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RESEARCH ARTICLE

AN INVENTORY MODEL WITH PRICE SENSITIVE DEMAND, VARIABLE HOLDING COST AND TRADE-CREDIT UNDER INFLATION

[*,1]Anupam Swami, [2]Sarla Pareek, [3]Singh, S. R. and [4]Ajay Singh Yadav

[1]Govt. P.G. College Sambhal, India
[2]Banasthali University Jaipur, India
[3]D.N.P.G. College Meerut, India
[4]SRM University NCR Campus, India

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ABSTRACT

In this article, an inventory model is developed under the situation in which a credit period is offered by the supplier to the purchaser. It is assumed that deterioration rate is a function of time and demand rate in the power law form of the price is considered. Shortages are allowed and are partially backordered with an exponentially decreasing time dependent backlogging rate; moreover variable holding cost and the effect of inflation are also taken into consideration. The model is illustrated with numerical experiments and convexity of the total average costs are revealed graphically, additionally sensitivity analyses with respect to the changes in system parameters are also discussed.

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INTRODUCTION

In long-established EOQ (Economic Order Quantity) models it is assumed that the purchasing cost for the items is paid by the retailer to the supplier as soon as the items have been received. In today's business transactions, it is more and more common to see that the retailer are allowed a fixed time period before they settle the account with the supplier. This provides an advantage to the retailer, due to the fact that he/she does not has to pay the supplier immediately after receiving the items, but instead, can postpone his/her payment until the end of the allowed period. Up to the end of the trade credit of a cycle, the retailer is free of charge, but he is charged on an interest for those items not being sold before this end. During trade credit period, the retailer can accumulate revenues by selling items and by earning interests. On the other hand, the permissible delay in payments produces benefits to the supplier such as it should attract new purchasers who consider it to be a type of price reduction. Goyal (1985) is the first person who developed an EOQ model under conditions of permissible delay in payments. Shah *et al*. (1988) studied the same model, incorporating shortages. Other motivating mechanisms in this research area are those of Aggarwal and Jaggi (1995), Singh, Kumari and Kumar (2011), Teng, Min and Pan (2012).

Deterioration of goods plays an important role in inventory system since in real life situations most of the physical goods deteriorate over time, so it should not be disregarded. Generally, deterioration is defined as decay, damage or spoilage etc., which result in decrease of the value of the original one. Ghare and Schrader (1963) presented the first model for decaying items. Covert and Philip (1973) extended their model considering Weibull distribution deterioration. Goyal and Giri (2001) provided a detailed review of deteriorating inventory literatures. Some recent models dealing with the same issue are Yang and Wee (2006), Bakker, Riezebos and Teunter (2012).

Corresponding author: Anupam Swami,
Govt. P.G. College Sambhal, India.

Price is an obvious strategy to influence demand rate, research in inventory models with price dependent demand rate have been received much attention. Kunreuther and Richard (1971) discussed the joint pricing and ordering policy for non seasonal products. After that Cohen (1977) discussed the joint pricing and ordering policy for an item deteriorating over time at a constant rate. Some other models related to this topic are Dye (2007), Sana (2011).

In most of the classical inventory models is considered the situation in which shortages are either completely backlogged or completely lost which is not practical. Many convenient experiences disclose that some but not all the consumers will wait for backlogged items during a shortage period, such as for trendy goods and the products with short existence phase. According to such observable facts backlogging rate should not be disregarded. Researchers, such as Park (1982) and Wee (1995) proposed inventory models with partial backorders. Singh and Singh (2008) presented a perishable inventory model with quadratic demand and partial backlogging. Recently some interesting work in this direction has been done by Skouri, Konstantaras and Ganas (2009), Hseih, Dye and Ouyang (2010), Sarkar, Ghosh and Chaudhuri (2012) etc.

