Quantity Discount Models

Quantity Discount Models

- Quantity discounts are commonly available.
- The basic EOQ model is adjusted by adding in the purchase or materials cost.

Total cost = Material cost + Ordering cost + Holding cost

$$\text{Total cost} = DC + \frac{D}{Q}C_o + \frac{Q}{2}C_h$$

where

D = annual demand in units

C_o = ordering cost of each order

C = cost per unit

C_h = holding or carrying cost per unit per year

Quantity Discount Models

Because unit cost is now variable,

$$\text{Holding cost} = C_h = IC$$

$$I = \text{holding cost as a percentage of the unit cost } (C)$$

$$\text{Total cost} = DC + \frac{D}{Q}C_o + \frac{Q}{2}C_h$$

where

D = annual demand in units

C_o = ordering cost of each order

C = cost per unit

C_h = holding or carrying cost per unit per year

Quantity Discount Models

- A typical quantity discount schedule can look like the table below.
- However, buying at the lowest unit cost is not always the best choice.

DISCOUNT NUMBER	DISCOUNT QUANTITY	DISCOUNT (%)	DISCOUNT COST ($)
1	0 to 999	0	5.00
2	1,000 to 1,999	4	4.80
3	2,000 and over	5	4.75

Table 6.3

Brass Department Store

- Brass Department Store stocks toy race cars.
- Their supplier has given them the quantity discount schedule shown in Table 6.3.
  - Annual demand is 5,000 cars, ordering cost is $49, and holding cost is 20% of the cost of the car
- The first step is to compute EOQ values for each discount.

$$\sqrt{\frac{2DC_o}{C_h}} = Q = \text{EOQ} = Q^*$$

$$\text{EOQ}_1 = \sqrt{\frac{(2)(5{,}000)(49)}{(0.2)(5.00)}} = 700 \text{ cars per order}$$

$$\text{EOQ}_2 = \sqrt{\frac{(2)(5{,}000)(49)}{(0.2)(4.80)}} = 714 \text{ cars per order}$$

$$\text{EOQ}_3 = \sqrt{\frac{(2)(5{,}000)(49)}{(0.2)(4.75)}} = 718 \text{ cars per order}$$

Brass Department Store Example

- The second step is adjust quantities below the allowable discount range.
- The EOQ for discount 1 is allowable as it is between 0 and 999
- The EOQs for discounts 2 and 3 are outside the allowable range and have to be adjusted to the smallest quantity possible to purchase and receive the discount:

$$Q_1 = 700$$
$$Q_2 = 1{,}000$$
$$Q_3 = 2{,}000$$

Brass Department Store

The **third step** is to compute the total cost for each quantity.

DISCOUNT NUMBER	UNIT PRICE (C)	ORDER QUANTITY (Q)	ANNUAL MATERIAL COST ($) = DC	ANNUAL ORDERING COST ($) = $(D/Q)C_o$	ANNUAL CARRYING COST ($) = $(Q/2)C_h$	TOTAL ($)
1	$5.00	700	25,000	350.00	350.00	25,700.00
2	4.80	1,000	24,000	245.00	480.00	24,725.00
3	4.75	2,000	23,750	122.50	950.00	24,822.50

The final step is to choose the alternative with the lowest total cost.

Table 6.4

Use of Safety Stock

- When the EOQ assumptions are met, it is possible to schedule orders to arrive so that stockoutsare completely avoided. However If demand or the lead time are uncertain, the exact ROP will not be known with certainty.
- To prevent *stockouts*, it is necessary to carry extra inventory called *safety stock.*
- Safety stock can prevent stockouts when demand is unusually high.
- Safety stock can be implemented by adjusting the ROP.

Use of Safety Stock

- The basic ROP equation is

$$\text{ROP} = d \times L$$

d = daily demand (or average daily demand)

L = order lead time or the number of working days it takes to deliver an order (or average lead time)

- A safety stock variable is added to the equation to accommodate uncertain demand during lead time

$$\text{ROP} = d \times L + SS$$

where

SS = safety stock