

Safety Stocks, Reorder Points & Lead Time

- **How can we manage inventories with uncertainty?**
- Types of uncertainty:
 - Future demand
 - Inventory usage rate
 - Delivery time
- We can modify the EOQ model to include factors such as:
 - Safety stock
 - Lead time and Reorder points

Safety Stocks

(A) SAFETY STOCKS

- It is an additional level of inventory.
 - Intended to enable the firm to continue to meet demand.
 - Sales levels may turn out to be higher than predicted.
 - Unexpected delays may occur in either receiving raw materials or in producing goods.
- To protect against stockouts, the firm must maintain a safety stock of inventory.

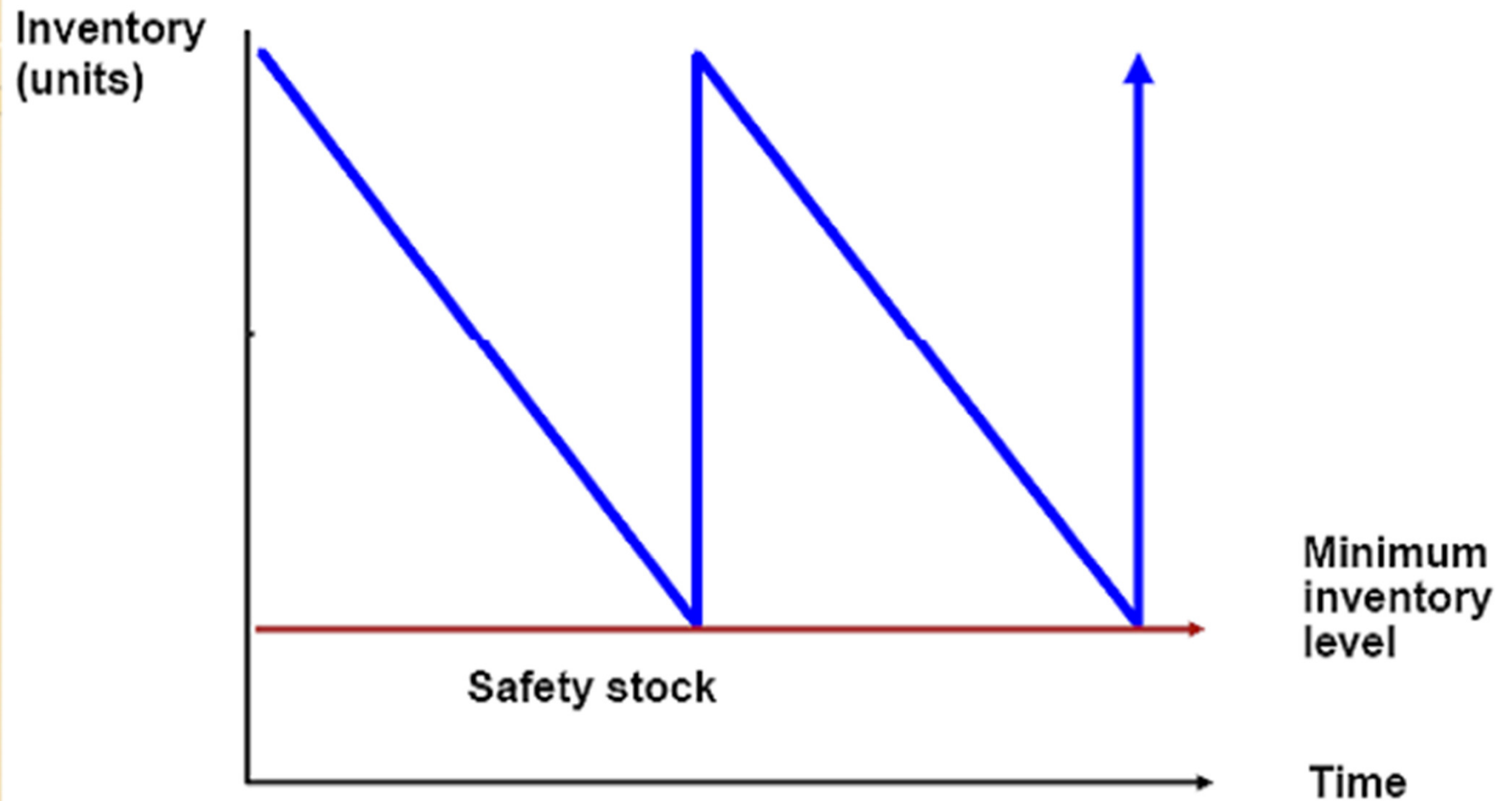
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- **Safety stock** provides insurance against unexpectedly rapid use or delayed delivery.
 - Additional supply of inventory that is carried at all times to be used when normal working stocks run out
 - Rarely advisable to carry so much safety stock that stockouts **never** happen
 - **Carrying costs** would be excessive.
- What factors enter into the determination of the level of safety stock?

