An Inflation Induced Stock-Dependent Demand Inventory Model with Permissible delay in Payment

Yashveer Singh
Research Scholar,
Singhania University,
Pacheri Bari, Jhunjhunu,
Rajasthan, (India)

A K Malik
Associate Professor,
Department of Mathematics
B. K. Birla Institute of Engg. &
Tech. Pilani, Rajasthan (India)

Satish Kumar
Associate Professor,
Department of Mathematics
D.N. Post Graduate College,
Meerut, U.P., (India)

ABSTRACT
This paper deals with an inflation induced stock dependent demand inventory model with permissible delay in payments. In real life situations, some products maintain freshness and quality for some time. This inventory model is developed for non-instantaneous deteriorating items. The purpose of this paper is to obtain the optimal policies for maximizing the total profit. Numerical examples are provided to demonstrate the developed model and also to provide the solution algorithm.

Keywords
Inflation, Inventory, Non-instantaneous deterioration, Permissible delay in payments. Purchasing cost. Sales revenue cost, Stock-dependent demand.

1. INTRODUCTION
In the modern age the display of the products/items in large quantities in the supermarkets attracts more and more customers and generates a higher demand. Therefore the effect of inflation and stock dependent demand cannot be ignored for obtaining the optimal inventory policy. It has been observed that most researchers on inventory models do not consider permissible delay in payment and inflation simultaneously. Inflation and permissible delay in payments play an important role in the optimal order policy and influences the demand of certain products.

First in (1975) Buzacott considered the EOQ inventory model with inflation. During the past few decades, many researchers have developed inventory models with permissible delay in payment. Goyal (1985) was the first to develop an EOQ model with a constant demand rate under the condition of permissible delay in payments. Aggarwal and Jaggi (1995) extended Goyal’s model to consider a deterministic inventory model with constant rate of deterioration. Hariga and M. Ben-daya (1996) presented an optimal time-varying lot sizing inventory models under inflationary conditions.

Gupta and Vrat (1986) first discussed the inventory model for consumer environment to minimize the cost with the assumption that stock-dependent consumption rate is a function of the initial stock level. Liao et al. (2001) presented an inventory for initial stock dependent consumption rate and permissible delay in payment.


In this paper, we have discussed an inventory model with inflation and stock-dependent demand. The optimal replenishment policy for non-instantaneous deteriorating items with inflation and stock-dependent demand is discussed in this study. The necessary and sufficient conditions of the existence and uniqueness of the optimal solutions are given. This paper is organized as follow: section 2 presents the notations and assumptions. In section 3, the inventory model is formulated, finding the optimal policy for maximum profits and solution algorithm. In section 4, numerical examples are cited to illustrate the inventory model with sensitivity analysis.

2. NOTATIONS AND ASSUMPTIONS
To develop the inventory model we have used the following notations and assumptions:
- The demand rate at time $t$ is $D(t) = a + bQ(t)$, Where $a$, $b$ are positive constants and $Q(t)$ is the inventory level at time $t$.
- Shortages are not permitted and lead time is zero.
- The retailer can accumulate revenue and earn interest after customers pay for the amount of purchasing cost to the retailer until the completion of the permissible delay in payment period offered by the supplier.
- $\alpha$ is the deterioration rate
- $C_o$ is the ordering cost per order
- $C_h$ is the inventory holding cost per unit time
- $C_p$ is the purchasing cost per unit
- $C_d$ is the deteriorating cost per unit
- $C_s$ is the sales revenue cost per unit
- $r$ is the discount rate, representing the time value of money
- $i$ is the inflation rate
- $R$ is the net discount rate of inflation; $R = r - i$
- $M$ is the permissible delay in payment offered by supplier in months
- $L_i$ is the interest charges per $ per month
- $L_s$ is the interest earned per $ in stocks per month
- $Q_i$ is the inventory level at time $[0, t_1]$ in which the product has no deterioration.
- $Q_2$ is the inventory level at time $[t_1, T]$ in which the product has deterioration. $[T = t_1 + t_2]$
- $t_1$ is the length of fresh product time.

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• \( t_2 \) is the length in which there is deterioration in product.
• TP is the total present value of profit per unit time of inventory system.

