MGT 236

Operations Management

Chapter 6

1. BASIC EOQ MODEL

Electronic Village stocks and sells a particular brand of personal computer. It costs the store $450 each time it places an order with the manufacturer for the personal computers. The annual cost of carrying the PCs in inventory is $170. The store manager estimates that annual demand for the PCs will be 1200 units.

Determine the optimal order quantity and the total minimum inventory cost.

Solution

$$
\begin{aligned}
D &= 1200 \text{ personal computers} \\
C_c &= \$170 \\
C_o &= \$450 \\
Q_{\text{opt}} &= \sqrt{\frac{2C_oD}{C_c}} \\
&= \sqrt{\frac{2(450)(1200)}{170}} \\
&= 79.7 \text{ personal computers} \\
\text{TC} &= \frac{C_oD}{Q_{\text{opt}}} + \frac{C_cQ_{\text{opt}}}{2} \\
&= 450\left(\frac{1200}{79.7}\right) + 170\left(\frac{79.7}{2}\right) \\
&= \$13{,}549.91
\end{aligned}
$$

2. PRODUCTION QUANTITY MODEL

I-75 Discount Carpets manufactures Cascade carpet, which it sells in its adjoining showroom store near the interstate. Estimated annual demand is 20,000 yards of carpet with an annual carrying cost of $2.75 per yard. The manufacturing facility operates the same 360 days the store is open and produces 400 yards of carpet per day. The cost of setting up the manufacturing process for a production run is $720.

Determine the optimal order size, total inventory cost, length of time to receive an order, and maximum inventory level.

$$C_o = \$720$$
$$C_c = \$2.75 \text{ per yard}$$
$$D = 20{,}000 \text{ yards}$$
$$d = \frac{20{,}000}{360} = 55.56 \text{ yards per day}$$
$$p = 400 \text{ yards per day}$$

$$Q_{\text{opt}} = \sqrt{\frac{2C_oD}{C_c\left(1 - \frac{d}{p}\right)}}$$

$$= \sqrt{\frac{2(720)(20{,}000)}{2.75\left(1 - \frac{55.56}{400}\right)}}$$

$$= 3487.4 \text{ yards}$$

$$\text{TC}_{\text{min}} = \frac{C_oD}{Q} + \frac{C_cQ}{2}\left(1 - \frac{d}{p}\right)$$

$$= \frac{(720)(20{,}000)}{3487.4} + \frac{(2.75)(3487.4)}{2}\left(1 - \frac{55.6}{400}\right)$$

$$= \$8258.33$$

$$\text{Production run} = \frac{Q}{p}$$

$$= \frac{3487.4}{400}$$

$$= 8.72 \text{ days per order}$$

$$\text{Maximum inventory level} = Q\left(1 - \frac{d}{p}\right)$$

$$= 3487.4\left(1 - \frac{55.6}{400}\right)$$

$$= 3003 \text{ yards}$$

Problems chapter 12 from the course textbook

2. Yasuko's Art Emporium (YAE) ships art from its studio located in the Far East to its distribution center located on the West Coast of the United States. YAE can send the art either via transoceanic ship freight service (15 days transit) or by air freight (2 days transit time). YAE ships 18,000 pieces of art annually.
(a) Calculate the average annual transportation inventory when sending the art via transoceanic ship freight service.
(b) Calculate the average annual transportation inventory when sending the art via air freight.
(c) What additional information is needed to compare the two alternatives?

4. Genuine Reproductions (GR) plans on increasing next year's sales by 20 percent while maintaining its same average inventory in dollars of $250,000.
(a) Calculate the expected inventory turnover for next year.
(b) Calculate the expected weeks of supply.

6. Frederick's Farm Factory (FFF) currently maintains an average inventory valued at $3,400,000. The company estimates its capital cost at 10 percent, its storage cost at 4.5 percent, and its risk cost at 6 percent.
(a) Calculate the annual holding cost rate for FFF.
(b) Calculate the total annual holding costs for FFF.