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- The level of safety stock depends on the ff:
 - The degree of uncertainty in our sales & production, and
 - The cost of lost sales, which comprises:
 - Sales lost
 - Loss of customer goodwill
- Stockouts result in lost sales, loss of customer good will, and production down-time.
 - With a safety stock, the firm reorders when inventory reaches a minimum level.

Figure: Safety Stock



Lead Time and Reorder Point

(B) LEAD TIME AND REORDER POINT

- **Lead time (ordering lead time)** is the time it takes between placing an order for more inventory and the time when it is received or produced.
 - Advance notice needed so that an order placed will arrive when required.
 - Usually estimated by item's supplier.
- The EOQ model can be modified:
 - Ordering takes place early enough so that the new inventory arrives just as the existing inventory runs out.

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- Example: If it takes 3 days to receive inventory, it is prudent to have an inventory level sufficient for at least 3 days at the reorder point.
- **Reorder point** – is level of inventory at which order is placed.
 - When there are lags in delivery or production times, the firm reorders when inventory reaches the reorder point.

$$\text{Reorder Point} = \text{Expected Lead Time Demand} + \text{Safety Stock}$$

$$\text{Annual Cost} = \text{Ordering Cost} + \text{Carrying Cost} + \text{Stockout Costs}$$

Figure: Reorder Point and Lead Time

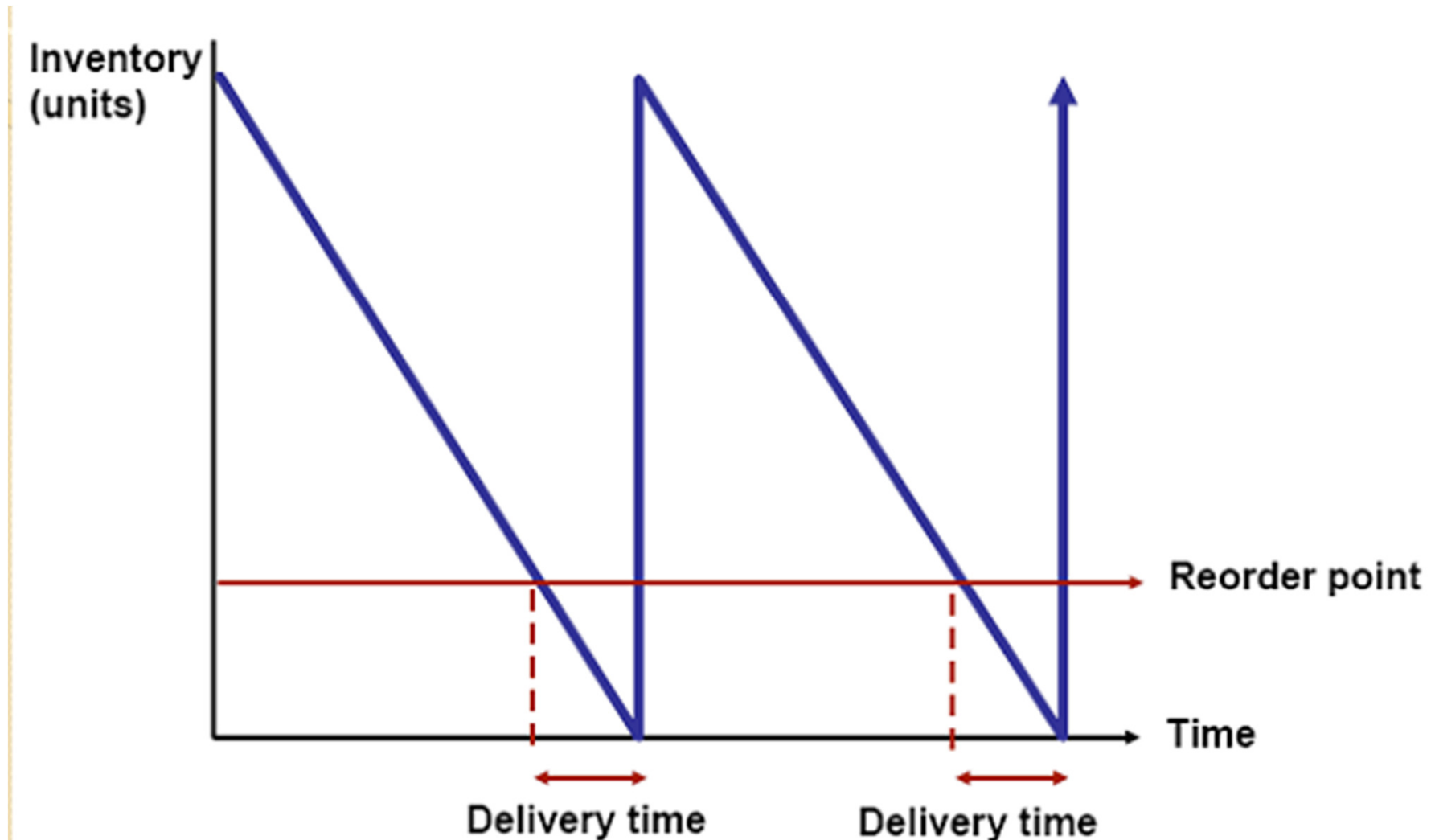
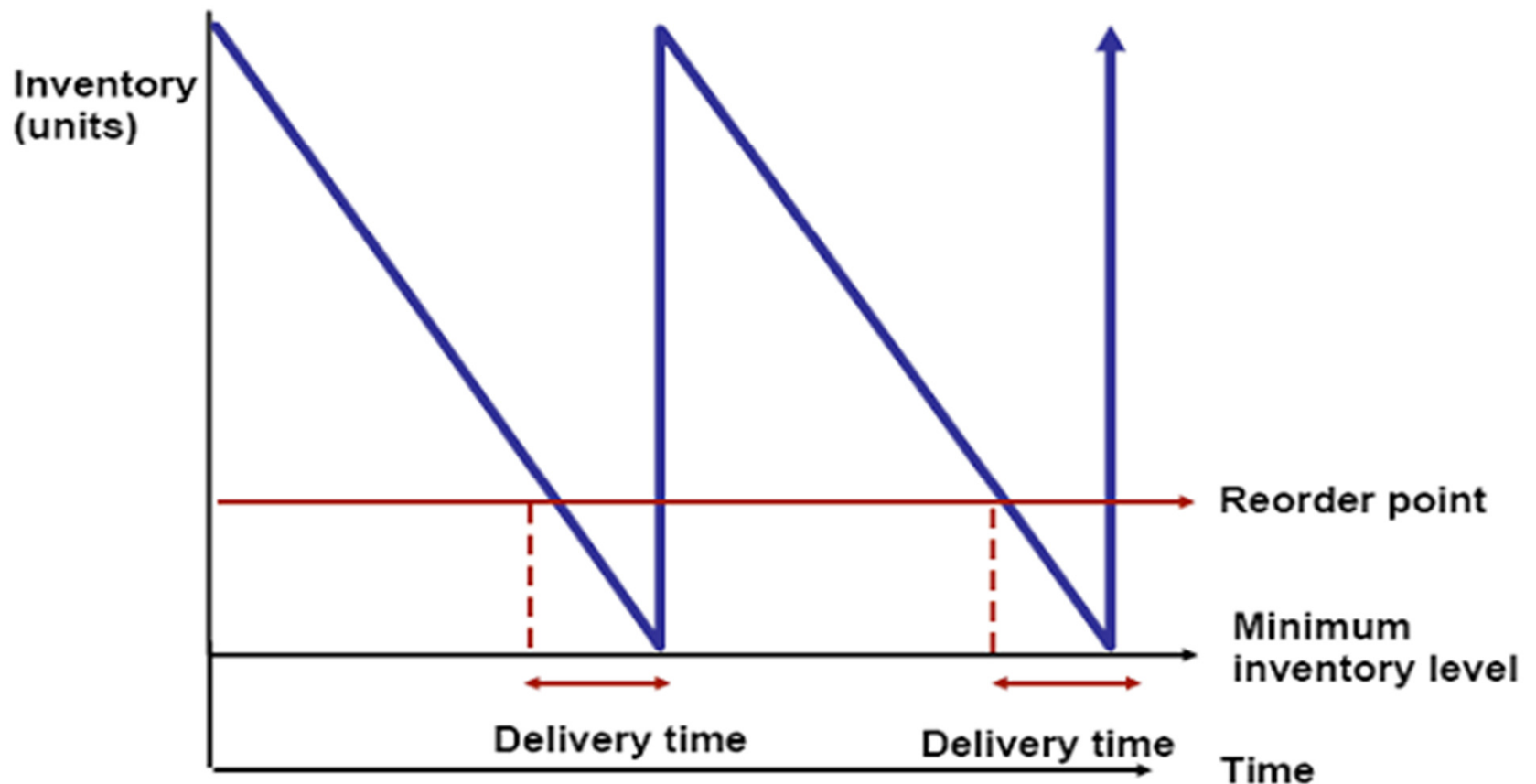