3. MATHEMATICAL MODEL

During the interval \([0, t_1]\), the inventory level drops due to stock-dependent demand rate. The inventory level drops to zero due to stock-dependent demand and deterioration during the time interval \([t_1, T]\). \( Q(t) \) denotes the inventory level at time \( t \) \( 0 \leq t \leq t_1 \) in which the product has no deterioration. \( Q(t) \) is the inventory level at time \( t_1 \leq t \leq T \) in which the product has deterioration. Therefore, the inventory level at any time \( t \) can be represented by the following differential equations:

\[
\frac{dQ(t)}{dt} = -[a + bQ(t)] \quad 0 \leq t \leq t_1 \quad \text{(1)}
\]

\[
\frac{dQ(t)}{dt} + \alpha Q(t) = -[a + bQ(t)] \quad t_1 \leq t \leq T \quad \text{(2)}
\]

With the boundary conditions showing \( Q(0) = L \);

\( Q(T) = 0 \) respectively, solving these differential equations, we get the inventory level as follows:

\[
Q(t) = \frac{a}{b} \left( e^{bt} - 1 \right) + L e^{-bt}, \quad 0 \leq t \leq t_1 \quad \text{(3)}
\]

\[
Q(t) = \frac{a}{b + \alpha} \left( e^{(b+\alpha)(t-t_1)} - 1 \right), \quad t_1 \leq t \leq T \quad \text{(4)}
\]

Considering continuity of \( Q(t) \) at \( t = t_1 \), it follows from Equations (3) and (4) that \( Q(t_1) = Q(t_1) \)

\[
L = \frac{a}{b + \alpha} \left( e^{(b+\alpha)(t-t_1)} - 1 \right) \quad \text{.....(5)}
\]

The total present value of profit per cycle consists of the following costs:

1) The ordering cost per cycle is \( OC = C_o \) \( \text{(6)} \)
2) The holding cost per cycle is given as

\[
HC = C_h \left( \int_0^t e^{bt} Q(t) \, dt + \int_t^T e^{bt} Q(t) \, dt \right)
\]

3) The deterioration cost per cycle is given as

\[
DC = C_d \int_0^T e^{(b+\alpha)t} Q(t) \, dt
\]

4) The purchasing cost per cycle is given as

\[
PC = C_p \times L = C_p \left( \int_0^\infty e^{(b+\alpha)t} \, dt \right) \quad \text{.....(7)}
\]

5) The sales revenue cost per cycle is given as

\[
SRC = C_r \int_0^T e^{bt} D(t) \, dt
\]

\[
= \frac{C_r a}{R} \left( 1 - e^{bt} \right) + \frac{ae^{-br} (R + b - Re^{-br})}{R(R + b)} - \frac{ab}{R}(1 - e^{-br}) \quad \text{.....(8)}
\]

\[
= \frac{bR}{R + b} \left( 1 - e^{-(b+R)t} \right) + \frac{ab}{R+b+\alpha} \left( (b+\alpha)e^{-(b+\alpha)t} + e^{-bt} (Re^{-(b+\alpha)t} - R - b - \alpha) \right) \quad \text{.....(9)}
\]

In this paper, we have considered permissible delay in payment in two periods (based on the length of \( T \) and \( M \))

\[
\text{Case-I:} \, t_2 \leq M \leq T, \text{ in this case, the interest payable is}
\]

\[
IP_t = C_p \int_0^T e^{bt} Q(t) \, dt
\]

\[
= \frac{C_p a}{b + \alpha} \left( e^{(b+\alpha)t} - 1 - (T - M)(b + \alpha) \right) \quad \text{.....(10)}
\]

The interest earned is

\[
IE_t = C_p \int_0^T e^{bt} Q(t) \, dt + \int_T^\infty e^{bt} Q(t) \, dt
\]

\[
= C_p \left[ \frac{aM^2}{2} - \frac{at_1 e^{-bt_1}}{b} - \frac{ae^{-bt_1}}{b^2} - \frac{at_1^2}{2} + \frac{1}{b^2} - L(e^{bt_1} - 1) \right]
\]

\[
+ \frac{ab}{b + \alpha} \left( - M e^{(b+\alpha)(t-T)} + e^{(b+\alpha)(t-M)} \right) \frac{M^2}{2}
\]

\[
+ t_1 \left( e^{(b+\alpha)t_1} + \frac{e^{(b+\alpha)t_1}}{b + \alpha} + \frac{1}{2} \right) \quad \text{.....(11)}
\]

