Inventory Management
Domain Academy

Inventory Management

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Introduction to Inventory Management

- What is Inventory ?
- Inventory represents raw materials ,work in process goods and completely finished goods that are considered to be the portion of a business assets those are ready or will be ready for sale.
- Inventory represents one of the most important assets of a business
- Turnover of inventory represents primary source of revenue generation in any business.

Introduction to Inventory Management (contd…)

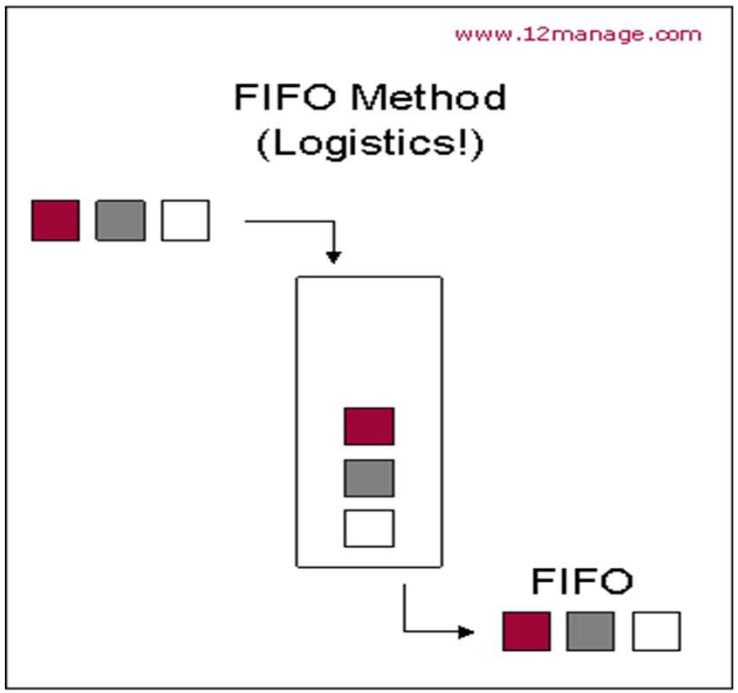
- What is an Inventory System?
- An inventory system must balance having enough inventories on hand to meet the demand of customers while investing as little money as possible in inventory.
- Inventory systems provide guidelines on how a company purchases materials and goods, stores items in the company's warehouses, values inventory and reconciles inventory from the accounting ledger to actual physical inventory.

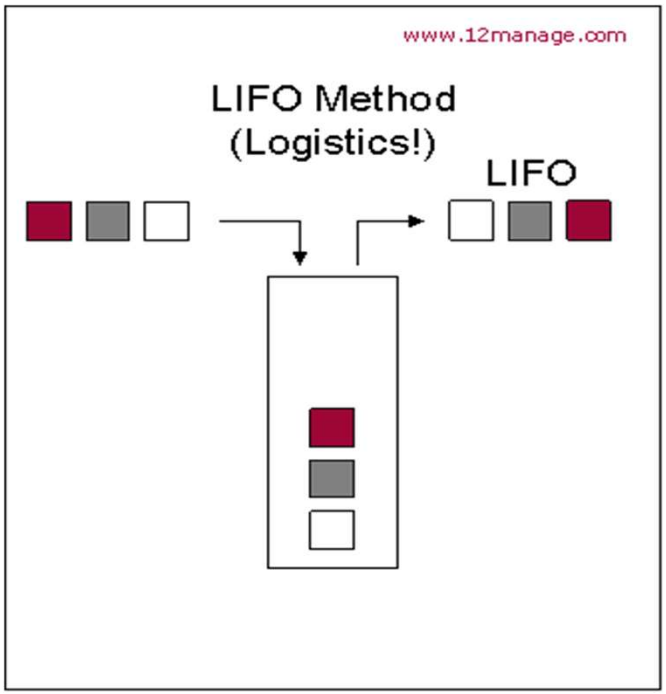
Introduction to Inventory Management (contd…)

- What are the features of Inventory system?
- The key inventory system features are
  - Display real-time inventory conditions of your products and product variants, including in stock, out-of-stock, back-ordered, or pre-orderable.
  - Filter products and product variants listings to show only those products that are currently available in stock.
  - Decrement inventory levels when orders are processed.
  - Receive notifications when inventory levels reach an out-of-stock threshold.
  - Integrate inventory levels with LOB applications.
  - Gain insight into how well products and product variants are selling.

