Formula of inventory management:

1. $EOQ = \sqrt{\frac{2AO}{C}}$

EOQ = Economic Order Quantity.

A = Annual needs/demand/usages.

O = Ordering cost per order.

C = Carrying cost per unit.

2. Number of order= $\frac{\text{Annual needs/demand/usages.}}{\text{Economic Order Quantity.}} = \frac{A}{EOQ}$

3. Annual Ordering cost= $\frac{A}{EOQ} \times O$

4. Annual Carrying cost= $\frac{EOQ}{2} \times C$

5. Total annual cost= $\left(\frac{A}{EOQ} \times O\right) + \left(\frac{EOQ}{2} \times C\right)$

6. Number of orders= $\frac{A}{EOQ}$

7. Safety Stock= (Maximum usage per day – Normal usage per day) × Lead time

= Daily usage× safety stock use days

8. Re-order point: If there is no Safety Stock:

(i) Re-order point= Maximum use × Maximum lead time

If there is remains Safety Stock:

(ii) Re-order point= (Average use × Maximum lead time) + Safety Stock

9. Number of working days= $\frac{A}{\text{Average daily usage}}$

10. Cycle time= $\frac{EOQ}{U}$ Where, U= Use rate

11. Run time= $\frac{EOQ}{P}$ Where, P = Production or delivery rate

12. Maximum level= ROL+EOQ – (Minimum usage × Minimum lead time)

13. Minimum level= ROL– (Normal usage × Average lead time)

Example-1: A local distributor for a national tire company expects to sell approximately 9,600 steel-belted radical tires of a certain size and tread design next year. Annual carrying cost is Tk. 16 per tire, and ordering cost is Tk. 75. The distributor operates 288 days a year.

a. What is the EOQ?

b. How many times per year does the store reorder?

c. What is the length of an order cycle?

d. What is the total annual cost if the EOQ quantity is ordered?

Solution: Given that:

Annual Demand, **A** = 9,600 tires per year   Carrying Cost, **C** = Tk. 16 per unit per year

Ordering Cost, **O** = Tk. 75 per year

a. $EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2\times 9{,}600\times 75}{16}} = 300\ tires$

b. No of orders per year $= \frac{A}{EOQ} = \frac{96.000}{300} = 32\ times$

c. Length of order cycle $= \frac{\text{EOQ}}{\text{A}} = \frac{300}{9600} = \frac{1}{32}$ of a year, which is $\frac{1}{32} \times 288$

$= 9$ workdays

d. Total Cost = Ordering Cost + Carrying Cost

$$= \left(\frac{A}{EOQ} \times O\right) + \left(\frac{EOQ}{2} \times C\right)$$

$$= \left(\frac{9600}{300}\right) 75 + \left(\frac{300}{2}\right) 16$$

$$= Tk.(2400 + 2400)$$

$$= Tk.4800$$

Example- 2: A toy manufacturer usage 48,000 rubber wheels per year for its popular dump truck series. The firm makes its own wheels, which it can produce at a rate of 800 per day. The toy trucks are assembled uniformly over the entire year. Carrying cost is $1 per wheel a year. Setup cost for a production run of wheels is $45. The firm operates 240 days per year. Determine the

a. Optimal run size.

b. Minimum total annual cost for carrying and setup.

c. Cycle time for the optimal run size.

d. Run time.

Solution:

Here, given that:

Yearly Demand, A = 48, 000 wheels per year

Ordering/Setup costs for a production run, O = $45

Carrying cost, C = $1 per wheel per year

Production rate, p = 800 wheels per year

Usages rate, u = 48,000 wheels per 240 days = 200 wheels per day.

a. We know, economic or optimum run quantity is

$$EOQ/EPQ = \sqrt{\frac{2AO}{C}\sqrt{\frac{P}{P-U}}} = \sqrt{\frac{2(48{,}000)45}{1}}\sqrt{\frac{800}{800-200}} = 2400\ wheels$$

b. We know, Minimum total annual cost for carrying and set up cost is

$$TC_{min} = \text{Carrying Cost} + \text{Setup Cost} = \left(\frac{I_{max}}{2}\right)C + \left(\frac{A}{EOQ}\right)0$$

Thus, we must first compute, I_{max}

$$I_{max} = \frac{EOQ}{p}(p-u) \qquad = I_{max} = \frac{2{,}400}{800}(800-200) \quad = 1{,}800 \text{ wheels}$$

$$TC_{min} = \left(\frac{1800}{2}\right)\times 1 + \frac{48000}{2400}\times 45 = \$900 + \$1800 = \$1800$$

c. We know,

$$\text{Cycle time} = \frac{EOQ}{u}$$

$$\text{Cycle time} = \frac{2400 \text{ wheels}}{200 \text{ wheels per day}} = 12 \text{ days.}$$

Thus, a run of wheels will be made every 12 days.

d. We know

$$\text{Run time} = \frac{\text{EOQ}}{\text{p}}$$

$$\text{Run time} = \frac{2400 \text{ wheels}}{800 \text{ wheels per day}} = 3 \text{ days}$$

Thus, each run will require three days to complete.