Additionally, the effect of inflation in inventory system was not considered in classical inventory models. But virtually due to high inflation rate in today's market surroundings, it is very important to consider the influence of the inflation. Buzacott (1975) developed EOQ model with constant demand and a single inflation rate for all associated costs. Bierman and Thomas (1977) then proposed an inventory model with time value of money and inflation. Recently, Singh and Jain (2009), Yang, Teng and Chern (2010) proposed the inventory models with inflation. In all the inventory systems that are discussed above, constant holding cost is considered. It is well known that the holding cost is an essential part of every inventory model and should be estimated as an increasing function of time. To incorporate variable holding cost, Weiss (1982) and Goh (1994) presented an order-level inventory model with assumption that variable holding cost are appropriate when the value of an item decrease the longer it is in stock. Sugapriya and Jiyaraman (2008) established an inventory model by considering variable holding cost.

The above cited models disclose that the inventory models with price sensitive demand, variable holding cost, shortages and trade-credit under the inflationary effects are extremely rare. So, in the proposed article, an inventory model with time proportional decaying rate, variable holding cost, price sensitive demand rate is developed under the facility of permissible delay in payment. The effect of inflation is also taken into consideration. Shortages are permitted and are partially backordered. Numerical examples to illustrate the theory have been provided and sensitivity analysis is also conducted. The necessary and sufficient conditions for the existence of the optimal solution are provided and convexity of the cost functions is also shown through the figures.

Assumptions and Notations

The notations and basic assumptions of the model are as follows:
c_1 is the ordering cost per cycle.
c_2 is the constant deterioration cost per unit item.
$(h+\eta t)$ is the time dependent inventory holding cost per unit per unit time.
c_3 is the constant purchase cost per unit item.
c_4 is the backordering cost per unit per unit time.
c_5 is the opportunity cost per unit.
p is the selling price per unit item.
D(p) represents the price-dependent demand rate, where $D(p)=\alpha p^{-\beta}$, $\alpha>0$, $\beta>1$ mark-up elasticity.
$\theta(t)$ is the time-proportional decay rate of the stock defined as $\theta(t)=bt$, $0<b<1$,. Since $b>0$, $(d\theta(t)/dt)=b>0$. Hence the decay rate increases with time at a rate b.
r is the inflation rate.
M is the trade credit period provided by the supplier to the retailer.
i_e is rate of interest which can be gained due to credit balance
i_c rate of interest charges for financing inventory
t_1 is the time at which inventory level reduces up to 0.
t_2 is the duration of each cycle.
$e^{-\delta t}$is the time dependent backlogging rate with $\delta \geq 0$.
$TC_1(t_1^*,t_2^*)$ is the optimal cost in the case when $M \leq t_1 \leq t_2$.
$TC_2(t_1^*,t_2^*)$ is the optimal cost in the case when $M > t_1$.

Mathematical Formulation and Solution

Let I(t) be the inventory level at time t ($0 \leq t \leq t_2$). During the time interval $(0, t_1)$ inventory level decreases due to the combined effect of demand and deterioration both and at t_1 inventory level depletes up to zero. The differential equation to describe immediate state over $(0,t_1)$ is given by

$$I'(t) = -btI(t) - D(p) \qquad 0 \leq t \leq t_1 \qquad \text{……………………(1)}$$

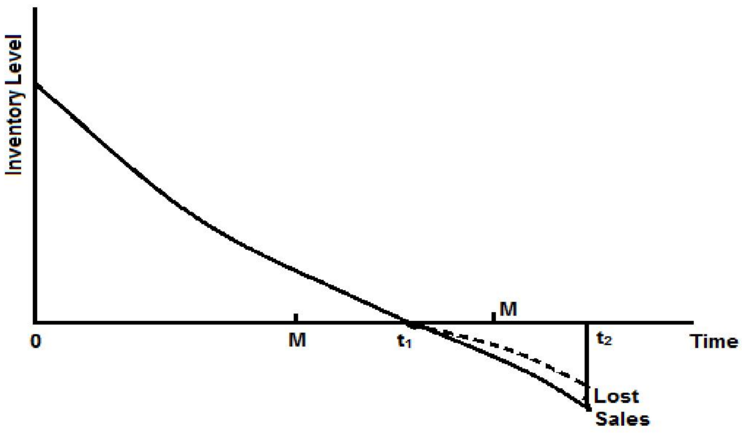

Fig. 1. Graphical representation of the inventory

Now, during time interval (t_1,t_2) shortages stars occurring and at t_2 there are maximum shortages, due to partial backordering some sales are lost. The differential equation to describe instant state over (t_1,t_2) is given by