The total profit \( TP_t \) per cycle per unit time is given by

\[
TP_t = \frac{1}{T} \left[ SRC - OC - HC - DC - PC - IP_t + IE_t \right] \quad \text{.....(12)}
\]

The necessary and sufficient conditions for \( TP_t \) (total present value of profit per unit time) is maximum if

\[
\frac{dTPT}{dt} = 0 \quad \text{.....(13)}
\]

and

\[
\frac{d^2TP}{dt^2} < 0 \quad \text{.....(14)}
\]

Case-II: \( M < t_2 \), in this case, the no interest charges are paid for the items, i.e., \( IP_t = 0 \) \( \text{.....(15)} \)

The interest earned is

\[
IE_t = C_p \int_0^T e^{bt} Q(t) \, dt + \int_T^\infty e^{bt} Q(t) \, dt
\]

\[
= C_p \left[ \frac{aM^2}{2} - \frac{at_1 e^{-bt_1}}{b} - \frac{ae^{-bt_1}}{b^2} - \frac{at_1^2}{2} + \frac{1}{b^2} - L(e^{bt_1} - 1) \right]
\]

\[
+ \frac{ab}{b + \alpha} \left( - M e^{(b+\alpha)(t-T)} + e^{(b+\alpha)(t-M)} \right) \frac{M^2}{2}
\]

\[
+ t_1 \left( e^{(b+\alpha)t_1} + \frac{e^{(b+\alpha)t_1}}{b + \alpha} + \frac{1}{2} \right) + aT(M - T) \quad \text{.....(16)}
\]

The total profit \( TP_t \) per cycle per unit time is given as

\[
TP_t = \frac{1}{T} \left[ SRC - OC - HC - DC - PC - IP_t + IE_t \right] \quad \text{.....(17)}
\]

The necessary and sufficient conditions for \( TP_t \) (total present value of profit per unit time) is maximum if

\[
\frac{dTPT}{dt} = 0 \quad \text{.....(18)}
\]

and

\[
\frac{d^2TP}{dt^2} < 0 \quad \text{.....(19)}
\]

Solution Algorithm for Proposed Model

Step 1. Input \( C_o, C_p, C_d, C_r, \alpha, R, a, b, M, t_1 \).

Step 2. Case-I: From equation (14) compute \( t_2 \) and from Relation (13) compute \( TP_t \).

Case-II: From equation (19) compute \( t_1^* \) and from Relation (18) compute \( TP_t^* \).

Step 3. Case-I: Put the value of \( t_2 \) in equation (15) to check the optimal solution. If satisfied then go to stop otherwise go to step 1 for changing the parameters values.

Case-II: Put the value of \( t_1^* \) in equation (20) to check the optimal solution. If satisfied then go to stop otherwise go to step 1 for changing the parameters values.
4. NUMERICAL EXAMPLE AND SENSITIVITY ANALYSIS
To illustrate the above results, we may consider the following examples:

Ex.1. \( A = 800, R = 0.01, C_p = 100 \) per unit, \( C_p = 40 \) per unit, \( M = 2 \) month, \( L_o = 0.1 \) per month, \( L = 0.08 \) per month, \( C_f = 0.40 \) per unit, \( C_e = 0.05 \) per unit, \( \alpha = 0.40 \) per unit, \( \alpha = 200 \) and \( b = 0.2 \) units. From Table 1.1, we observe that the system cost (\( TP_1 \)) is Maximum when \( t_1 = 1/2 \) and \( t_2 = 5.177 \) (month).

Table 1.1 Variation of demand ‘a’ according to \( t_2, L \) and \( TP_1 \)

<table>
<thead>
<tr>
<th>Demand part ( a )</th>
<th>200</th>
<th>300</th>
<th>400</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>5.177</td>
<td>5.170</td>
<td>5.167</td>
</tr>
<tr>
<td>( L )</td>
<td>7964</td>
<td>11900</td>
<td>15835</td>
</tr>
<tr>
<td>( TP_1 )</td>
<td>4990</td>
<td>7538</td>
<td>10087</td>
</tr>
</tbody>
</table>

If the demand rates (\( a \)) increases, then the lower time \( t_2 \), the longer order quantity (\( L \)) and total profit (\( TP_1 \)) increase.

