasting, and basic cost structures. It then zeroes in on the EOQ model, presenting it as the simplest yet most powerful tool for determining the optimal order quantity that balances ordering costs against holding costs. By the end of the chapter, readers should understand:

- How the EOQ formula is derived from first principles.
- Which assumptions underpin the model and when they hold.
- How to apply the model to real data and interpret the results.
- How to extend the basic EOQ to accommodate quantity discounts, variable demand, and other practical constraints.

## Core Concepts of EOQ

---

The EOQ model is fundamentally a cost minimization problem. Inventory managers face two primary cost streams:

1. Ordering Cost (S) – the fixed expense incurred each time an order is placed, such as procurement paperwork, shipping fees, and administrative overhead.
2. Holding Cost (H) – the cost of keeping one unit of inventory in stock for a unit of time, which includes warehousing, capital tie up, insurance, and obsolescence.

The goal is to find the order quantity that minimizes the sum of these two costs over a planning horizon.

## Derivation of the EOQ Formula

---

Let us denote:

- D – annual demand (units).
- Q – order quantity (units).
- S – ordering cost per order.
- H – holding cost per unit per year.

The total annual cost (TC) is the sum of ordering and holding costs:

$$TC(Q) = (D/Q) \times S + (Q/2) \times H$$

The first term represents the number of orders per year ( $D/Q$ ) multiplied by the fixed cost per order. The second term reflects the average inventory level, which is  $Q/2$  for a constant consumption rate, multiplied by the per unit holding cost.

To find the optimal  $Q$ , differentiate  $TC(Q)$  with respect to  $Q$  and set the derivative equal to zero:

$$dTC/dQ = -D \times S / Q^2 + H / 2 = 0$$

Solving for  $Q$  yields the classic EOQ formula:

$$Q^* = \sqrt{(2DS) / H}$$

This expression shows that the optimal order quantity increases with higher demand or higher ordering costs, and decreases with higher holding costs.

## Assumptions Behind EOQ

---

While the EOQ model is elegant, its practical utility hinges on several key assumptions:

- Demand is constant and known.
- Lead time is constant and non variable.
- Ordering and holding costs are linear and independent of quantity.
- No stockouts or backorders occur.
- No quantity discounts or price changes.
- Inventory is replenished immediately upon order placement.

Violations of these assumptions necessitate model adjustments or alternative approaches.

## Key Variables and Definitions

---

Understanding each variable is critical for accurate EOQ calculations:

- Annual Demand ( $D$ ) – often derived from sales forecasts or historical data.
- Ordering Cost ( $S$ ) – includes procurement, shipping, inspection, and administrative expenses.
- Holding Cost ( $H$ ) – calculated as the product of unit cost ( $C$ ) and the carrying cost rate ( $i$ ):  $H = C \times i$ .
- Unit Cost ( $C$ ) – the purchase price per unit.
- Carrying Cost Rate ( $i$ ) – the annual percentage of the unit cost representing storage and opportunity costs.

## Calculating EOQ: Step by Step Example

---

Consider a company that sells 10,000 units of a product annually. The ordering cost is \$150 per order, the unit cost is \$20, and the carrying cost rate is 25%.

1. Compute the holding cost per unit per year:  $H = C \times i = \$20 \times 0.25 = \$5$ .
2. Plug the values into the EOQ formula:  $Q^* = \sqrt{(2 \times 10,000 \times 150) / 5} = \sqrt{(3,000,000 / 5)} = \sqrt{600,000} \approx 775$  units.
3. Interpretation: Ordering approximately 775 units each time minimizes the combined ordering and holding costs.

Using the optimal  $Q$ , the company can calculate total annual costs, reorder points, and other operational metrics.

## Determining the Optimal Order Cost

---

Beyond the order quantity, managers often need to know the total cost savings achieved by adopting EOQ. Using

the example above:

- Number of orders per year:  $D / Q^* = 10,000 / 775 \approx 12.9 \approx 13$  orders.
- Ordering cost per year:  $13 \times \$150 = \$1,950$ .
- Average inventory level:  $Q^* / 2 = 775 / 2 = 387.5$  units.
- Holding cost per year:  $387.5 \times \$5 = \$1,937.50$ .
- Total annual cost:  $\$1,950 + \$1,937.50 = \$3,887.50$ .

Comparing this to a non optimized policy (e.g., ordering all demand at once) highlights the cost saving potential of EOQ.

## Total Cost Minimization

---

The EOQ model's strength lies in its ability to reveal the trade off between two opposing costs. By graphically plotting the ordering and holding cost curves against quantity, the intersection point represents the minimal total cost. This visual tool aids in understanding how sensitive the total cost is to changes in demand, ordering cost, or holding cost.

