# EOQ with Quantity Discount

**Quantity Discounts are price reductions for large orders offered to customers to induce them to buy in large quantities.** If quantity discounts are offered, the customer must weigh the potential benefits of reduced purchase price and fewer orders that will result from buying in large quantities against the increase in carrying costs caused by higher average inventories

**TC = carrying cost + Ordering cost + Purchasing Cost**

$$TC = \frac{Q}{2}.H + \frac{D}{Q}.S + PD. \quad \textbf{Where: P = Unit price}$$

# Example

The maintenance department of a large hospital uses about 816 cases of liquid cleanser annually. Ordering costs are $12, carrying costs are $4 per case a year, and the new price schedule indicates that orders of less than 50 cases will cost $20 per case, 50 to 79 cases will cost $18 per case, 80 to 99 cases will cost $17 per case, and larger orders will cost $16 per case. Determine the optimal order quantity and the total cost.

$D$ = 816 cases per year  $S$ = \$12  $H$ = \$4 per case per year

| Range | Price |
|---|---|
| 1 to 49 . . . . . . . . . | $20 |
| 50 to 79 . . . . . . . . . | 18 |
| 80 to 99 . . . . . . . . . | 17 |
| 100 or more . . . . . . . | 16 |

1. Compute the common EOQ: $= \sqrt{\frac{2DS}{H}} = \sqrt{\frac{2(816)12}{4}} = 69.97 \approx 70$ cases
2. The 70 cases can be bought at $18 per case because 70 falls in the range of 50 to 79 cases. The total cost to purchase 816 cases a year, at the rate of 70 cases per order, will be

$$\begin{aligned} TC_{70} &= \text{Carrying cost} + \text{Order cost} + \text{Purchase cost} \\ &= (Q/2)H + (D/Q_0)S + PD \\ &= (70/2)4 + (816/70)12 + 18(816) = \$14{,}968 \end{aligned}$$

Because lower cost ranges exist, each must be checked against the minimum cost generated by 70 cases at $18 each. In order to buy at $17 per case, at least 80 cases must be purchased. (Because the TC curve is rising, 80 cases will have the lowest TC for that curve's feasible region.) The total cost at 80 cases will be

$$TC_{80} = (80/2)4 + (816/80)12 + 17(816) = \$14{,}154$$

To obtain a cost of $16 per case, at least 100 cases per order are required, and the total cost at that price break will be

$$TC_{100} = (100/2)4 + (816/100)12 + 16(816) = \$13{,}354$$

Therefore, because 100 cases per order yields the lowest total cost, 100 cases is the overall optimal order quantity.

## Problem#1

A large bakery buys flour in 25-pound bags. The bakery uses an average of' 4,860 bags a year. Preparing an order and receiving a shipment of flour involves a cost of $10 per order. Annual carrying costs are $75 per bag.

(A) Determine the economic order quantity.
(B) What is the average number of bags on hand?
(C) How many orders per year will there be?
(D) Compute the total cost of ordering and carrying flour.
(E) If ordering costs were to increase by $1 per order, how much that would affect the minimum total annual cost?

## Problem#2

A large law firm uses an average of 40 boxes of copier paper a day. The firm operates 260 days a year. Storage and handling costs for the paper are $30 a year per box, and its costs approximate $ 60 to order and receive a shipment of paper.

(A) What order size would minimize the sum of annual ordering and carrying costs?
(B) Compute the total annual cost using your order size from part a?
(C) Except for rounding, are annual ordering and carrying costs always equal at EOQ?
(D) The office manager is currently using an order size of 200 boxes. The partners of the firm expect the office to be managed "in a cost-efficient manner." Would you recommend that the office manages use the optimal order size instead of 200 boxes? Justify your answer.

## Problem#3

Highland Electric Co. buys coal from Cedar Creek Coal Co. to generate electricity. CCCC can supply coal at the rate of 3,500 tons per day for $10.50 per ton. HEC uses the coal at a rate of 800 tons per day and operates 365 days per year. HEC's annual carrying cost for coal is $2 per ton, and the ordering cost is $5,000.

a) What is the economical production lot size?
b) What is HEC's maximum inventory level for coal?
c) What is Cycle time and run time for the optimum run size.

## Problem#4

The friendly Sausage factory (FSF) can produce hot dogs at a rate of 5,000 units per day. FSF supplied hot dogs to local restaurant at a steady state rate of 250 per day. The cost to prepare equipment for producing hot dog is $66. Annual holding cost is 45 cents per hot dog. The factory operates 300 days a year. Find

a) The optimal run size.
b) The number of runs per year.
c) The length (in days) of a run.

## Problem#5

A chemical firm produces sodium bisulphate in 100-pound bags. Demand for this product is 20 tons per day. The capacity for producing the product is 50 tons per day. Setup cost $100 and storage and handling cost are $5 per ton a year. The firm operates 200 days a year. (Note 1 ton = 2000 pounds)

a) How many bags per run are optimal?
b) What would the average inventory be for this lot size?
c) Determine the approximate length of a production run in days?
d) About how many runs per year would there be?
e) How much could the company save annually if the setup cost reduced to $25 per run?

## Problem#6

A mail order house uses 18,000 boxes a year. Carrying cost are 60 cent of a box cost price and ordering cost are $96 per order. The following price schedule applied. Determine:-

a) The optimal order quantity?
b) The number of orders per year?

| Number of boxes | Price per box |
|---|---|
| 1000 to 1900 | $ 1.25 |
| 2000 to 4999 | $ 1.20 |
| 5000 to 9999 | $ 1.15 |
| 10000 or more | $1.10 |

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