Example- 3: Piddling Manufacturing assembles security monitors. It purchases 36,00 black-and-white cathode ray tubes a year at Tk. 65 each. Ordering costs are Tk. 31, and annual carrying costs are 20 percent of the purchase price. Compute the optimal quantity and the total annual cost of ordering and carrying the inventory.

Solution:

Here: **A** = 3,600 cathode ray tubes per year **O** = Tk. 31 **C** = (Tk. 65) 0.20 = Tk. 13

$$EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2(3600)31}{13}} = 131 \text{cathode ray tubes}$$

Total Cost = Carrying Cost + Ordering Cost

$$= \left(\frac{EOQ}{2} \times C\right) + \left(\frac{A}{EOQ} \times O\right)$$

= (131/2)13 + (3600/131)31

= Tk. 852 + Tk. 852

= Tk. 1704

Example- 4: ABC Company requires 50,000 units of raw material of a certain product for the next year. The cost of placing an order is Tk. 20. The carrying cost per unit is 10% of cost of the material. The cost of price of material is Tk. 5 per unit. Normal lead time is 5 days. The working days may be 250 days. You are required to calculate:

a. The Economic Order quantity (EOQ). b. No of orders

c. Safety stock (two days usage). d. Re-order point.

Solution: (a) Given that: Annual Demand, A= 50,000 units of raw material

Ordering cost, O = 20, Carrying cost, C = 5×10%=.5

The Economic Order quantity:

$$EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2\times 50{,}000\times 20}{.5}} = 4ooo\ units$$

(b) No of orders $= \frac{A}{EOQ} = \frac{50.000}{4{,}000} = 12.5\ times$

$(C) Safety\ stock = Daily\ usage \times 2$

$$= \frac{50{,}000}{250} \times 2 = 400\ units$$

(d) Re-order point= Safety stock + (Lead time × usage) $|Usage = \frac{50{,}000}{250} = 200$

$= 400 + (5 \times 200) = 400 + 1000 = 1400\ units$

Example- 5: A company has an expected usage of 1, 00,000 units of certain product the next year. The cost of placing an order is Tk. 500 and carrying cost per units Tk.1.

Calculate: i) EOQ iii) Total carrying cost

ii) Total order cost iv) Total inventory cost

Solution: (i) Given that: Annual Demand, A=1, 00,000 units

Ordering cost, O = Tk.500, Carrying cost, C = Tk. 1

The Economic Order quantity:

$$EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2\times 1{,}00{,}000\times 500}{1}} = 10000\ units$$

(ii) Total ordering cost $= \frac{A}{EOQ} \times O = \frac{1{,}00{,}000}{10{,}000} \times 500 = Tk. 5{,}000$

iii) Total carrying cost$= \frac{EOQ}{2} \times C = \frac{10{,}000}{2} \times 1 = Tk. 5{,}000$

iv) Total inventory cost=Total ordering cost+ Total carrying cost

= (5,000+5,000) Tk.

=Tk. 10,000

Example- 6: Annual demand for raw materials of Elton Enterprise is 80,000 units. The cost per unit is Tk. 12, Order cost is Tk. 7 per order and carrying cost is 25%. Lead time is 5 days and the safety stock level is 2 days usage. Assume 360 days a year. Determine-

a) Economic Order quantity (EOQ).

b) No of orders

c) Safety stock

d) Re-order point.

Solution: (a) The Economic Order quantity:

$$EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2\times80{,}000\times7}{3}} = 611 \text{ units}$$

A=80,000

O = 7

C=12× 25%=3

b) No of orders= $\frac{A}{EOQ} = \frac{80.000}{611} = 130.93 = 131\ times$

C) Safety stock $= Daily\ usage \times 2$

$$= \frac{80{,}000}{360} \times 2 = 222.22 \times 2 = 444.44\ units$$

(d) Re-order point= Safety stock + (Lead time × usage)

$Daily\ Usage = \frac{80{,}000}{360} = 222.22$

$= 444.44 + (5 \times 222.22) = 444.44 + 1111.10$

$= 1{,}555.54 = 1{,}556\ units$

Example-7: You are given the following data of a company:

Annual demand 12,000 units, purchase price per unit Tk. 20, the cost of placing an order is Tk.60, carrying cost 20% of purchase price, lead time is 15 days, total working days 200. If the company keeps safety stock for 30 days use only.