Table 1.2. Variation of demand ‘b’ according to \( t_2, L \) and \( TP_1 \)

<table>
<thead>
<tr>
<th>Demand part ( b )</th>
<th>0.18</th>
<th>0.19</th>
<th>0.20</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>4.436</td>
<td>4.679</td>
<td>5.177</td>
</tr>
<tr>
<td>( L )</td>
<td>467</td>
<td>5626</td>
<td>7964</td>
</tr>
<tr>
<td>( TP_1 )</td>
<td>532</td>
<td>2711</td>
<td>4990</td>
</tr>
</tbody>
</table>

If the demand rate (\( b \)) increases, then the longer time \( t_2 \), the longer order quantity (\( L \)) and total profit (\( TP_1 \)) increase.

Table 1.3. Variation of Deterioration rate \( \alpha \) according to \( t_2, L \) and \( TP_1 \)

<table>
<thead>
<tr>
<th>Deterioration rate ( \alpha )</th>
<th>0.40</th>
<th>0.45</th>
<th>0.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>5.177</td>
<td>4.112</td>
<td>3.535</td>
</tr>
<tr>
<td>( L )</td>
<td>7964</td>
<td>4689</td>
<td>3538</td>
</tr>
<tr>
<td>( TP_1 )</td>
<td>4990</td>
<td>2621</td>
<td>845</td>
</tr>
</tbody>
</table>

If deterioration rate (\( \alpha \)) increases, then the time \( t_2 \), order quantity (\( L \)) and total profit (\( TP_1 \)) decrease.

Table 1.4. Variation of Sales revenue cost \( C_r \) according to \( t_2, L \) and \( TP_1 \)

<table>
<thead>
<tr>
<th>Sales revenue cost ( C_r )</th>
<th>90</th>
<th>95</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>3.765</td>
<td>4.274</td>
<td>5.177</td>
</tr>
<tr>
<td>( L )</td>
<td>3263</td>
<td>4522</td>
<td>7964</td>
</tr>
<tr>
<td>( TP_1 )</td>
<td>367</td>
<td>2359</td>
<td>4990</td>
</tr>
</tbody>
</table>

If the sales revenue cost (\( C_r \)) increases, then the time \( t_2 \), order quantity (\( L \)) and total profit (\( TP_1 \)) increase.

Table 1.5. Variation of Purchasing cost \( C_p \) according to \( t_2, L \) and \( TP_1 \)

<table>
<thead>
<tr>
<th>Purchasing cost ( C_p )</th>
<th>40</th>
<th>41</th>
<th>42</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>5.177</td>
<td>4.659</td>
<td>4.314</td>
</tr>
<tr>
<td>( L )</td>
<td>7964</td>
<td>5767</td>
<td>4640</td>
</tr>
<tr>
<td>( TP_1 )</td>
<td>4990</td>
<td>3699</td>
<td>2629</td>
</tr>
</tbody>
</table>

If purchasing cost (\( C_p \)) increases, then the time \( t_2 \), order quantity (\( L \)) and total profit (\( TP_1 \)) decrease.

Table 1.6. Variation of Holding cost \( C_h \) according to \( t_2, L \) and \( TP_1 \)

<table>
<thead>
<tr>
<th>Holding cost ( C_h )</th>
<th>.35</th>
<th>.40</th>
<th>.45</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>5.240</td>
<td>5.177</td>
<td>5.110</td>
</tr>
<tr>
<td>( L )</td>
<td>8281</td>
<td>7964</td>
<td>7675</td>
</tr>
<tr>
<td>( TP_1 )</td>
<td>5113</td>
<td>4990</td>
<td>4871</td>
</tr>
</tbody>
</table>

If the holding cost (\( C_h \)) increases, then the time \( t_2 \), order quantity (\( L \)) and total profit (\( TP_1 \)) decrease.

Table 1.7. Variation of Ordering cost \( C_o \) according to \( t_2, L \) and \( TP_1 \)

<table>
<thead>
<tr>
<th>Ordering cost ( C_o )</th>
<th>600</th>
<th>700</th>
<th>800</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>5.171</td>
<td>5.174</td>
<td>5.177</td>
</tr>
<tr>
<td>( L )</td>
<td>7933</td>
<td>7948</td>
<td>7964</td>
</tr>
<tr>
<td>( TP_1 )</td>
<td>5025</td>
<td>5008</td>
<td>4990</td>
</tr>
</tbody>
</table>

If the ordering cost (\( A \)) increases, then it is quite natural that the total profit (\( TP_1 \)) for this purpose decrease.