8. A technology problem has rendered some of the inventory at FFF (Problem 6) obsolete. FFF estimates that the risk cost of its
inventory is now 10 percent.
(a) Calculate the new annual holding cost rate.
(b) Calculate the new total annual holding costs for FFF.

10. Custom Computers, Inc. from Problem 9 is considering a new ordering policy. The new order quantity would be 650 heat sinks. Recalculate Problem 9, parts (a) through (e), and compare results.

12. A local nursery, Greens, uses 1560 bags of plant food annually. Greens works 52 weeks per year. It costs $10 to place an
order for plant food. The annual holding cost rate is $5 per bag. Lead time is one week.
(a) Calculate the economic order quantity.
(b) Calculate the total annual costs.
(c) Determine the reorder point.

23. Healthy Plants Ltd. (HP) produces its premium plant food in 50-pound bags. Demand for the product is 100,000 pounds per week. HP operates 50 weeks per year and can produce 250,000 pounds per week. The setup cost is $200 and the annual holding cost rate is $0.55 per bag. Currently, HP produces its premium plant food in batches of 1,000,000 pounds.
(a) Calculate the maximum inventory level for HP.
(b) Calculate the total annual costs of this operating policy.

24. Using the data provided in Problem 23, determine what will happen if HP uses the economic production quantity model to establish the quantity produced each cycle.
(a) Calculate the economic production quantity (EPQ).
(b) Calculate the maximum inventory level using the EPQ.
(c) Calculate the total annual cost of using the EPQ.
(d) Calculate the penalty cost HP is incurring with its current policy.

Answers:

2.

a. AIT = (15)(18000)/365 = 739.7 units
b. AIT = (2)(18000)/365 = 98.6 units
c. Cost related information is needed to compare the two alternatives. For example, transportation costs, insurance costs, and the speed and reliability of the mode of service delivery are among the important considerations in comparing the two alternatives.

4.

a. Inventory Turnover = $3,600,000/$250,000 = 14.4 inventory turns
b. Weeks of Supply = $250,000/(3,600,000/52) = 3.6 weeks of supply

6.

a. Annual holding cost rate = 20.5%
b. Annual holding costs = ($3,400,000)(0.205) = $697,000

8.

a. Annual holding cost rate = 10% + 4.5% + 10% = 24.5%
b. Total annual holding costs = (0.245)(3,400,000) = $833,000

10.

a. Average inventory level = $\frac{Q}{2} = \frac{650}{2}$ = 325 units
b. Number of orders placed per year = $\frac{D}{Q} = \frac{5200}{650}$ = 8 orders
c. Annual inventory holding cost = $\frac{Q}{2}H$ = (325)(3) = $975
d. Total annual ordering cost = (D/Q)(S) = (8)(50) = $400
e. Total annual cost = $975 + $400 = $1375
   Plus $62,400 (the cost of the heat sinks) = $63,775.

An order quantity of 650 units yields lower total annual costs than an order quantity of 1300 units.

12.

a. EOQ = $\sqrt{\frac{2DS}{H}} = \sqrt{\frac{(2)(1560)(10)}{5}}$ = 79 units

b. Total annual cost = (79/2)(5) + (1560/79)(10) = $197.50 + $197.47 = $394.97

c. Reorder point = R = dL = (1560 bags/year)(1 year/52)(1 week) = 30 units

23.

a. I_{max} = Q(1 – d/p) = 1,000,000(1 – 100,000/250,000) = 660,000 pounds

b. Total Cost= $\frac{(5,000,000)(200)}{1,000,000} + \frac{(600,000)(0.55/50)}{2}$ = $4300

24.

a. EPQ = $\sqrt{\frac{(2)(5,000,000)(200)}{(0.55/50)(1-100,000/250,000)}}$ = 550,481.85 pounds or 11009.64 bags

b. I_{max} = Q(1 – d/p) = 550,481.85(1 – 100,000/250,000) = 330,289.11 pounds or 6605.78 bags

c. Total Cost = $\frac{(5,000,000)(200)}{550,481.85} + \frac{(330,289.11)(0.55/50)}{2}$ = $3633.18

d. Penalty Cost = $4300 - $3633.18 = $666.82