Figure: Safety Stocks & Reorder Point

- By combining **safety stocks** and **reorder points**, the firm maintains a buffer against unforeseen events.



Formula (With Safety Stock)

- Average Inventory = $\frac{Q}{2} + \text{Safety Stock}$
- Total Carrying Cost = $c \left(\frac{Q}{2} + \text{Safety Stock} \right)$
- Total Ordering and Carrying Cost =
$$TC = c \left(\frac{Q}{2} + \text{Safety Stock} \right) + F \left(\frac{D}{Q} \right)$$

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Maximum stock level = ROL + ROQ - (Min. usage x Min. Lead time)

EOQ = $\sqrt{\frac{2 C_o D}{C_h}}$

ROL = Max. Usage X Max. Lead-time

Minimum stock level = ROL - (Average usage x Average Lead-time)

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Re-order level (ROL)

This is the level where when inventory falls to, fresh inventories needs to be ordered

$$\text{ROL} = \text{Maximum Usage} \times \text{Maximum Lead time}$$

Maximum Inventory Level (max)

This is the level of inventory above which capital is being tied up unnecessarily

$$\text{Max Inventory level} = \text{ROL} + \text{ROQ} - (\text{minimum usage} \times \text{minimum lead time})$$

- **Re-order Quantity (ROQ), or EOQ**
 - No. of units a company should order at any given time when inventory reaches the re-order level, so as to minimize total annual cost of inventories.

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Minimum Inventory Level (Min)

This is the level of inventory below, which the company is in urgent need of replacing inventory and may be in danger of running out of inventory.

$$\text{Min. Inventory level} = \text{ROL} - (\text{Average Usage} \times \text{Average Lead Time})$$

Remember

To calculate average if not given in the question, then use

$$\left\{ \frac{\text{Maximum} + \text{Minimum}}{2} \right\}$$

Example

- Consider the following inventory data for XYZ Company: $S = 26,000$ shirts per year; Carrying cost = 25%; Purchase price = Birr 4.92; and Ordering cost = Birr 1,000 per order. The EOQ level is 6,500 units.
- Assume the following information:
 - Weekly sales 500 units
 - The maximum likely sales 1000 units
 - Safety stock 1000 units
 - Lead-time 2 weeks

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- **Required:**

- (a) How much should XYZ Company initially order?
- (b) What is the reorder level (at what point reorder should be made)?
- (c) What is the average inventory balance.
- (d) What is the additional/incremental carrying cost incurred by the Company due to the safety stock?

Answers

Inventory Control Systems

- Inventory control system may run from very simple to extremely complex depending on the size of the firm & nature of its inventories.
- Popular inventory control systems:
 - The ABC System
 - The JIT System
- Other Systems of Controlling Inventories:
 - Red Line Method
 - Two Bin Method
 - Computerized inventory control systems