Table 1.8. Variation of Inflation rate \( R \) according to \( t_2, L \) and \( TP_1 \)

<table>
<thead>
<tr>
<th>Inflation rate ( R )</th>
<th>.010</th>
<th>.020</th>
<th>.030</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>5.177</td>
<td>4.785</td>
<td>4.497</td>
</tr>
<tr>
<td>( L )</td>
<td>7964</td>
<td>6242</td>
<td>5207</td>
</tr>
<tr>
<td>( TP_1 )</td>
<td>4990</td>
<td>3928</td>
<td>3024</td>
</tr>
</tbody>
</table>

If the inflation rate (\( R \)) increases, then it is quite natural that the total profit (\( TP_1 \)) for this purpose decrease.

The following graphs (Fig. 1 and 2) show the relation between total profit (\( TP_1 \)) and time period \( t_1 \) and \( t_2 \).

Fig 1: Total Profit TP1 v/s t2 for different t1 values

Fig 2: 3D view of Total Profit TP1 v/s t2 for different t1 values
Therefore we see that in the above study the sensitivity analysis of the parameters present in this inventory model shows the total profit changes significantly with changes in the different parameters.

Ex.2. \( A=800, \ R=0.01, \ C_p=100 \) per unit, \( C_p=40 \) per unit, \( M=7.5 \) month, \( L_0=0.08 \) per month, \( C_{h}=0.40 \) per unit, \( C_{p}=0.05 \) per unit, \( \alpha=0.40 \) per unit, \( a=200 \) and \( b=0.2 \) units. From Table 2.1. we observe that the system cost (TP) is Maximum when \( t_1=1/2 \) and \( t_2^*=2.757 \) (month).

<table>
<thead>
<tr>
<th>Demand part ( a )</th>
<th>200</th>
<th>300</th>
<th>400</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2^* )</td>
<td>2.757</td>
<td>2.671</td>
<td>2.632</td>
</tr>
<tr>
<td>L</td>
<td>1662</td>
<td>2348</td>
<td>3047</td>
</tr>
<tr>
<td>TP</td>
<td>19183</td>
<td>28868</td>
<td>36555</td>
</tr>
</tbody>
</table>

If the demand rates \( (a) \) increases, then the lower time \( t_2^* \), the longer order quantity (L) and total profit (TP) increase.

<table>
<thead>
<tr>
<th>Demand part ( b )</th>
<th>0.18</th>
<th>0.19</th>
<th>0.20</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2^* )</td>
<td>2.955</td>
<td>2.842</td>
<td>2.757</td>
</tr>
<tr>
<td>L</td>
<td>1821</td>
<td>1726</td>
<td>1662</td>
</tr>
<tr>
<td>TP</td>
<td>15559</td>
<td>17470</td>
<td>19183</td>
</tr>
</tbody>
</table>

If the demand rate \( (b) \) increases, then the lower time \( t_2^* \), the lower order quantity (L) and total profit (TP) increase.

<table>
<thead>
<tr>
<th>Deterioration rate ( \alpha )</th>
<th>0.40</th>
<th>0.45</th>
<th>0.50</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2^* )</td>
<td>2.757</td>
<td>1.910</td>
<td>1.566</td>
</tr>
<tr>
<td>L</td>
<td>1662</td>
<td>941</td>
<td>734</td>
</tr>
<tr>
<td>TP</td>
<td>19183</td>
<td>18861</td>
<td>18742</td>
</tr>
</tbody>
</table>

If deterioration rate \( (\alpha) \) increases, then the time \( t_2^* \), order quantity (L) and total profit (TP) decrease.

<table>
<thead>
<tr>
<th>Sales revenue cost ( C_s )</th>
<th>90</th>
<th>95</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2^* )</td>
<td>1.846</td>
<td>2.106</td>
<td>2.757</td>
</tr>
<tr>
<td>L</td>
<td>85</td>
<td>1039</td>
<td>1662</td>
</tr>
<tr>
<td>TP</td>
<td>15590</td>
<td>17326</td>
<td>19183</td>
</tr>
</tbody>
</table>

If the sales revenue cost \( (C_s) \) increases, then the time \( t_2^* \), order quantity (L) and total profit (TP) increase.

