INVENTORY MANAGEMENT

1. EOQ

The total costs of a material usually consist of Buying Cost + Total Ordering Cost + Total Carrying Cost.

Economic Order Quantity is 'The size of the order for which both ordering and carrying cost are minimum.

Ordering Cost: The costs which are associated with the ordering of material. It includes cost of staff posted for ordering of goods, expenses incurred on transportation, inspection expenses of incoming material....etc

Carrying Cost: The costs for holding the inventories. It includes the cost of capital invested in inventories. Cost of storage, Insurance.....etc

The assumptions underlying the Economic Ordering Quantity: The calculation of economic order of material to be purchased is subject to the following assumptions:-

(a) Ordering cost per order and carrying cost per unit per annum are known and they are fixed.

(b) Anticipated usage of material in units is known.

(c) Cost per unit of the material is constant and is known as well.

(d) The quantity of material ordered is received immediately i.e lead time is Zero.

The famous mathematician 'WILSON' derived the formula used for determining the size of order for each purchases at minimum ordering and carrying costs, which is as below :-

Economic Ordering Quantity =

$$EOQ \sqrt{\frac{2 \times A \times 0}{C}}$$

Where,

A = Annual demand

O = Ordering Cost

C = Carrying Cost

Illustration 1 :

(1) Calculate the Economic Order Quantity from the following information. Also state the number of orders to be placed in a year.

Consumption of materials per annum	=	10,000 kg
Order placing cost per order	=	Rs 50
Cost per kg of raw materials	=	Rs 2
Storage costs	=	8% on average inventory

Solution:

(1) $EOQ \sqrt{\frac{2 \times A \times B}{C}}$

A = Units consumed during year = 10,000

B = Order cost per order = 50

C = Inventory carrying cost per unit per annum 2 × 8% = 0.16

$EOQ = \sqrt{\frac{2 \times 10{,}000 \times 50}{0.16}}$

EOQ = 2,500 kg.

(2) No. of orders to be placed in a year $= \frac{\text{Total Consumption of material per annum}}{EOQ}$

$= \frac{10{,}000}{2{,}500} =$ **4 Orders per year**

Illustration 2:

The average annual consumption of a material is 18,250 units at a price of Rs 36.50 per unit. The storage cost is 20% on an average inventory and the cost of placing an order is Rs 50. How much quantity is to be purchased at a time?

Solution:

$EOQ \sqrt{\frac{2 \times A \times B}{C}}$

A = Units consumed during year = 18,250

B = Order cost per order = Rs50

C = Inventory carrying cost per unit per annum 36.50x 20%= Rs 7.3

$EOQ = \sqrt{\frac{2 \times 18{,}250 \text{ unit} \times \text{Rs. } 50}{7.3}}$

= 500 Units

Illustration 3

The following information relating to a type of Raw Material is available:

Annual Demand	2,000 units
Storage Cost	2% p.a
Interest Rate	8% p.a
Unit Price	Rs. 20

Ordering cost per order ` 20

Calculate EOQ and Total Annual Inventory Cost of the Raw Material**.**

Solution:

1. EOQ= $\sqrt{\frac{2 \times A \times B}{C}}$ Where	A= Annual Requirement of Raw Material = 2,000 units (given) B = buying Cost Per Order = ` 20 per order (given C= Carrying Cost per unit per annum = ` 20 × 10% (i.e. 2% + 8%) = ` 2 p.u On substitution, EOQ = 200 units
2. Inventory Carrying Cost p.a.	= Average Inventory (i.e ½ of EOQ) x Carrying Cost per Unit per annum = 100 units x ` 2 p.u. p.a. = ` 200
3. Ordering cost	Number of order 2000/ 20= 10 order. Ordering cost = 10 x20= Rs 200
4. Buying cost	2000x 20= Rs 40,000
5. Total cost (Inventory Carrying Cost p.a + Ordering cost+ Buying cost)	40,000+ 200+200= 40,400

Illustration 4

A manufacture buys certain essential spares from outside suppliers at ` 40 per set. Total annual requirement are 45,000 sets. The annual cost of investment in inventory is 10% and cost like rent, stationery, insurance, taxes, etc. per unit per year works out to be ` 1. Cost of placing an order is ` 5.

