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OPTIMAL ORDERING POLICY IN DEMAND DECLINING MARKET UNDER INFLATION WHEN SUPPLIER CREDITS LINKED TO ORDER QUANTITY

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***Abstract**: In this research paper, a lot–size model is proposed when supplier offers the retailer a credit period to settle the account if the retailer orders a large quantity. The proposed study is meant for demand declining market. Here, the retailer needs to arrive at a static decision when demand of a product is decreasing and on the other side the supplier offer the credit period if the retailer orders for more than pre – specified quantity. Shortages are not allowed and the effect of inflation is incorporated. The objective to minimize the total cost in demand declining market under inflation when the supplier offers a credit period to the retailer if the ordered quantity is greater than or equal to pre – specified quantity. An easy – to – use flow chart is given to find the optimal replenishment time and the order quantity. The mathematical formulation is supported by a numerical example. The sensitivity analysis of parameters on the optimal solution is carried out.*

***Keywords**: Demand declining market, inflation, trade credit, lot – size.*

1. Introduction

Wilson's classical economic order quantity (EOQ) model is derived under the assumption that the demand of the product is uniform over a time. However, the demand of seasonal goods, weather selected garments, Christmas tree etc. decreases after the practical phase is over. The another stringent assumption of the classical EOQ is that the retailer settles the due accounts for the items as soon as items are received in his inventory system. In practice, the supplier offers a permissible credit period to the retailer if the outstanding amount is paid within the allowable credit period and the order quantity is larger than that specified by the supplier. The credit period

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is treated as a promotional tool to attract more customers. It can be regarded as a kind of price discount because paying later indirectly reduces the purchase cost, motivating the retailer to increase his order quantity. Goyal [9] developed an EOQ model under the conditions of permissible delay in payments. Shah et al. [12] extended Goyal's model by allowing shortages. Mandal and Phaujdar [10] included interest earned from the sales revenue on the stock remaining beyond the settlement period Chung and Hung [4] studied Goyal's model when replenishment rate is finite.
Davis and Gaither [8] derived optimal policy for the firm that offers a one time opportunity to delay payment for an order of a commodity. Such delayed payments results in a reduction of the effective purchase cost, which is a function of the return available on alternative investments, the number of units of commodity ordered and the length of the extended period Chung [3] established the convexity of the total annual variable cost function for optimal economic order quantity under conditions of permissible delay in payments analytically, it is shown that the economic order quantity under conditions of permissible delay in payments is generally higher than the economic order quantity given by the Wilson's formula.
Using principles of financial analysis, Dallenbach [6, 7], Ward and Chapman [13], Chapman and Ward [1] argued that if trade credit has the characteristic of a renewable source of capital, then the usual assumption that the value of the inventory investment opportunity cost made by the traditional inventory theory is correct. Chung et al. [5] computed the economic order quantity under conditions of the permissible delay time in payments depends on the quantity ordered when the order quantity at which the delay in payments is allowed, the payment for the item should be settled immediately. Otherwise, the fixed credit period is allowed. Some more interesting articles are by Samanta and Bhowmick [13], Roy and Samanta [12], Sugapriya and Jeyaraman [15].
The average cost approach does take into account the time value of money. Hence, there is no distinction between out – of pocket holding cost and opportunity cost due to inventory investments. To overcome this scenario, researchers suggested discounted – cash – flow (DCF) approach which allows proper recognition of the financial implication of the opportunity cost and out – of pocket costs in the inventory analysis. Chung [2] presented DCF – approach for the analysis of the optimal inventory policy under the effect of the trade credit. Rachmadugu [11] established that the best order quantity is an increasing function of allowable delay period.
In this paper, an attempt is made to formulate lot – size model when demand of the commodity is decreasing under inflation. The supplier offers to the retailer a credit period for a larger order that is greater than or equal to pre – specified quantity. It is assumed that if the order is less than the pre – specified quantity then the retailer must settle the account immediately for the items received. An easy – to – use flow chart is given to derive the optimal decision. The numerical example is given to support the working rules for the optimal solution. The sensitivity analysis is carried out to examine the effect of parameters on the optimal solution.