Introduction to Inventory Management (contd…)

- Company typically selects an inventory systems such as FIFO (First in First Out),Last in First Out(LIFO),Weighted Average Inventory Valuation.
- **FIFO** requires companies to sell older inventory first**.**
- **LIFO** sells newer inventory first .
- The **weighted average method** does not dictate which sells first.





- These methods relate to accounting procedures for general ledger inventory accounting.

Introduction to Inventory Management (contd…)

- What are the functions of an Inventory System?
- Following are the main functions of Inventory system
  - Eliminates excess inventory
  - Improves inventory accuracy
  - Optimizes space utilization
  - Reduces inventory loss and spoilage
  - Increases productivity

Importance of Inventory Management System

- Why we need Inventory Management?
- Inventory management is the process of efficiently overseeing the constant flow of units into and out of an existing inventory.
- Effective inventory management is all about knowing what is on hand, where it is in use, and how much finished product results.
- This process usually involves controlling the transfer of units in order to prevent the inventory from becoming too high.
- Inventory management system balances the various tasks of Inventory Management by paying attention to the following aspects of inventory.
  - Time.
  - Calculation of buffer stock.
  - Managing the movement of raw materials through the various stages of operation.
  - Effective Inventory management involves keeping the accurate record of finished goods that are ready for shipment.

Importance of Inventory Management System (cont..)

- **Time** : This means time required for a supplier to process an order and execute a delivery.
- Inventory management also demands that a solid understanding of how long it will take for those materials to transfer out of the inventory be established.
- Knowing these two important lead times makes it possible to know when to place an order and how many units must be ordered to keep production running smoothly.

- **Calculation of buffer stock : ** Buffer stock is additional units above and beyond the minimum number required to maintain production levels.
- Creating this buffer helps to minimize the chance for production to be interrupted due to a lack of essential parts in the operation supply inventory.

Importance of Inventory Management System (cont ..)

- **Managing the movement of raw materials through the various stages of operation**
- The movement of those materials as they go through the various stages of the operation is also important.
- Typically known as a goods or work in progress inventory.
- Tracking materials as they are used to create finished goods also helps to identify the need to adjust ordering amounts before the raw materials inventory gets dangerously low or is inflated to an unfavorable level.

Importance of Inventory Management System (cont ..)

- **Effective Inventory management involves keeping the accurate record of finished goods that are ready for shipment.**
- This means posting the production of newly completed goods to the inventory totals as well as subtracting the most recent shipments of finished goods to buyers.
- When the company has a return policy in place, there is usually a sub-category contained in the finished goods inventory to account for any returned goods that are reclassified as refurbished or second grade quality.

How can we add value through Inventory?

- We can add values through inventory using the following
  - Quality
  - Speed
  - Flexibility
  - Cost
- Quality - inventory can be a “buffer” against poor quality; conversely, low inventory levels may force high quality.
- Speed - location of inventory has gigantic effect on speed.
- Flexibility - location, level of anticipatory inventory both have effects.
- Cost -there are two types of cost
  - Direct: purchasing, delivery, manufacturing
  - Indirect: holding, stock out.