Calculate:

1. The EOQ (By formula method)
2. No. of order to be placed.

Solution:

A = Annual requirement = 45,000 sets

O = Ordering cost per order = ` 5

C = Carrying cost p.u. = ` 40 x 10/100 = ` 4 + ` 1 = ` 5

E.O.Q. $\sqrt{\frac{2AxB}{C}}$ = $\sqrt{\frac{2 \times 45000 \times 5}{5}}$ = **300 sets**

No. of Orders = $\frac{\text{Annual Consumption}}{\text{EOQ}}$

= $\frac{45,000}{300}$

= **150 orders**

Illustration 5

The Purchase Manager of an organisation has collected the following data for one of the A class items.

Interest of the locked up capital	20%
Order processing cost (`) for each order	` 100
Inspection cost per lot	` 50

Follow up cost for each order	` 80
Pilferage while holding inventory	5%
Other holding cost	15%
Other procurement cost for each order	` 170
Annual demand	1,000 units
Cost per item	` 10

What should be the EOQ

Solution:

A = Annual Demand = 1,000

B = Ordering cost = 100 + 50 + 80 + 170 = ` 400 per order

C = Inventory Carrying cost = 40% (20% + 5% + 15%) of ` 10 = 4.00 per unit

$$\textbf{E.O.Q.} \sqrt{\frac{2AB}{C}} = \sqrt{\frac{2 \times 1000 \times 400}{4}}$$

= **447 units**

Illustration 6:

A company manufactures a special product which require a component Alpha . The particulars are collected for the year 2015:

1. Annual demand for Alpa 8000 units.
2. Cost of placing an order Rs 200 per order.
3. Cost per unit of Alpa Rs 400
4. Cost of carrying 20% p.a

The company has been offered a quantity discount of 4% on purchase of Alpa provided that the order size is 4000 components at a time.

Required:

a. compute the economic order quantity
b. Advise whether quantity discount offer can be accepted.

Solution:

(a) Calculation of Economic Order Quantity

$$EOQ = \sqrt{\frac{2 \times A \times B}{C}}$$

$$= \sqrt{\frac{2 \times 8000 \text{ Units Rs. } 200}{\text{Rs. } 400 \times 20/100}}$$

= 200 Units

(b) Evaluation of Profitability of Different Options of Order Quantity

(a) When EOQ is ordered

Purchase Cost	8000 units × Rs400)	32,00,000
Ordering Cost	[(8,000 units / 200 units) ×` 200]	8,000
Carrying Cost	(200 units x Rs 400× ½ x 20/100	8,000

Total Cost		32,16,000

(b) When quantity discount is accepted

Purchase Cost	(8,000 units × Rs 384)	30,72,000
Ordering Cost	(8,000 units / 4000 units) × 200]	400
Carrying Cost	(4000 units × Rs 384 × ½ x 20/100	1,53,600
Total Cost		32,26,000

Advise:

The total cost of inventory is lower if EOQ is adopted. Hence, the company is advised not to accept the quantity discount.

Illustration 7:

Anil company buys its annual requirement of 36,000 units in six instalments. Each unit costs Re 1 and the ordering cost is Rs 25. The inventory carrying cost is estimated at 20% of unit value. Find the total annual cost of the existing inventory policy. How much money can be saved by using E.O.Q?

$$EOQ = \sqrt{\frac{2 \times A \times B}{C}}$$

$$= \sqrt{\frac{2 \times 36{,}000 \times 25}{1 \times 20\%}}$$

$$= \sqrt{\frac{18{,}00{,}000}{0.2}}$$

= 3,000 Units

Statement Showing computation of comparative inventory cost of existing policy and proposed EOQ policy:

	Particulars	Existing Policy		EOQ	
i)	Purchase cost	(36,000 x 1)	36,000	(36,000 x 1)	36,000
ii)	Ordering Cost	[36,000/6,000 x 25]	150	(36000/3000 x 25]	300
iii)	Carrying Cost	[1/2 X 6000 x 1 x 20%]	600	1/2 X 3000 x 1 x 20%	300
			36,750		36,600

Saving by using EOQ = 36,750 – 36,600 = `150

2. COMPUTATION LEVEL

1. Maximum Level:

The Maximum Level indicates the maximum quantity of an item of material that can be held in stock at any time. The stock in hand is regulated in such a manner that normally it does not exceed this level.