2. Notation and assumptions

The following notations and assumptions are used for the development of proposed model.

2.1 Notations

H the length of planning horizon

$R(t)$ $= a(1-bt)$, the demand rate, where $'a'$ denotes constant demand and $'b'$ is rate of change of demand with respect to time where $a, b > 0$, $a >> b$

h the holding cost rate per unit time excluding interest charges.

r constant rate of inflation per unit time where $0 < r < 1$

$P(t)$ Pe^{rt}; the selling price per unit at time t, where P is the unit selling price at $t = 0$.

$C(t)$ Ce^{rt}; the purchase cost per unit at time t, where C is the unit purchase cost at $t = 0$.

$A(t)$ Ae^{rt}; the ordering cost per order at time t, where A is the ordering cost at $t = 0$.

M the permissible trade credit in settling the account.

I_c the interest charged per \$ in stocks per annum by the supplier.

I_e the interest earned per \$ per year

Note : $I_e < I_c$

Q the order quantity (decision variable)

Q_d the pre – specified quantity at which the delay in payments is allowed

T_d the time at which Q_d – units are depleted to zero due to declining demand

$I(t)$ the inventory level at any instant of time t, $0 \le t \le T$.

T the replenishment time (decision variable)

$K(T)$ the total cost over finite planning horizon of length H

2.2 Assumptions

1. The inventory system deals with a single item.
2. The demand $R(t) = a(1-bt)$ is decreasing function of time t, where a denotes the constant demand and b denotes the rate of change of demand with respect to time t, a > 0, b > 0, a > > b, 0 < b < 1.
3. The inflation rate is constant.
4. Shortages are not allowed and the lead – time is zero or negligible.
5. If the order quantity is less than Q_d, then the payments for the goods received must be done immediately.
6. If the order quantity is greater than or equal to Q_d, then the delay in payments up to M is allowed. During the permissible delay period, the account is not settled; the generated sales revenue is deposited in an interest bearing account. At the end of the delay period, the retailer pays off all units orders and start paying the interest charges on the items in stock.

3. Mathematical Model

We assumed that the length of planning horizon is $H = nT$; where n is an integer for the number of orders to be made during period H, and T is the replenishment time. The inventory level; $I(t)$ depletes to meet the demand. The rate of change of inventory level at any instant of time is governed by the following differential equation.

$$\frac{dI(t)}{dt} = -R(t)\ ; \qquad 0 \le t \le T \tag{1}$$

with the boundary condition $I(0)=Q$ and $I(T)=0$. Consequently, the solution of differential equation (1) is given by:

$$I(t) = a\left[T - t + \frac{b}{2}(t^2 - T^2)\right];\ \ 0 \le t \le T \tag{2}$$

and the order quantity is:

$$Q = I(0) = a\left[T - \frac{b}{2}T^2\right] \tag{3}$$

From (3), we can obtain the cycle time at which Q_d units are reduced to zero. In fact, T_d is the solution of :

$$T_d = \frac{a \pm \sqrt{a^2 - 2abQ_d}}{ab} \tag{4}$$

It is clear $Q < Q_d$ holds if and only if $T < T_d$. Since the time intervals are of equal length, using (2) we have :

$$I(kT + t) = a\left[T - t + \frac{b}{2}(t^2 - T^2)\right] \qquad 0 \le k \le n-1, \quad 0 \le t \le T \tag{5}$$

The total cost for the planning horizon consists of the following cost components.

1. Ordering Cost

$$OC = A(0) + A(T) + A(2T) + ... + A((n-1)T) = A\left(\frac{e^{rH} - 1}{e^{rT} - 1}\right) \tag{6}$$

2. Purchase cost:

$$PC = Q\begin{bmatrix} C(0) + C(T) + C(2T) \\ + ... + C((n-1)T) \end{bmatrix} = a\left(T - \frac{1}{2}bT^2\right)\left(\frac{e^{rH} - 1}{e^{rT} - 1}\right) \tag{7}$$

3. Inventory holding cost:

$$IHC = h\sum_{k=0}^{n-1} C(kT)\int_0^T I(kT+t)dt \;= \frac{1}{6}hCaT^2(3-2bT)\left(\frac{e^{rH}-1}{e^{rT}-1}\right) \tag{8}$$

For the interest charged and the interest earned, we have four possible cases based on the values of T, M and T_d.