<table>
<thead>
<tr>
<th>Purchasing cost ( C_p )</th>
<th>40</th>
<th>41</th>
<th>42</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2^* )</td>
<td>2.757</td>
<td>2.320</td>
<td>2.122</td>
</tr>
<tr>
<td>L</td>
<td>1662</td>
<td>1218</td>
<td>1052</td>
</tr>
<tr>
<td>TP</td>
<td>19183</td>
<td>18721</td>
<td>18306</td>
</tr>
</tbody>
</table>

If purchasing cost \( (C_p) \) increases, then the time \( t_2^* \), order quantity (L) and total profit (TP) decrease.

<table>
<thead>
<tr>
<th>Holding cost ( C_h )</th>
<th>.35</th>
<th>.40</th>
<th>.45</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2^* )</td>
<td>2.887</td>
<td>2.757</td>
<td>2.675</td>
</tr>
<tr>
<td>L</td>
<td>1819</td>
<td>1662</td>
<td>1570</td>
</tr>
<tr>
<td>TP</td>
<td>19218</td>
<td>19183</td>
<td>19151</td>
</tr>
</tbody>
</table>

If the holding cost \( (C_h) \) increases, then the time \( t_2^* \), order quantity (L) and total profit (TP) decrease.

### Table 2.7. Variation of Ordering cost \( C_o \) according to \( t_2^* \), \( L \) and TP

<table>
<thead>
<tr>
<th>Ordering cost ( C_o )</th>
<th>600</th>
<th>700</th>
<th>800</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2^* )</td>
<td>2.671</td>
<td>2.712</td>
<td>2.757</td>
</tr>
<tr>
<td>L</td>
<td>1566</td>
<td>1611</td>
<td>1662</td>
</tr>
<tr>
<td>TP</td>
<td>19245</td>
<td>19214</td>
<td>19183</td>
</tr>
</tbody>
</table>

If the ordering cost \( (A) \) increases, then it is quite natural that the total profit (TP) for this purpose decrease.

### Table 2.8. Variation of Inflation rate \( R \) according to \( t_2, L \) and TP

<table>
<thead>
<tr>
<th>Inflation rate ( R )</th>
<th>.010</th>
<th>.020</th>
<th>.030</th>
</tr>
</thead>
<tbody>
<tr>
<td>( t_2 )</td>
<td>2.757</td>
<td>2.310</td>
<td>2.101</td>
</tr>
<tr>
<td>L</td>
<td>1662</td>
<td>1209</td>
<td>1036</td>
</tr>
<tr>
<td>TP</td>
<td>19183</td>
<td>18798</td>
<td>18467</td>
</tr>
</tbody>
</table>

If the inflation rate \( (R) \) increases, then it is quite natural that the total profit (TP) for this purpose decrease.

The following graphs (Fig. 3 and 4) show the relation between total profit (TP) and time period \( t_1 \) and \( t_2^* \).
It is observed that the sensitivity analysis of the parameters present in this inventory model shows that the total profit changes significantly with changes in the different parameters values.

5. CONCLUSION
This paper presents the concept of an inventory control system against the non-instantaneous deteriorating items with inflation and permissible delay in payments. Two numerical examples have been considered in this inventory model to illustrate the results and the significant features of the results are also discussed. A possible future research direction is the study of an inventory model for production rate, shortages, partial backlogging, two warehouses, linear demand and quadratic demand etc.

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7. REFERENCES

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8. AUTHOR’S PROFILE
Mr. Yashveer Singh is a Research Scholar, Singhania University, Pacheri Bari, Jhunjhunu (Rajasthan) in the Department of Computer Science and Engineering. He received M.Sc. (Mathematics), from Gurukula Kangri University, Haridwar & MCA Degree from College of Engineering, Roorkee, affiliated to Uttarakhand Technical University Dehradun. His research interests include inventory control and soft computing techniques.

Dr. A. K. Malik, Associate Professor of Mathematics in B. K. Birla Institute of Engineering & Technology, Pilani (Rajasthan), has experience of nine years in academics and research work. He has published more than twenty five research papers in reputed national and international journals. His areas of interests are Inventory control, soft computing and Supply Chain Management.

Dr. Satish Kumar, Associate Professor of Mathematics in D.N. College, Meerut (U.P.) has more than twenty years of experience in academics and research work. He received his PhD Degree from CCS University Meerut. He has published a number of research papers in reputed national and international journals. His areas of specialization are Operations Research, and Reliability theory.