Maximum Level = Re-Order Level + Re-Order Qty – (Minimum Rate of Consumption X Minimum Re- Order Period)

2. Minimum Level:

The Minimum Level indicates the lowest quantitative balance of an item of material which must be maintained at all times so that there is no stoppage of production due to the material being not available.

Minimum Level = Re-Order level – (Normal Rate of Consumption X Normal Re-Order Period)

3. Re-Order Level:

When the stock in hand reach the ordering or re-ordering level, store keeper has to initiate the action for replenish the material. This level is fixed somewhere between the maximum and minimum levels in such a manner that the difference of quantity of the material between the Re-ordering Level and Minimum Level will be sufficient to meet the requirements of production up to the time the fresh supply of material is received.

Re-Ordering level=Minimum Level + (Normal Rate of Consumption × Normal Re-order Period) Another formula for computing the Re-Order level is as below

Re-Order level = Maximum Rate of Consumption x Maximum Re-Order period (lead time)

4. Danger Level:

It is the level at which normal issue of raw materials are stopped and only emergency issues are only made. This is a level fixed usually below the Minimum Level. When the stock reaches this level very urgent action for purchases is indicated. This presupposed that the minimum level contains a cushion to cover such contingencies. The normal lead time cannot be afforded at this stage. It is necessary to resort to unorthodox hasty purchase procedure resulting in higher purchase cost.

Danger Level = Normal Rate of Consumption × Maximum Reorder Period for emergency purchases

Illustration 8

The components A and B are used as follows:

Normal usage .... 300 units per week each

Maximum usage .... 450 units per week each

Minimum usage .... 150 units per week each

Reorder Quantity .... A 2,400 units; B 3,600 units

Reorder period .... A 4 to 6 weeks, B 2 to 4 weeks.

Calculate for each component:

(a) Re-order Level (b) Minimum Level (c) Maximum Level (d) Average Stock Level.

Solution:

		A	B
a)	Reorder Level [Max. Consumption × Max. Re-order Period]	2700 units (450 × 6)	1800 units (450 × 4)
b)	Minimum Level [ROL – (Normal Consumption × Normal Re-order period)]	1200 units [2700 – (300×5)	900 units [1800 – (300×3)]
c)	Maximum Level [ROL + ROQ – (Min. Consumption × Min. Re-order Period)]	4500 units [2700 + 2400 – (150×4)]	5100 units [1800 + 3600 – (150 × 2)]
d)	Average Stock Level [Min. Level + Max. Level] / 2	2850 units [4500 + 1200 / 2]	3000 units [5100 + 900 / 2]

Illustration 9:

Two components A and B are used as follows:

Normal usage = 50 per week each

Re-order quantity = A- 300; B-500

Maximum usage = 75 per week each

Minimum usage = 25 per week each

Re-order period: A - 4 to 6 weeks; B - 2 to 4 weeks

Calculate for each component:

(a) Re-order level; (b) Minimum level; (c) Maximum level; (d) Average stock level.

Solution:

		A	B
a)	Reorder Level [Max. Consumption × Max. Re-order Period]	450 units (75 x 6)	300 units (75 x 4)
b)	Minimum Level [ROL – (Normal Consumption × Normal Re-order period)]	200 units [450 – (50x5)	150 units [300 – (50x3)]
c)	Maximum Level [ROL + ROQ – (Min. Consumption × Min. Re-order Period)]	650 units [450 + 300 – (25x4)]	750 units [300 + 500 – (25 x 2)]
d)	Average Stock Level [Min. Level + Max. Level] / 2]	425 units [200 + 650 / 2]	450 units [150 + 750 / 2]

3. INVENTORY MANAGEMENT –ABC ANALAYSIS

1. What is ABC Method of Inventory Control?

It has become an indispensable part of a business and the ABC analysis is widely used for unfinished good, manufactured products, spare parts, components, finished items and assembly items.