Case 1: $0 < T < T_d$

Here, replenishment cycle time T is less than T_d and so the delay in payments is not allowed. The retailer must pay immediately for the units received. This is the scenario of the classical EOQ model. The retailer has to pay interest charges for all unsold items. Hence, interest charged payable during planning horizon H is:

$$IC_1 = I_c\sum_{k=0}^{n-1} C(kT)\left[\int_0^T I(kT+t)dt\right] = \frac{1}{6}CI_c aT^2(3-2bT)\left(\frac{e^{rH}-1}{e^{rT}-1}\right) \tag{9}$$

Therefore, the total cost during planning horizon is:

$$Z_1(T) = OC + PC + IHC + IC_1 \tag{10}$$

Case 2: $T_d \le T < M$

Since, $T < M$, there is no interest charges and interest earned during planning horizon is:

$$IE_2 = I_e\sum_{k=0}^{n-1} P(kT)\left[\int_0^T R(t)tdt + R(T)T(M-T)\right]$$
$$= PI_e a\left[\begin{array}{l}\dfrac{T^2(3-2bT)}{6}\\ +(1-bT)T(M-T)\end{array}\right]\left(\frac{e^{rH}-1}{e^{rT}-1}\right) \tag{11}$$

As a result, total cost in this case during the planning horizon is:

$$Z_2(T) = OC + PC + IHC - IE_2 \tag{12}$$

Case 3: $T_d \le M \le T$

In this case, cycle time is greater than both T_d and M, Hence, the trade credit is allowed. Here, total cost of an inventory system will have two additional components viz. interest charged and interest earned. The interest charged during planning horizon is:

$$IC_1 = I_c \sum_{k=0}^{n-1} C(kT)\left[\int_M^T I(kT+t)dt\right] = CI_c a \begin{bmatrix} \frac{1}{2}T^2 - \frac{1}{3}bT^3 - TM \\ +\frac{1}{2}bMT^2 - \frac{1}{6}bM^3 + \frac{1}{2}M^2 \end{bmatrix}\left(\frac{e^{rH}-1}{e^{rT}-1}\right) \tag{13}$$

and interest earned is:

$$IE_2 = I_e \sum_{k=0}^{n-1} P(kT)\left[\int_0^M R(t)tdt\right] = \frac{1}{6}PI_e aM^2(3-2bM)\left(\frac{e^{rH}-1}{e^{rT}-1}\right) \tag{14}$$

Hence, the total cost is:

$$Z_3(T) = OC + PC + IHC + IC_3 - IE_3 \tag{15}$$

Case 4: $M \le T_d \le T$

In this case, the replenishment cycle time T is greater than or equal to both T_d and M. Thus, case 4 is similar to case 3, therefore, the total cost during planning horizon is:

$$Z_4(T) = OC + PC + IHC + IC_3 - IE_3 \tag{16}$$

4. Theoretical Discussion

Since, the value of inflation r is very small, using a truncated Taylor series expansion for the exponential term, we have:

$$e^{rH} \approx 1 + rH + \frac{r^2H^2}{2} \tag{17}$$

$$e^{rT} \approx 1 + rT + \frac{r^2T^2}{2} \tag{18}$$

Using the above approximations, the total cost $Z_k(T)$, k $=1, 2, 3, 4$ can be written as:

$$Z_1(T) = \left(A + Ca\left(T - \frac{1}{2}bT^2\right) + (h+I_c)CaT^2\frac{(3-2bT)}{6}\right)\left(\frac{rH + \frac{1}{2}r^2H^2}{rT + \frac{1}{2}r^2T^2}\right) \tag{19}$$

$$Z_2(T)=\begin{pmatrix} A+Ca\left(T-\frac{1}{2}bT^2\right)+hCaT^2\,\frac{(3-2bT)}{6} \\ +PI_e aT^2\,\frac{(3-2bT)}{6}+(1-bT)T(M-T) \end{pmatrix}\left(\frac{rH+\frac{1}{2}r^2H^2}{rT+\frac{1}{2}r^2T^2}\right) \tag{20}$$