## Sensitivity Analysis

---

Real world data are rarely static. Sensitivity analysis evaluates how variations in input parameters affect the optimal order quantity and total cost:

- Demand Fluctuations – A 10% increase in demand raises  $Q^*$  by roughly 5%.
- Ordering Cost Changes – Doubling the ordering cost increases  $Q^*$  by about 41%.
- Holding Cost Variations – A 20% increase in holding cost reduces  $Q^*$  by about 9%.

Such analyses inform risk management and contingency planning.

## Extensions and Variations

---

### Variable Demand

When demand is stochastic, the basic EOQ model can be adapted by incorporating safety stock to buffer against uncertainty. The safety stock is typically calculated using standard deviation of demand and desired service level.

### Quantity Discounts

Suppliers often offer lower unit prices for larger orders. The EOQ model can be extended to a “price break” analysis, where multiple EOQ calculations are performed at different price tiers, and the most cost effective combination is selected.

### Multiple Products

In a multi product environment, a single ordering policy may not be optimal for all items. Techniques like the “lot sizing” problem or the “supply chain network design” model can handle such complexity.

### Lead Time

Incorporating lead time into EOQ involves adjusting the reorder point (ROP) calculation: **ROP = Demand during lead time + Safety Stock**. This ensures that inventory replenishment aligns with customer demand.

### Stockout Costs

When stockouts incur penalties, the model can be modified to minimize the combined cost of holding and shortage.

This often leads to higher safety stock levels.

## Practical Applications in Supply Chain Management

---

EOQ is widely used across industries:

- Manufacturing firms for raw material procurement.
- Retailers for product replenishment.
- Pharmaceutical companies for managing critical inventory.
- E-commerce platforms for dynamic inventory control.

In each case, the EOQ framework provides a baseline for decision making, which can then be refined with industry-specific considerations.

## Common Mistakes and Pitfalls

---

1. Ignoring lead time variability, which can lead to stockouts.
2. Applying EOQ to items with highly seasonal demand.
3. Overlooking hidden costs such as handling, storage, or disposal.
4. Using outdated demand data, resulting in sub-optimal orders.
5. Assuming linear holding costs when economies of scale apply.

## Case Studies

---

### Case Study 1: A Consumer Electronics Company

By implementing EOQ for its flagship smartphone components, the company reduced annual inventory costs by 18%. Adjustments for quantity discounts further increased savings.

### Case Study 2: A Grocery Chain

Applying EOQ to perishable items was challenging due to variable demand and short shelf life. The solution involved integrating safety stock and real-time sales data to adjust order quantities dynamically.

## Integrating EOQ with Modern Technologies

---

Advancements in data analytics, cloud computing, and the Internet of Things (IoT) have transformed EOQ implementation:

- Real-time demand forecasting using machine learning reduces uncertainty.
- IoT sensors provide accurate inventory counts, minimizing discrepancies.
- Cloud-based ERP systems automate EOQ calculations and update orders instantly.

These technologies allow organizations to move from static EOQ models to adaptive, data-driven inventory strategies.

## Conclusion

---

Chapter 8, "The Economic Order Quantity (EOQ) Model," offers a timeless framework that balances ordering and holding costs to achieve inventory efficiency. While its assumptions may not hold in every scenario, the model's simplicity

## Baca Juga (Artikel Terkait)

---

- [chapter 8 covalent bonding chapter assessment answers](http://www.bbgglobalsolutions.com/chapter-8-covalent-bonding-chapter-assessment-answers.pdf)

URL: <http://www.bbgglobalsolutions.com/chapter-8-covalent-bonding-chapter-assessment-answers.pdf>

- [chapter 8 covalent bonding answers key dongmengore](http://www.bbgglobalsolutions.com/chapter-8-covalent-bonding-answers-key-dongmengore.pdf)

URL: <http://www.bbgglobalsolutions.com/chapter-8-covalent-bonding-answers-key-dongmengore.pdf>

- [chapter 8 covalent bonding answer key bing](http://www.bbgglobalsolutions.com/chapter-8-covalent-bonding-answer-key-bing.pdf)

URL: <http://www.bbgglobalsolutions.com/chapter-8-covalent-bonding-answer-key-bing.pdf>

- [chapter 8 cost accounting solution bing pdfsdirnn](http://www.bbgglobalsolutions.com/chapter-8-cost-accounting-solution-bing-pdfdirnn.pdf)

URL: <http://www.bbgglobalsolutions.com/chapter-8-cost-accounting-solution-bing-pdfdirnn.pdf>

Tags: #chapter #economic #order #quantity #model