This method of management divides the items into three categories A, B and C; where A is the most important item and C the least valuable.

2. Why the need for prioritizing inventory?

Item A**:**

In the ABC model of inventory control, items categorized under A are goods that register the highest value in terms of annual consumption. It is interesting to note that the top 70 to 80 percent of the yearly consumption value of the company comes from only about 10 to 20 percent of the total inventory items. Hence, it is crucial to prioritize these items.

Item B:

These are items that have a medium consumption value. These amount to about 30 percent of the total inventory in a company which accounts for about 15 to 20 percent of annual consumption value.

Item C:

The items placed in this category have the lowest consumption value and account for less than 5 percent of the annual consumption value that comes from about 50 percent of the total inventory items.

Note: The annual consumption value is calculated by the formula:

(Annual demand) × (item cost per unit)

3. What are the policies governing the ABC method of inventory management?

The idea behind using the ABC analysis is to leverage the imbalances of sales. This means that each item must be given the appropriate amount of weight depending on their class:

Item A:

a) These are subjected to strict inventory control and are given highly secured areas in terms of storage

b) These goods have a better forecast for sales

c) These are also the items that require frequent reorders on a daily or a weekly basis

d) They are kept as a priority item and efforts are made to avoid unavailability or stock-out of these items

Item B:

a) These items are not as important as items under section A or as trivial as items categorized under C

b) The important thing to note is that since these items lie in between A and C, they are monitored for potential inclusion towards category A or in a contrary situation towards category C

Item C:

a) These items are manufactured less often and follow the policy of having only one of its item on hand or in some cases they are reordered when a purchase is actually made

b) Since these are low demand goods with a comparatively higher risk of cost in terms of excessive inventory, it is an ideal situation for these items to stock-out after each purchase

c) The questions managers find themselves dealing with when it comes to items in category C is not how many units to keep in stock but rather whether it is even needed to have to these items in store at all

4. JUST IN TIME

Just in time inventory is the reduced amount of inventory owned by a business after it installs a just-in-time manufacturing system. The intent of a JIT system is to ensure that the components and sub-assemblies used to create finished goods are delivered to the production area exactly on time. Doing so eliminates a considerable investment in inventory, thereby reducing the working capital needs of a business. This type of system is called a "pull" system. Under the JIT concept, inventory may be reduced by the following means:

- *Reduced production runs*. Fast equipment setup times make it economical to create very short production runs, which reduces the investment in finished goods inventory.
- *Production cells*. Employees walk individual parts through the processing steps in a work cell, thereby reducing scrap levels. Doing so also eliminates the work-in-process queues that typically build up in front of a more specialized work station.
- *Compressed operations*. Production cells are arranged close together, so there is less work-in-process inventory being moved between cells.
- *Delivery quantities*. Deliveries are made with the smallest possible quantities, possibly more than once a day, which nearly eliminates raw material inventories.
- *Certification*. Supplier quality is certified in advance, so their deliveries can be sent straight to the production area, rather than piling up in the receiving area to await inspection.
- *Local sourcing*. When suppliers are located quite close to a company's production facility, the shortened distances make it much more likely that deliveries will be made on time, which reduces the need for safety stock.

Advantages of JIT Inventory

There are a multitude of improvements related to JIT inventory, particularly in relation to reduced cash requirements and the ease with which manufacturing problems can be uncovered. Advantages of JIT inventory include:

- *Working capital*. JIT inventory is designed to be exceedingly low, so the investment in working capital is minimized.
- *Obsolete inventory*. Since inventory levels are so low, there is little risk of having much obsolete inventory.

- *Defects*. With so little inventory on hand, defective inventory items are more easy to identify and correct, resulting in lower scrap costs.
- *Process time*. A thoroughly implemented JIT system should shorten the amount of time required to manufacture products, which may decrease the quoted lead times given to customers placing orders.
- *Engineering change orders*. It is much easier to implement engineering change orders to existing products, because there are few existing stocks of raw materials to draw down before you can implement changes to a product.

==========