$$Z_3(T)=\begin{pmatrix} A+Ca\left(T-\frac{1}{2}bT^2\right)-PI_e aM^2\,\frac{(3-2bM)}{6} \\ +hCaT^2\,\frac{(3-2bT)}{6}+CI_c a\begin{pmatrix}\frac{1}{2}T^2-\frac{1}{3}bT^3-TM \\ +\frac{1}{2}bMT^2-\frac{1}{6}bM^3+\frac{1}{2}M^2\end{pmatrix} \end{pmatrix}\left(\frac{rH+\frac{1}{2}r^2H^2}{rT+\frac{1}{2}r^2T^2}\right) \tag{21}$$

$$Z_4(T)=\begin{pmatrix} A+Ca\left(T-\frac{1}{2}bT^2\right)+hCaT^2\,\frac{(3-2bT)}{6} \\ +CI_c a\begin{pmatrix}\frac{1}{2}T^2-\frac{1}{3}bT^3-TM \\ +\frac{1}{2}bMT^2-\frac{1}{6}bM^3+\frac{1}{2}M^2\end{pmatrix}-PI_e aM^2\,\frac{(3-2bM)}{6} \end{pmatrix}\left(\frac{rH+\frac{1}{2}r^2H^2}{rT+\frac{1}{2}r^2T^2}\right) \tag{22}$$

The necessary condition for $Z_1(T)$ in (3.19) is:

$$\frac{dZ_1}{dT}=\begin{pmatrix} -\frac{A\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}+Ca\left(1-bT\right)-\frac{Ca\left(T-\frac{1}{2}bT^2\right)\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)} \\ +\frac{hCaT(3-2bT)}{3}-\frac{hCaT^2b}{3}-\frac{hCaT^2(3-2bT)\left(r+r^2T\right)}{6\left(rT+\frac{1}{2}r^2T^2\right)} \\ +\frac{I_cCaT(3-2bT)}{3}-\frac{I_cCaT^2b}{3}-\frac{I_cCaT^2(3-2bT)\left(r+r^2T\right)}{6\left(rT+\frac{1}{2}r^2T^2\right)} \end{pmatrix}\frac{\left(rH+\frac{1}{2}r^2H^2\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}=0 \tag{23}$$

Similarly,

$$\frac{dZ_2}{dT}=\begin{pmatrix} -\frac{A\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}+Ca\left(1-bT\right)-\frac{Ca\left(T-\frac{1}{2}bT^2\right)\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)} \\ +\frac{hCaT(3-2bT)}{3}-\frac{hCaT^2b}{3}-\frac{hCaT^2(3-2bT)\left(r+r^2T\right)}{6\left(rT+\frac{1}{2}r^2T^2\right)} \\ +PI_e a\begin{pmatrix}\frac{T(3-2bT)}{3}-\frac{bT^2}{3} \\ -bT(M-T) \\ +(1-bT)(M-2T)\end{pmatrix}-\frac{PI_e a\begin{pmatrix}\frac{T^2(3-2bT)}{6} \\ +(1-bT)T(M-T)\end{pmatrix}\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)} \end{pmatrix}\frac{\left(rH+\frac{1}{2}r^2H^2\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}=0 \tag{24}$$

$$\frac{dZ_3}{dT} = \begin{pmatrix} -\frac{A\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}+Ca\left(1-bT\right)-\frac{Ca\left(T-\frac{1}{2}bT^2\right)\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}+\frac{hCaT(3-2bT)}{3} \\ -\frac{hCaT^2b}{3}-\frac{hCaT^2(3-2bT)\left(r+r^2T\right)}{6\left(rT+\frac{1}{2}r^2T^2\right)}+CI_ca\left(T-bT^2-M+bMT\right) \\ -\frac{CI_ca\begin{pmatrix}\frac{1}{2}T^2-\frac{1}{3}bT^3-TM \\ +\frac{1}{2}bMT^2-\frac{1}{6}bM^3+\frac{1}{2}M^2\end{pmatrix}\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}+\frac{PI_eaM^2(3-2bM)\left(r+r^2T\right)}{6} \end{pmatrix} \frac{\left(rH+\frac{1}{2}r^2H^2\right)}{\left(rT+\frac{1}{2}r^2T^2\right)} = 0 \qquad (25)$$