Inventory Holding Pattern

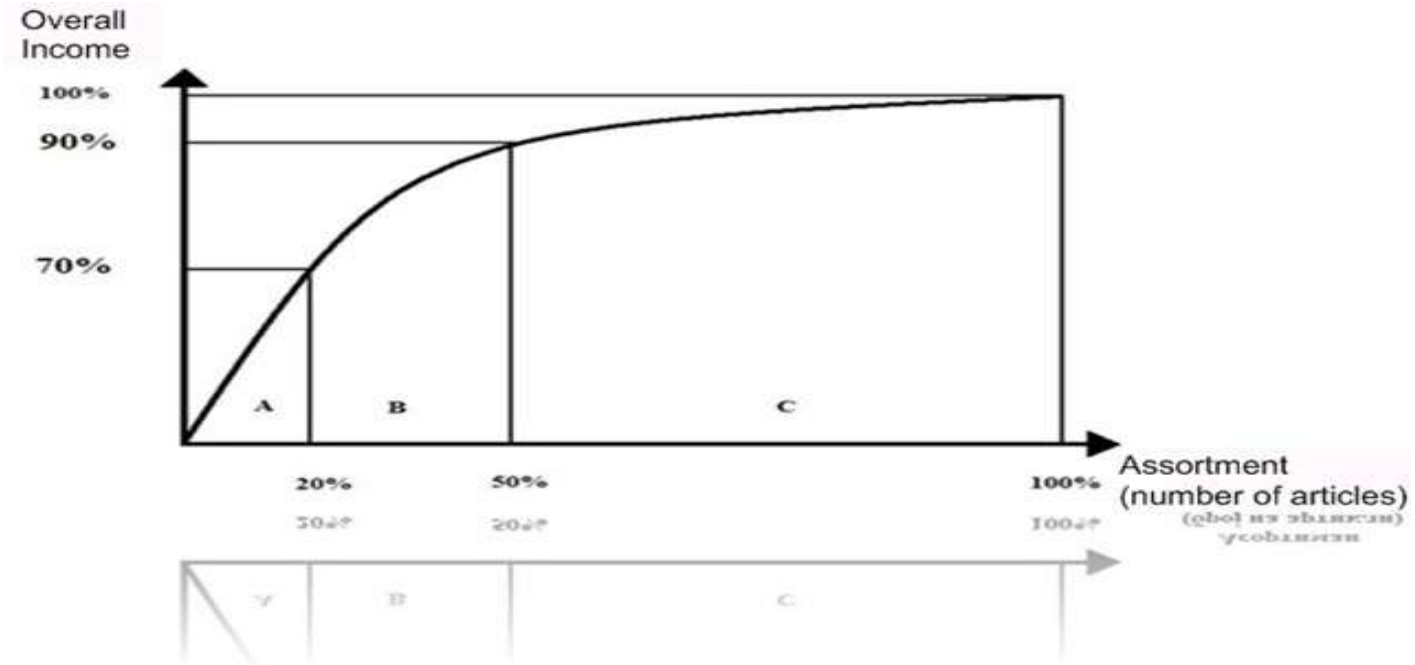
- Depending upon the nature of business, the inventory holding patterns may vary.
- While in some cases the inventory may be very high in value, in some other cases inventory may be very high in volumes and number of SKU.
- Inventory may be held physically at the manufacturing locations or in a third party warehouse location.
- Inventory Controllers are engaged in managing Inventory.
- Inventory management involves several critical areas.
- Primary focus of inventory controllers is to maintain optimum inventory levels and determine order/replenishment schedules and quantities.
- They try to balance inventory all the time and maintain optimum levels to avoid excess inventory or lower inventory, which can cause damage to the business.

Classifying Items based on Inventory

- Inventory is held in various forms including Raw Materials, Semi Finished Goods, finished Goods and Spares.
- Every unit of inventory has an economic value and is considered an asset of the organization irrespective of where the inventory is located or in which form it is available.
- Even scrap has residual economic value attached to it.
- There are a number of inventory classifications used by organizations.
- ABC Classification
- Inventory in any organization can run in thousands of part numbers or classifications and millions of part numbers in quantity.
- Therefore inventory is required to be classified with some logic to be able to manage the same.
- In most of the organizations inventory is categorized according to ABC Classification Method, which is based on pareto principle.

Classifying Items based on Inventory(cont…)

- Here the inventory is classified based on the value of the units. The principle applied here is based on 80/20 principles.
- Accordingly the classification can be as under:
- A Category Items Comprise 20% of SKU & Contribute to 80% of $ spend.
  B Category Items Comprise 30% of SKU & Contribute to 15% of $ spend.
  C Category Items Comprise 50% of SKU & Contribute to 5% of $ spend



Classifying Items based on Inventory(cont…)

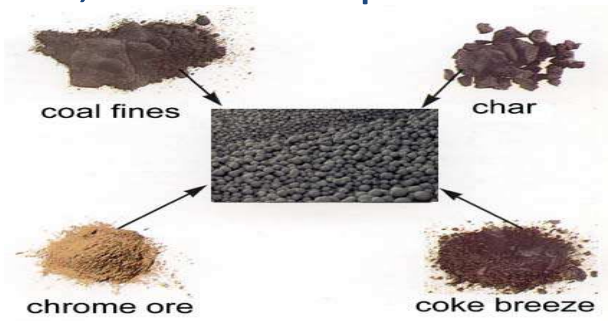
- **Advantages of ABC Classification**
- Helps one manage the entire volume and assign relative priority to the right category.
- **A Category Items**: Helps one identify these stocks as high value items and ensure tight control in terms of process control, physical security as well as audit frequency.
- **B Category Items**: These can be given second priority with lesser frequency of review and less tightly controls with adequate documentation, audit controls in place.
- **C Category Items**: Can be managed with basic and simple records. Inventory quantities can be larger with very few periodic reviews.
- Disadvantages of ABC classification
- Inventory Classification does not reflect the frequency of movement of SKU(Stock Keeping Unit) and hence can mislead controllers.
- B & C Categories can often get neglected and pile in huge stocks or susceptible to loss, pilferage, slackness in record control etc.