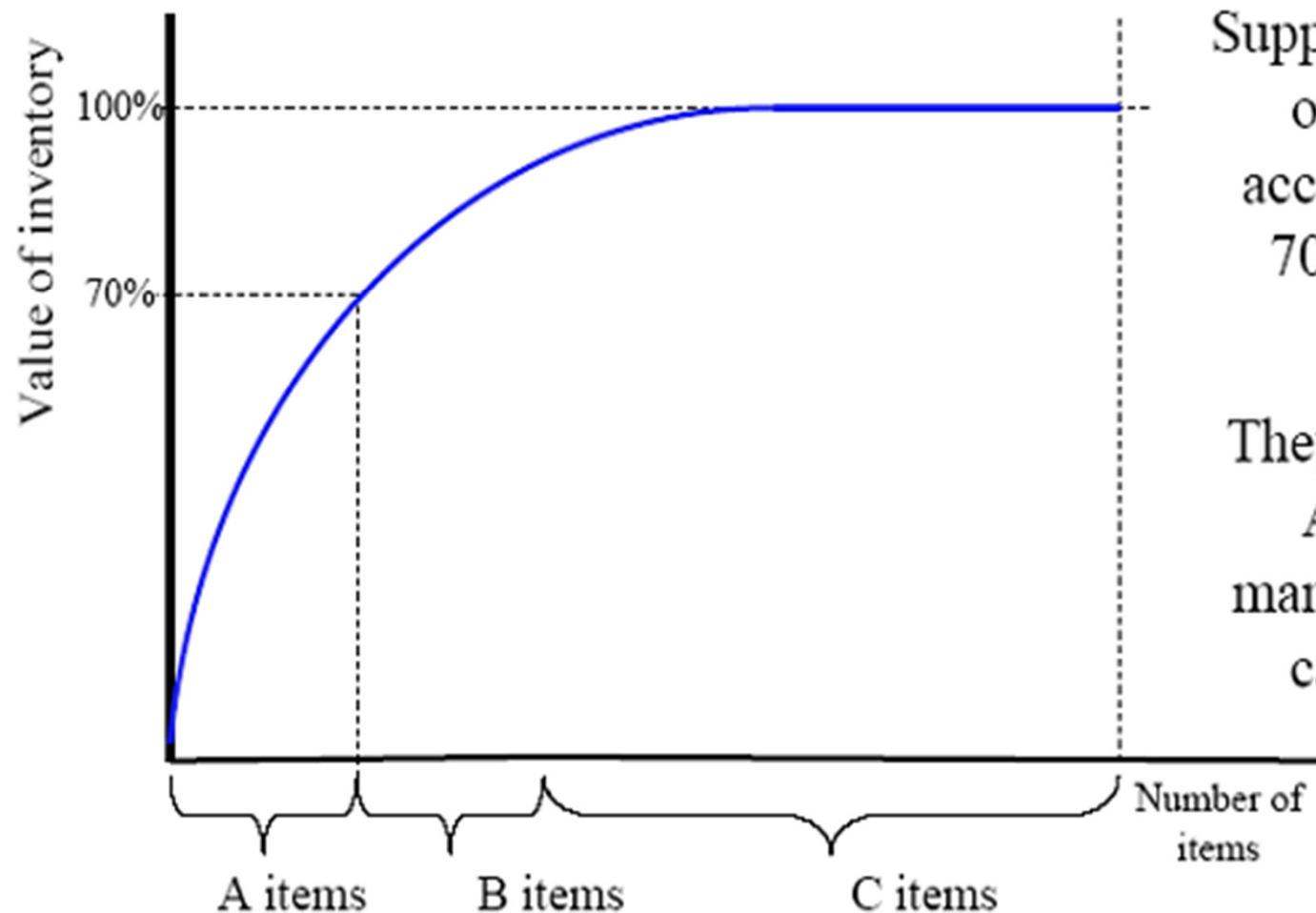
Tracking Inventories: The ABC System

- Inventory items are classified into three groups on the basis of critical needs.
 - Group A items
 - Group B items
 - Group C items
- Some inventory items (A items) are most critical (require great deal of attention)
 - Very expensive
 - Critical to firm's processes or to those of customers

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- Critical items are managed very carefully.
- Some inventory items do not require great deal of attention (**C items**) least critical.
 - Commonplace, easy to obtain
- **B items** fall between A items & C items.
- **ABC system** segregates items by value and places tighter control on higher cost (value) pieces.