Find out: a) The Economic Order quantity (EOQ).

b) No of orders

c) Cost of ordering

d) Cost of carrying

e) Safety stock

f) Re-order point.

g) Total cost of inventory

Solution: (a) The Economic Order quantity:

$$EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2\times 12{,}000\times 60}{4}} = \sqrt{\frac{14{,}40.000}{4}} = \sqrt{3{,}60{,}000}$$

=600 units

A=12,000 units

O = Tk.60

C=20 × 20%=Tk.4

b) No of orders= $\frac{A}{EOQ} = \frac{12000}{600} = 20\ times$

C) Cost of ordering $= \frac{A}{EOQ} \times O = \frac{12{,}000}{600} \times 60 = Tk. 1{,}200$

d) Cost of carrying $= \frac{EOQ}{2} \times C = \frac{600}{2} \times 4 = Tk. 12{,}00$

e) Safety stock $= Daily\ usage \times 30$

$$= \frac{12{,}000}{200} \times 30 = 60 \times 30 = 1800\ units$$

f) Re-order point= Safety stock + (Lead time × usage)

$= 1800 + (15 \times 60)$

$= 1800 + 900$

$= 2700\ units$

$Daily\ Usage = \frac{12{,}000}{200} = 60$

g) Total cost of inventory= Carrying Cost + Ordering Cost

$$= \left(\frac{A}{EOQ} \times O\right) + \left(\frac{EOQ}{2} \times C\right)$$

= 1200 + 1200

= Tk. 2400

Example-8: Nicco Corporation requires 75,000 units of product-'N' annually. Monthly average usage of the product is 6,250 units. Purchase price of the production is Tk. 1.50 per unit, annual carrying cost is 20% and per order cost is Tk. 18. Lead time is 45 days and Nicco Corporation maintains its safety stock at 3,250 units.

Required: 1) The Economic Order quantity (EOQ).

2) Total number of order per year

3) Re-order point

4) Economic Order quantity which purchase price the product-'N'increase to Tk. 4.50 per unit

Solution: (1) The Economic Order quantity:

$$EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2\times75{,}000\times18}{.30}} = \sqrt{\frac{27{,}00.000}{.30}} = \sqrt{900{,}000}$$

=3000 units

A=75,000 units

O = Tk.18

C=1.50 × 20%=0.30

2) Total number of order per year= $\frac{A}{EOQ} = \frac{75000}{3000} = 25\ times$

3) Re-order point= (Lead time × usage) + Safety stock

$$= (45 \times 208.33) + 3{,}250$$

$$= 9374.85 + 3{,}250$$

$$= 12624.85 = 12625\ units$$

$Daily\ Usage = \frac{6250}{30} = 208.33$

4) $EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2\times75{,}000\times18}{.90}} = \sqrt{\frac{27{,}00.000}{.90}} = \sqrt{3{,}00{,}000}$

=1732 units

A=75,000 units

O = Tk.18

C=4.50 × 20%=0.90

Example-9: Annual requirement 5,000 units

Ordering cost per order Tk.15

Purchase price Tk. 9.5

Carrying cost (20% of Purchase price)

Lead time 7 weeks, Safety stock 3 weeks.

Calculate: i) EOQ
ii) No of order
iii) Total ordering cost
iv) Total carrying cost
v) Total inventory cost
vi) Safety stock
vii) Re-order point

Solution: (1) The Economic Order quantity:

$$EOQ = \sqrt{\frac{2AO}{C}} = \sqrt{\frac{2\times5{,}000\times15}{1.90}} = \sqrt{\frac{1{,}50{,}000}{1.90}} = \sqrt{78947.37}$$

=280.98=281 units

A=5,000 units

O = Tk.15

C=9.50 × 20%=1.90

ii) No of orders= $\frac{A}{EOQ} = \frac{5{,}000}{281} = 17.79 = 18\ times$

(iii) Total ordering cost = $\frac{A}{EOQ} \times O = \frac{5{,}000}{281} \times 15 = Tk.267$

(iv) Total carrying cost= $\frac{EOQ}{2} \times C = \frac{281}{2} \times 1.9 = Tk.267$

(v) Total cost of inventory= Carrying Cost + Ordering Cost

$$= \left(\frac{A}{EOQ} \times O\right) + \left(\frac{EOQ}{2} \times C\right)$$

= (267+267) Tk. = Tk. 534

(vi) Safety stock = $Daily\ usage \times 21$

$$= \frac{5{,}000}{365} \times 21 = 13.7 \times 21 = 287.7\ units$$

vii) Re-order point= (Lead time × usage) + Safety stock

$Daily\ Usage = \frac{5000}{365} = 13.7$

$$= (7 \times 13.7) + 287.7$$

$$= 95.9 + 287.7$$

$$= 383.6\ units$$