Different Types of Inventory

- Inventory is mainly classified into two types
  - Merchandising
  - Manufacturing
- **Merchandise inventory** is the goods owned by the business organization which are held for sale to the consumers.
- In a trading form of business organization, the primary function of the business is the sale of a product.
- At the end of the accounting period for this form of business it was necessary to determine the value of the ending merchandise inventory.
- **Manufacturing Inventory**
- Materials on hand needed for the manufacturing process.
- A manufacturing inventory consists of three different parts:
  - raw materials
  - work in process
  - finished goods

Different Types of Inventory (Cont ..)

- **Raw Material:**
- Raw Material is those basic inputs that are converts into finished goods through manufacturing process.
- Raw Material inventories are those units, which will purchase & stored for future production.



- **Work in progress**:
- Work in progress inventories are semi-manufactured products.
- They represent products that need more work before they become finished products for sale.
- **Finished goods**:
- These are completely manufactured products which are ready for sale.
- Stock of raw materials and work in progress facilitates production while stock of finished goods is required for smooth marketing operations.

Different Types of Inventory (Cont ..)

- **Spare Parts Inventories**
- Spare parts are extra parts that are available and in proximity to a functional item, such as an automobile, boat, engine, for which they might be used for repair.
- Spare parts are sometimes considered uneconomical since:
  - the parts might never be used
  - the parts might not be stored properly, leading to defects
  - Maintaining inventory of spare parts has associated costs
  - parts may not be available when needed from a supplier

- But without the spare part on hand, a company's customer satisfaction levels could drop if a customer has to wait too long for their item to be fixed.
- Therefore companies need to plan and align their service parts inventory and workforce resources to achieve optimal customer satisfaction levels with minimal costs.

Just In Time Inventory

- Just In Time (JIT) is an inventory control method where parts or supplies are delivered at the moment they are needed.
- Requires a high level of coordination and trust with suppliers and a highly efficient production process.
- Creates very low inventory overhead and cost.
- Little room for error or delays.
- Any problems with transportation, production or supply could cause widespread inventory outages.

General management of Inventory

- The overseeing and controlling of the ordering, storage and use of components that a company will use in the production of the items it will sell as well as the overseeing and controlling of quantities of finished products for sale.
- A business's inventory is one of its major assets and represents an investment that is tied up until the item is sold or used in the production of an item that is sold.
- It also costs money to store, track and insure inventory.
- Inventories that are mismanaged can create significant financial problems for a business, whether the mismanagement results in an inventory glut or an inventory shortage.

Inventory Costs

- What are Inventory Costs?
- The cost of holding goods in stock.
- Expressed usually as a percentage of the inventory value.
- It includes capital, warehousing, depreciation, insurance, taxation, obsolescence, and shrinkage costs.
- There are mainly three costs associated with the inventory.
  - Procurement costs
  - Carrying Costs
  - Out of stock costs and Cost of Replenishment

Inventory Costs (Cont..)

- **Ordering Cost (Procuring Cost)**
- Cost of procurement and inbound logistics costs form a part of Ordering Cost.
- Ordering Cost is dependant and varies based on two factors - The cost of ordering excess and the Cost of ordering too less.
- Both these factors move in opposite directions to each other.
- Ordering excess quantity will result in carrying cost of inventory.
- Whereas ordering less will result in increase of replenishment cost and ordering costs.
- These two above costs together are called Total Stocking Cost. I
- This functional analysis and cost implications form the basis of determining the Inventory Procurement decision by answering the two basic fundamental questions - How Much to Order and When to Order.
- How much to order is determined by arriving at the Economic Order Quantity or EOQ.

Inventory Cost (Cont..)