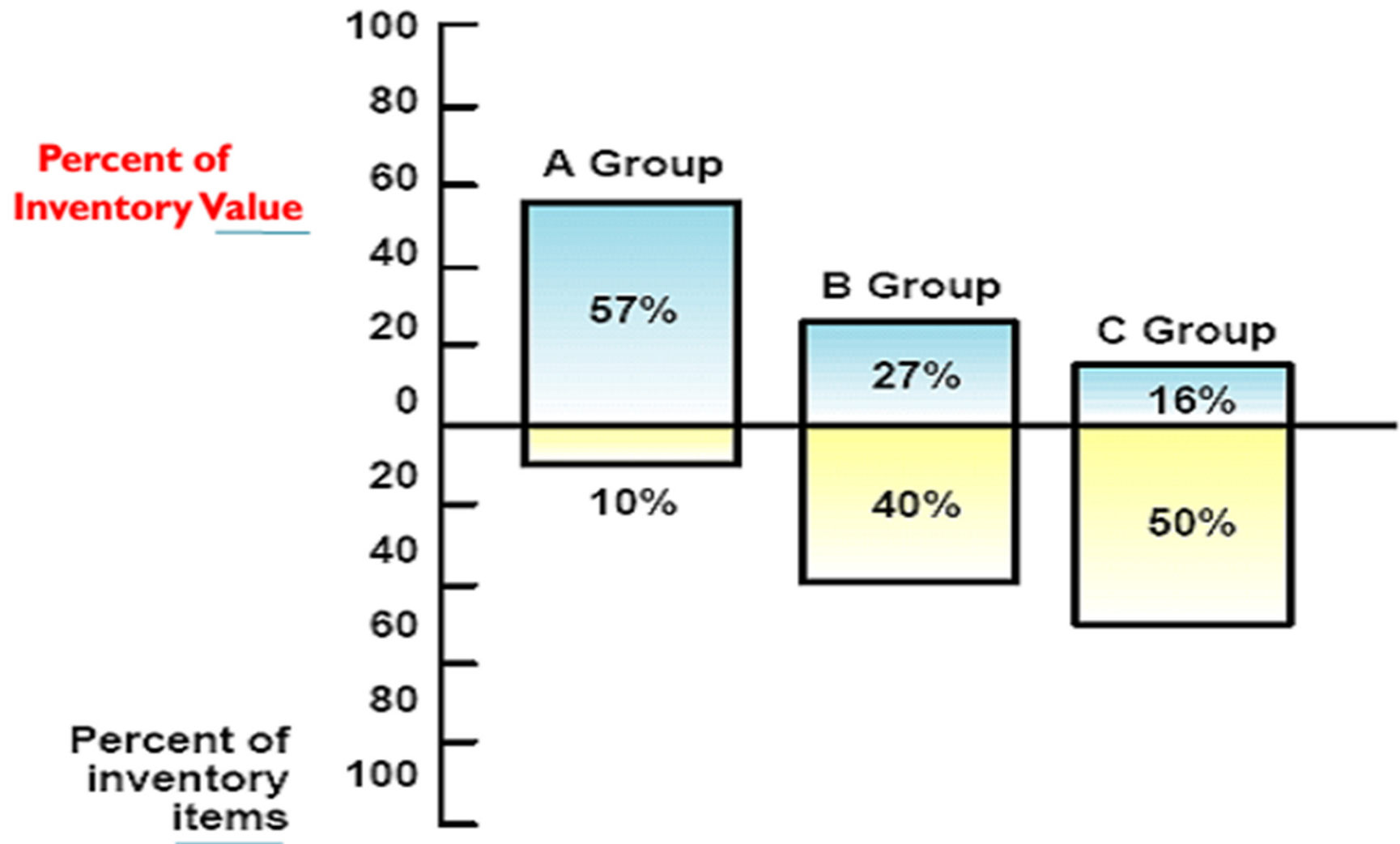
Figure: ABC System of Inventory Management



Suppose 15% of our items accounted for 70% of our sales.

They would be A items, managed most carefully.

Figure: Another Way of Looking At ABC Inventory Analysis



Just-In-Time Inventory System

- What is JIT?
 - Inventory management system
 - Attempts to eliminate, or at least to substantially reduce the need to hold inventory
- JIT is a workflow organization technique:
 - allow rapid, high quality, flexible production
 - minimizing inventories levels and manufacturing waste

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- The goal of JIT:
 - To cut down on the firm's need to keep inventory on hand, coordinating the supply of raw materials with the production and marketing of the goods.
 - To have zero inventory or as near zero as possible without adversely affecting production or sales.
- In JIT, the raw materials are only acquired precisely when they are needed—just in time.

JIT: Other Considerations

- The goal of both the economic order quantity and JIT is to minimize the costs of holding and ordering inventory.
 - EOQ model does this through the quantity of goods ordered that will minimize costs.
 - JIT inventory management does this by focusing on the source of these costs and minimizing holding costs.
- In addition to the holding and ordering costs, there are other considerations in determining the appropriate level of inventory.

Other Inventory Control Systems

- **Red Line Method:**

- Inventories stocked in a bin & red line is drawn around the inside of the bin at the level of the reorder point.
- The inventory clerk will place an order when the red line shows.

- **Two Bin Method:**

- Inventory is stocked in two bins.
- When the working bin is empty, an order is placed and inventory is drawn from the second bin.

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- **Computerized Inventory Control Systems:**
 - Larger companies apply this system.
 - The computer starts with an inventory count in memory.
 - As withdrawals are made, the computer records them and when the reorder point reaches it automatically places an order.

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