$$\frac{dZ_4}{dT} = \begin{pmatrix} -\frac{A\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}+Ca\left(1-bT\right)-\frac{Ca\left(T-\frac{1}{2}bT^2\right)\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}+\frac{hCaT(3-2bT)}{3} \\ -\frac{hCaT^2b}{3}-\frac{hCaT^2(3-2bT)\left(r+r^2T\right)}{6\left(rT+\frac{1}{2}r^2T^2\right)}+CI_ca\left(T-bT^2-M+bMT\right) \\ -\frac{CI_ca\begin{pmatrix}\frac{1}{2}T^2-\frac{1}{3}bT^3 \\ -TM+\frac{1}{2}bMT^2 \\ -\frac{1}{6}bM^3+\frac{1}{2}M^2\end{pmatrix}\left(r+r^2T\right)}{\left(rT+\frac{1}{2}r^2T^2\right)}+\frac{PI_eaM^2(3-2bM)\left(r+r^2T\right)}{6} \end{pmatrix} \frac{\left(rH+\frac{1}{2}r^2H^2\right)}{\left(rT+\frac{1}{2}r^2T^2\right)} = 0 \qquad (26)$$

The sufficient conditions are:

$$\frac{d^2Z_1}{dT^2} = \frac{-2H(2+rH)}{3T^3(2+rT)^3}\begin{pmatrix} -12A+4I_cCaT^3b-9Ar^2T^2+3I_cCaT^3r-18ArT \\ -3CaT^3r^2-3CaT^3br+3hCaT^3r+4hCaT^3b \end{pmatrix} > 0 \qquad (27)$$

$$\frac{d^2Z_2}{dT^2} = \frac{2H(2+rH)}{3T^3(2+rT)^3}\begin{pmatrix} 12A+3CaT^3r^2+9Ar^2T^2+18ArT+3CaT^3br-3hCaT^3r \\ -4hCaT^3b+3I_ePaT^3r+8I_ePaT^3b+6PI_eaT^3bMr+3PI_eaT^3Mr^2 \end{pmatrix} > 0 \qquad (28)$$

$$\frac{d^2Z_3}{dT^2}=\frac{H(2+rH)}{3T^3(2+rT)^3}\begin{pmatrix}-24A-18Ar^2T^2-36ArT-6CaT^3r^2-6CaT^3br+6hCaT^3r\\+8hCaT^3b+6I_cCaT^3r+8I_cCaT^3b-12CI_caM^2+6CI_caT^3bMr\\+12PI_eaM^2+4I_cCabM^3+6I_cCabM^3rT-18I_cCaM^2rT\\+18PI_eaM^2rT-8PI_eaM^3b-12PI_eaM^3brT+6CI_caT^3Mr^2\\+3CI_cabM^3r^2T^2-9I_cCaM^2r^2T^2+9PI_eaM^2r^2T^2-6PI_eaM^3br^2T^2\end{pmatrix} \quad (29)$$
$$>0$$

$$\frac{d^2Z_4}{dT^2}=\frac{H(2+rH)}{3T^3(2+rT)^3}\begin{pmatrix}-24A-18Ar^2T^2-36ArT-6CaT^3r^2-6CaT^3br+6hCaT^3r+8hCaT^3b\\+6I_cCaT^3r+8I_cCaT^3b-12CI_caM^2+6CI_caT^3bMr+4I_cCabM^3+6I_cCabM^3rT\\-18I_cCaM^2rT+12PI_eaM^2+18PI_eaM^2rT-8PI_eaM^3b-12PI_eaM^3brT\\+6CI_caT^3Mr^2+3CI_cabM^3r^2T^2-9I_cCaM^2r^2T^2+9PI_eaM^2r^2T^2-6PI_eaM^3br^2T^2\end{pmatrix} \quad (30)$$
$$>0$$

5. Computational Flow Chart

To obtain optimal solution, decision maker can use following flow – chart (figure 1).