- **Carrying Cost**
- Inventory storage and maintenance involves various types of costs namely:
  - Inventory Storage Cost
  - Cost of Capital
- Inventory carrying involves Inventory storage and management either using in house facilities or external warehouses owned and managed by third party vendors.
- In both cases, inventory management and process involves extensive use of Building, Material Handling Equipments, IT Software applications and Hardware Equipments coupled managed by Operations and Management Staff resources.

Inventory Cost (Cont..)

- Inventory Storage Cost
- Inventory storage costs typically include Cost of Building Rental and facility maintenance and related costs.
- Cost of Material Handling Equipments, IT Hardware and applications, including cost of purchase, depreciation or rental or lease as the case may be.
- Further costs include operational costs, consumables, communication costs and utilities, besides the cost of human resources employed in operations as well as management
- Cost of Capital
- Includes the costs of investments, interest on working capital, taxes on inventory paid, insurance costs and other costs associate with legal liabilities.
- The inventory storage costs as well as cost of capital is dependent upon and varies with the decision of the management to manage inventory in house or through outsourced vendors and third party service providers.

Inventory Costs (Cont…)

- **Out of stock cost**

  This includes the following :-

  - Cost of Loss, pilferage, shrinkage and obsolescence etc.
  - Cost of Logistics
  - Sales Discounts, Volume discounts and other related costs.

How to measure inventory?

- Someone in any company must learn to measure inventory because this is a way of finding out how a product is doing in the market.
- Without this kind of activity and business practice, one will not be able to see how well the inventory is being managed, especially for products that are sold on consignment.
- Whenever inventory is analyzed or measured, what needs to be seen or captured in the data is the number of times that finished goods are sold.
- This may be done on a weekly, monthly, or annual basis.
- Following are the measures of inventory
  - Aggregate Inventory Values
  - Weeks of supply
  - Inventory Turnovers

How to measure inventory? (cont…)

- **Aggregate Inventory:** - The total volume of multiple classifications of goods contained within a storage facility.
- The inventory may contain finished goods, raw materials and components. Also called aggregate stock.
- Average aggregate inventory value (AAIV) is the value of all items held in inventory for the company, valued at cost.
- **Weeks of supply:** Weeks of supply tells the inventory manager how long the current on hand will last based on current sales demand.
- Helps to avoid inventory stock outs and lost sales.
- It can be calculated as

  Average aggregate Inventory Value / Weekly Sales (at cost)
- **Inventory Turnovers:**- A ratio showing how many times a company's inventory is sold and replaced over a period
- It can be calculated as:

