Certified in Planning and Inventory Management

Economic Order Quantity and Lot-Size Rules

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Economic Order Quantity and Lot-Size Rules

1. Economic Order Quantity (EOQ) Fundamentals

EOQ determines the optimal order quantity that minimizes the total cost of inventory, including ordering and carrying costs. CPIM candidates must understand EOQ assumptions: constant demand, constant lead time, fixed ordering cost, and no quantity discounts. EOQ balances the trade-off between ordering too frequently (high ordering costs) and holding too much inventory (high carrying costs). It is widely used for independent demand items in stable environments.

2. EOQ Formula and Key Inputs

The EOQ formula uses annual demand (D), ordering cost (S), and annual holding cost (H). The classic formula—$EOQ = \sqrt{(2DS/H)}$—helps identify the ideal replenishment quantity. CPIM learners must understand how changes in demand, cost structure, or carrying cost percentage influence EOQ. Sensitivity analysis is important, as EOQ is highly responsive to cost variations. Understanding each input ensures accurate inventory planning.

3. Total Annual Cost Curve

The total cost curve in EOQ combines ordering cost and carrying cost. It is important for CPIM candidates to understand how the cost curve is minimized at EOQ. Near the EOQ value, total cost changes slowly, meaning small variations in order quantity do not significantly impact cost. Understanding the curve helps managers select practical quantities close to EOQ when constraints exist.

4. Assumptions and Limitations of EOQ

EOQ is based on idealized assumptions such as steady demand, constant lead time, no shortages, and unlimited capacity. CPIM learners must understand how real-world variability can limit EOQ effectiveness. For example, fluctuating demand, quantity discounts, or production constraints may require alternate lot-sizing methods. Knowing when EOQ is appropriate ensures effective decision-making.

5. Reorder Point (ROP) and EOQ

EOQ determines order quantity, but the Reorder Point determines when to reorder. CPIM candidates must understand how ROP is calculated based on lead-time demand and safety stock. Combining EOQ with ROP creates a complete replenishment model. EOQ reduces cost per order, while ROP prevents stockouts. Understanding their integration is essential for independent-demand inventory planning.

6. Safety Stock and EOQ

Safety stock protects against demand and lead-time variability but does not directly change the EOQ value. However, the presence of safety stock affects the reorder point and overall inventory investment. CPIM learners must understand how safety stock policies interact with EOQ-based ordering. High variability environments may require frequent adjustments to safety stock levels even when EOQ is unchanged.

7. Production Order Quantity (POQ or EPQ)

The Production Order Quantity model applies when items are produced internally rather than purchased. CPIM candidates should understand how EPQ considers production rate, demand rate, and holding cost. Unlike EOQ, inventory builds gradually during production. EPQ is ideal for manufacturing environments with batch operations. Understanding EPQ helps optimize production lot sizes and reduce carrying cost.

8. Fixed Order Quantity (FOQ)

FOQ is a static lot-size rule where a predefined quantity is ordered whenever inventory falls to the reorder point. FOQ ensures consistent replenishment and is easy to implement. CPIM learners must understand how FOQ may result in excess inventory if demand varies. FOQ is commonly used for items supplied in fixed packaging or contractual quantities.

9. Lot-For-Lot (L4L)

Lot-for-lot ordering generates quantities exactly equal to net requirements for each period. It minimizes carrying cost but increases ordering or setup costs. CPIM candidates must understand that L4L is most appropriate for dependent demand items in MRP environments. L4L supports just-in-time operations and reduces WIP but can burden scheduling due to frequent orders.

10. Period Order Quantity (POQ)

POQ orders enough inventory to cover demand for a fixed number of periods. Unlike EOQ, which uses fixed quantities, POQ uses fixed time intervals. CPIM learners must understand how POQ balances order frequency and holding cost. POQ is useful when ordering cost is significant but demand is variable. Its flexibility allows adjusting the number of periods to optimize total cost.

11. Fixed Period Requirements (FPR)
FPR ordering occurs at regular intervals—weekly, monthly, etc.—regardless of stock levels. Quantities vary each cycle depending on demand. CPIM candidates should understand how periodic review systems work and how safety stock must be higher due to review interval uncertainty. FPR is common in retail and distribution environments where synchronized replenishment is needed.

12. Part Period Balancing (PPB)
PPB minimizes the sum of ordering and carrying costs by balancing the number of “part periods” (periods multiplied by inventory held). CPIM learners must understand how PPB selects order quantities that equalize the cost trade-offs across planning periods. It is more responsive to demand variability than EOQ and often performs well in MRP environments.

13. Least Unit Cost (LUC) Method
LUC selects a lot size that results in the lowest average cost per unit, including ordering and carrying cost. CPIM candidates must understand how LUC evaluates multiple lot quantity options to identify the most economical one. LUC is particularly useful when production or purchasing constraints make EOQ impractical.

14. Least Total Cost (LTC) Method
LTC evaluates incremental cost increases for holding inventory versus placing additional orders. The method

identifies the quantity that results in the minimum total cost for the planning horizon. CPIM learners must understand this method’s iterative nature and how it responds dynamically to variable demand. LTC is a widely used MRP lot-sizing technique.

15. Wagner-Whitin Algorithm

This is an optimal dynamic programming model for determining lot sizes in environments with variable demand. CPIM candidates must understand that Wagner-Whitin provides the lowest possible cost but can be computationally intensive. It eliminates unnecessary orders and ensures optimality for each planning horizon. It is ideal for long-term planning when computing power is available.

16. Quantity Discounts and EOQ Adjustments

Quantity discount models modify EOQ to account for lower unit prices at higher order quantities. CPIM learners must understand how to compare total cost across price breaks, not just calculate EOQ. Selecting a higher order quantity may reduce price but increase carrying cost. Understanding discount models supports strategic purchasing decisions.

17. Setup Cost Reduction

Setup cost reduction directly impacts EOQ because lower ordering or setup costs reduce optimal lot size. CPIM candidates must understand how SMED, standardization, and process simplification enable smaller batches, higher flexibility, and lower inventory. Reducing setup cost is a core pillar of lean manufacturing and supports pull systems.

18. Lead-Time Variability and Lot-Sizing

Lead-time variability affects the timing and size of replenishment orders. CPIM learners must understand how unpredictable lead times may require adjustments to lot-sizing rules or safety stock levels. EOQ assumes constant lead time, but real environments require continuous monitoring. Effective lead-time control improves accuracy and stability of replenishment systems.

19. Demand Variability and Lot-Sizing

Demand variability influences the effectiveness of lot-sizing methods. EOQ performs best under stable demand, while dynamic methods like PPB or LTC perform better under fluctuating demand. CPIM candidates should understand how variation increases safety stock and carrying cost. Matching lot-size rules to demand patterns improves service levels and minimizes total cost.

20. Choosing the Right Lot-Sizing Rule

Selecting the appropriate lot-size rule requires balancing cost, demand pattern, capacity, and replenishment strategy. CPIM candidates must understand that no single method fits all scenarios. The choice depends on item criticality, demand predictability, planning environment (MRP vs. reorder point), and operational constraints. Using the right lot-sizing rule improves flow, reduces waste, and enhances financial performance.

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