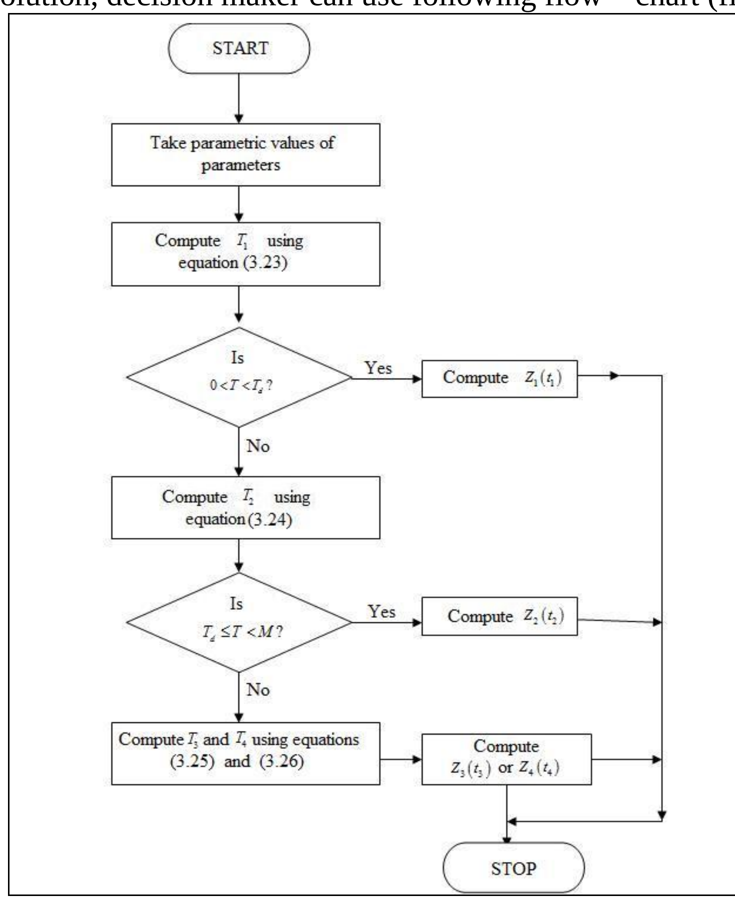

Figure 1. Computational Flow Chart.

6. Numerical Examples

Consider following parametric values in proper units.

$$\left[H,\ a,\ b,\ h,\ I_c,\ I_e,\ r,\ C,\ P,\ M,\ A\right]=\left[1,\ 50,\ 0.10,\ 2,\ 0.10,\ 0.06,\ 0.05,\ 20,\ 50,\ \frac{30}{365},120\right]$$

then if Q_d = 6, 15 solving (3.26) for T_4 gives = 0.3636 and corresponding minimum total cost is $ 1702.84 and corresponding $\frac{d^2Z_4(T_4)}{dT_4^2}$ =4930 > 0 for all T_4.

Example 1 (for first case)

$$\left[H,\ a,\ b,\ h,\ I_c,I_e,\ r,\ C,\ P,\ M,\ A\right]=\left[1,\ 50,\ 0.10,\ 2,\ 0.10,\ 0.06,\ 0.05,\ 20,\ 50,\ \frac{30}{365},120\right]$$

and Q_d = 35 gives T_d = 0.7264. Solving (3.23) for T_1 gives = 0.3636650670 and corresponding minimum total cost is $ 1710.94 and corresponding $\frac{d^2Z_1(T_1)}{dT_1^2}$ = 4926 >0 for all T_1.

Example 2 (for second case)

$$\left[H,\ a,\ b,\ h,\ I_c,\ I_e,\ r,\ C,\ P,\ M,\ A\right]=\left[1,\ 50,\ 0.10,\ 2,\ 0.10,\ 0.06,\ 0.05,\ 20,\ 50,\ \frac{150}{365},120\right]$$

then Q_d = 15 gives T_d = 0.3046. Solving (3.26) for T_2 gives = 0.3842 and corresponding minimum total cost is $ 1712.37 and corresponding $\frac{d^2Z_2(T_2)}{dT_2^2}$ = 4973 > 0 for all T_2.