  Cost of Goods Sold)/Avg Inventory Investment

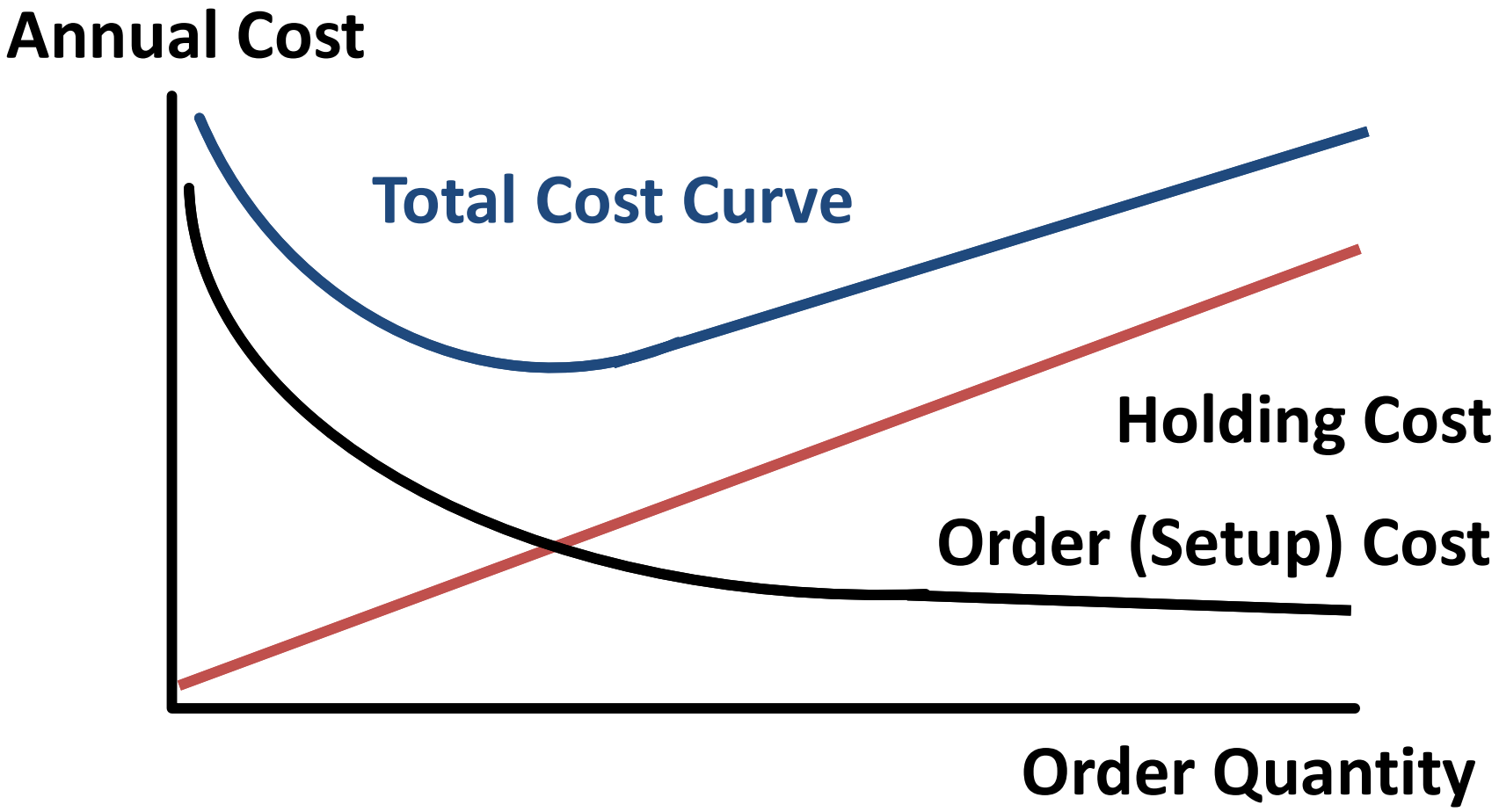
Economic Order Quantity (EOQ)

- EOQ is one of the techniques of inventory control which minimizes total holding and ordering cost of the year.
- EOQ is essentially an accounting formula that determines at which the combination of order cost and inventory carrying cost are the least. The result is the most cost effective quantity to order. In purchasing it is known as order quantity and in manufacturing it is known as production lot size.
- EOQ solves the problem of material manager.

Assumptions of EOQ Model

- Demand is known and constant.
- Lead time is known and constant.
- Receipt of inventory is instantaneous.
- Quantity discounts are not possible.
- The only cost pertaining to inventory model are the cost of placing an order and cost of holding or storing inventory over time.

EOQ(Cont..)



EOQ(Cont..)

- EOQ minimizes the sum of holding and setup costs

EOQ Formula

- $Q = \quad 2DC_o/C_h$

  D = annual demand

  C_o = ordering/setup costs

  C_h = cost of holding one unit of inventory

The EOQ Model with Quantity Discounts

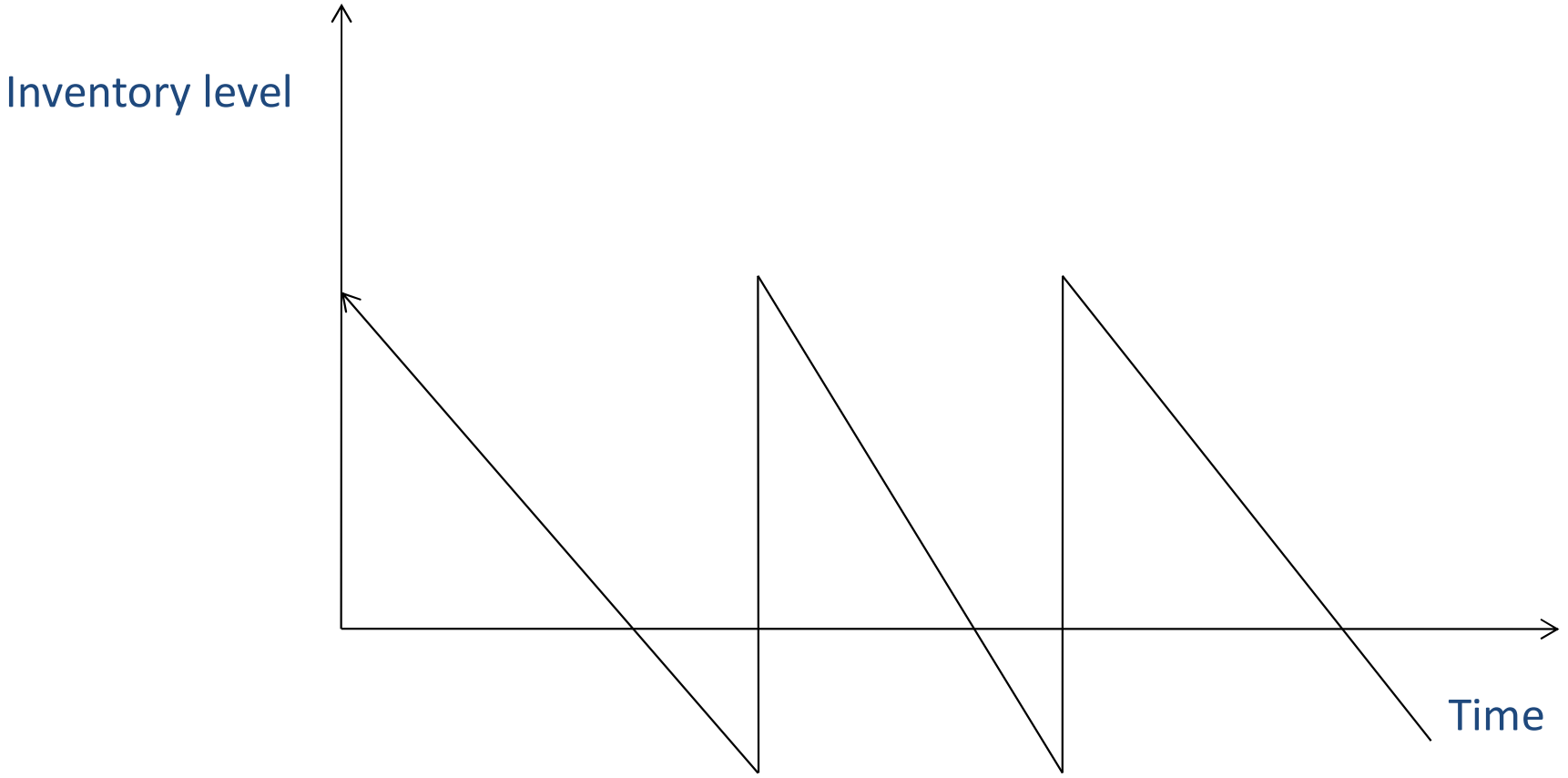
- The preceding models have assumed that the unit cost of an item is the same regardless of the quantity in the batch.
- In fact, this assumption resulted in the optimal solutions being independent of this unit cost.
- The EOQ model with quantity discounts replaces this assumption by the following new assumption
- The unit cost of an item now depends on the quantity in the batch.
- In particular, an incentive is provided to place a large order by replacing the unit cost for a small quantity by a smaller unit cost for every item in a larger batch, and perhaps by even smaller unit costs for even larger batches.

The EOQ Model with Planned Shortages

- One of the banes of any inventory manager is the occurrence of an inventory shortage (sometimes referred to as a stock out)—demand that cannot be met currently because the inventory is depleted.
- This causes a variety of headaches, including dealing with unhappy customers and having extra record keeping to arrange for filling the demand later (backorders) when the inventory can be replenished.
- If the cost of holding inventory is high relative to these shortage costs, then lowering the average inventory level by permitting occasional brief shortages may be a sound business decision.
- The EOQ model with planned shortages addresses this kind of situation by replacing only the third assumption of the basic EOQ model by the following new assumption.
- Planned shortages now are allowed.
- When a shortage occurs, the affected customers will wait for the product to become available again. Their backorders are filled immediately when the order quantity arrives to replenish inventory.

The EOQ Model with Planned Shortages(Cont..)

- Inventory level diagram for EOQ model with planned shortages.



Demand Uncertainty - Safety Stocks

- Most companies treat the world as if it were predictable:
  - Production and inventory planning are based on forecasts of demand made far in advance of the selling season
  - Companies are aware of demand uncertainty when they create a forecast, but they design their planning process as if the forecast truly represents reality
- Recent technological advances have increased the level of demand uncertainty:
  - Short product life cycles
  - Increasing product variety
- **SAFETY STOCK** (SS) or security stock ensures that the item is available up to the pre-defined required service level, even when the re-ordered material arrives later then expected, or the fluctuations in demand during the lead-time cause the demand to be larger then expected.
- This strategy is employed when the lead time of manufacturing is too long to satisfy the customer demand at the right cost/quality/waiting time.