Example 3 (for third case)

$$\left[H,\ a,\ b,\ h,\ I_c,\ I_e,\ r,\ C,\ P,\ M,\ A\right]=\left[1,\ 50,\ 0.10,\ 2,\ 0.10,\ 0.06,\ 0.05,\ 20,\ 50,\ \frac{120}{365},120\right]$$

and Q_d = 15 gives T_d = 0.3046. Solving (3.26) for T_3 gives = 0.3641 and corresponding minimum total cost is $ 1679.79 and corresponding $\frac{d^2Z_3(T_3)}{dT_3^2}$ = 4934 > 0 for all T_3

Example 4 (for fourth case)

$$\left[H,\ a,\ b,\ h,\ I_c,\ I_e,\ r,\ C,\ P,\ M,\ A\right]=\left[1,\ 50,\ 0.10,\ 2,\ 0.10,\ 0.06,\ 0.05,\ 20,\ 50,\ \frac{30}{365},120\right]$$

and Q_d = 15 gives T_d = 0.3046. Solving (3.26) for T_4 gives = 0.3636 and corresponding minimum total cost is $ 1702.84 and corresponding $\frac{d^2Z_4(T_4)}{dT_4^2}$ = 4930 > 0 for all T_4.

Next we study effect of changes in critical parameter on decision variables and objective function with data same as given in example 4.

Table 1. Variations in Q_d.

Q_d	T	Q	Z	Case
6	0.3636	17.8492	1694.9357	4
15	0.3636	17.8492	1694.9357	4
20	0.3637	17.8526	1710.9357	1

The number of pre-specified units to be procured is varied in Table 1. When Q_d is increases it increases the total cost of an inventory system.

Table 2. Variations in r.

r	T	Q	Z	Case
0.05	0.3636	17.85	1702.84	3
0.07	0.3670	18.01	1713.25	3
0.09	0.3705	18.18	1723.52	3

The inflation rate is increased in Table 2. Increase in inflation rate increase cycle time, optimum procurement quantity and total cost of an inventory system.

Table 3. Variations in a.

a	T	Q	Z	Case
50	0.3636	17.85	1702.84	3
150	0.2067	30.69	4250.01	3
200	0.1785	35.39	5454.83	3

The increase in constant demand decreases cycle time, increases optimum purchase quantities and total cost of an inventory system. The decision variables and objective function is very sensitive to changes in 'a'.

Table 4. Variations in b.

b	T	Q	Z	Case
0.10	0.3636	17.85	1702.84	3
0.12	0.3678	17.98	1697.25	3
0.15	0.3745	18.19	1688.71	3

The rate of change of demand; 'b' increase cycle time and decreases purchase units and total cost of an inventory system marginally.

Table 5. Variations in A.

A	T	Q	Z	Case
100	0.3308	16.27	1644.29	3
120	0.3636	17.85	1702.84	3
150	0.4083	20.00	1781.75	3
170	0.4359	21.32	1829.81	3

The effect of variations in ordering cost is very significant. Increase in ordering cost decreases cycle time and increases optimum procurement quantities and total cost of an inventory system.

Table 6. Variations in M.

M	T	Q	Z	case
30/365	0.3636	17.8491	1702.84	3
45/360	0.3635	17.8494	1698.86	3
60/365	0.3636	17.8511	1694.94	3

The increase in delay period decreases total cost because retailer can earn more interest and having some cost savings.

7. Conclusion

An EOQ model is developed under inflation when demand of a product is decreasing in the market to determine the optimal ordering policy when the supplier provides a trade credit linked to order quantity. The effect of the values of the parameters on the optimal solution is studied to illustrate the developed theoretical results. The following managerial phenomena are observed:

(1) A higher value of minimum order quantity for avail of a permissible trade credit lowers the optimal order quantity and increases the total cost;
(2) Increase in ordering cost increases optimal cycle time and total cost of an inventory system;
(3) Increase in delay period lowers the total cost of an inventory system;
(4) Increase in inflation rate increases order quantity and total cost of an inventory system.

Increase in demand rate increases total cost of an inventory system.

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