Continuous Review Inventory System

- Also known as Lot size reorder point systems (Q, R) system.
- Inventory level is constantly monitored and a new order place when a pre-established reorder point R is met
- Demand is random and stationary.
- Inventory Model Decision variables: Q and R
- Inventory related costs
  - Order preparation costs / setup costs
  - Inventory carrying costs
  - Shortage & customer service costs

Periodic Review Inventory System

- Classic independent inventory system
- Inventory levels start at some restocking level, **R.**
- At regular time intervals (ex. – 3 days, two weeks, etc.), the inventory level is reviewed. This new inventory level is called **I**.
- Some amount, **Q**, is added to bring the inventory level back up to **R**:

$$\mathbf{Q = R - I}$$

Determining the restocking level

$$RS = D_{RP+L} + SS$$

- D_{RP+L} =average demand during the reorder period plus the replenishment lead time (if there is a delay getting new products in).
- SS =safety stock.

Single Period Inventory Model

- A single period inventory model is used to identify the amount of inventory to purchase given a perishable good or single opportunity to purchase.
- The amount of the single order is based on balancing the cost of over- and under-estimating demand. This is a very common problem in areas such as:
  - Overbooking of airline seats or hotel rooms
  - Ordering of fashion items
  - Any type of one-time order (t-shirts for a sporting event)
- When you know:
  - Co = the cost per unit of overestimating demand
  - Cu = the cost per unit of ~~over~~underestimating demand
  - μ = the average number of units sold over the planning horizon
  - σ = the standard deviation of units sold over the planning horizon

Single Period Inventory Model(Cont..)

- You can calculate the safety stock needed to balance the costs of over- and under-estimating demand, by (assuming sales are normally distributed):
- 1. Calculate the probability of a unit will not be sold:

$$P <= Cu / (Co + Cu)$$

- 2. Find the point on our demand distribution that corresponds to the cumulative probability of a unit not being sold by finding the Z-score

$$\text{Z-score} = \text{NORMSINV}(P)$$

- 3. Calculate the amount of safety stock as:
- $$\text{Safety stock} = \text{ROUND}(\text{Z-score} * \sigma)$$
- 4. Total order = μ + Safety stock

Use of computers in Inventory Management Systems

- Computerization has revolutionized inventory management, as technologies ranging from automatic scanners to radio frequency identification chips now allow businesses to track their inventory from the moment a company buys it wholesale to the moment the products leave the building in the hands of a customer.
- **Receipt of Goods**
- A retail store or a central warehouse uses bar code or radio-frequency identification scanning at the point of receipt of goods.
- Scanning individual items or shipment pallets allows a company to itemize all shipments from the supplier, which can be compared against the purchase order for errors or losses in transit.
- When your business ships these goods out of the warehouse to their point of sale, a second scan can automatically tally the remaining stock in the warehouse, and send messages to the purchasing managers indicating that it is time to reorder.

Use of computers in Inventory Management (cont…)

- **Retail Turnover**
- Many businesses use similar scanning techniques at the point of checkout.
- As of 2010, bar code scanners are more popular than RFID for this purpose.
- Both will automatically enter the correct price at the register and prevent data entry errors.
- They also can create a perfect real-time record of how much stock remains on the shelves, how much is available in on-site storage, and whether a new shipment is necessary from the warehouse.
- Combine this information with warehousing data, and your business can create additional alerts to key management when a bottleneck occurs.

Use of computers in Inventory Management (cont…)

- **Stock Management and Cost Reduction**
- The process of moving goods through a company pipeline is always economically inefficient.
- The purchase of the goods represents an investment of company capital, which your business cannot recoup until you sell your inventory.
- Warehousing of goods before sale introduces the possibility of inventory shrinkage in value from theft, damage, deterioration or changes in customer taste.
- Moving goods from warehouses to the point of sale involves shipping costs, especially if the shipment is incorrect, or if the internal shipping process is inefficient.
- Computerization provides a real time picture of this entire work flow process, and allows managers to reduce purchasing costs through minimizing inventory , increase the efficiency of internal shipping systems, and reduce the possibility of theft or damage by being able to track each item down to the individual staffer who takes responsibility for it.

Thank You!