$$I'(t) = -e^{-\delta(t_2-t)} D(p) \qquad t_1 \le t \le t_2 \qquad \text{.......................... (2)}$$

with boundary condition $I(t_1) = 0$

The solutions of the differential Equations 1, 2 are as follows:

$$I(t) = D(p)\left[\left(t_1 + \frac{bt_1^3}{6}\right) - \left(t + \frac{bt^3}{6}\right)\right] e^{-bt^2/2} \qquad 0 \le t \le t_1 \qquad \text{..........................(3)}$$

$$I(t) = \frac{D(p)}{\delta}\left[e^{-\delta(t_2-t_1)} - e^{-\delta(t_2-t)}\right] \qquad t_1 \le t \le t_2 \qquad \text{..............................(4)}$$

The inventory level at time t = 0 is I(0) and is given by

$$I(0) = D(p)\left(t_1 + \frac{bt_1^3}{6}\right) \qquad \text{............................ (5)}$$

The maximum shortages occurs at time $t = t_2$ is $I(t_2)$ and is given by

$$I(t_2) = \frac{D(p)}{\delta}\left[e^{-\delta(t_2-t_1)} - 1\right] \qquad \text{......................... (6)}$$

The total order quantity is Q and is given by

$$Q = I(0) + \left[-I(t_2)\right] = \left[D(p)\left(t_1 + \frac{bt_1^3}{6}\right) - \frac{D(p)}{\delta}\left(e^{-\delta(t_2-t_1)} - 1\right)\right] \qquad \text{..........................(7)}$$

Now, total average cost consists of the following costs

1. The present value of the ordering cost is

$OC = c_1$ ....(8)

2. The present value of the deteriorating cost is DC and is given by

$$DC = c_2 \int_0^{t_1} btI(t)e^{rt}\,dt \qquad DC = \frac{c_2 D(p) b}{r^5}\left[\left(r^3 t_1 + \frac{br^3t_1^3}{6} + 2r^2 - 16b - 3brt_1\right) + e^{rt_1}\left(16b - 2r^2 + r^3t_1 - 13brt_1 - \frac{4br^3t_1^3}{3} + 5br^2t_1^2 + \frac{br^4t_1^4}{3}\right)\right] \quad \text{.........(9)}$$

3. The present value of the holding cost is HC and is given by

$$HC = \int_0^{t_1} (h + \eta t) I(t) e^{rt}\,dt$$

$$\begin{aligned} HC = \frac{D(p)}{r^7}\Bigg[& e^{rt_1}\Bigg\{ r^5\left(h + \eta t_1 - \frac{b^2ht_1^4}{4} - \frac{b^2\eta t_1^5}{4}\right) + r^4\left(bht_1 + b\eta t_1^2 + \frac{3b^2ht_1^3}{2} + 2b^2\eta t_1^4 - 2\eta\right) \\ & - r^3b\left(2h + 5\eta t_1 + 5bht_1^2 + \frac{19b\eta t_1^3}{2}\right) + 2r^2b\left(4\eta + 5bht_1 + 15b\eta t_1^2\right) - 10b^2r\left(h + \eta t_1\right) + 60b^2\eta\Bigg\} \\ & + \Bigg\{\left(t_1 + \frac{bt_1^3}{6}\right)\left(\eta r^5 + bhr^4 - hr^6 - 3b\eta r^3\right) - hr^5 + 2\eta r^4 + 2bhr^3 - 8b\eta r^2 + 10b^2hr - 60b^2\eta\Bigg\}\Bigg] \end{aligned} \quad \text{..................(10)}$$

4. The present value of the purchasing cost is PC and is given by

$$PC = c_3 Q = c_3\left[D(p)\left(t_1 + \frac{bt_1^3}{6}\right) - \frac{D(p)}{\delta}\left(e^{-\delta(t_2 - t_1)} - 1\right)e^{rt_2}\right] \quad \text{.................... (11)}$$

5. The present value of the shortage cost is SC and is given by

$$SC = c_4 \int_{t_1}^{t_2} \left[-I(t)\right] e^{rt}\,dt$$

$$SC = -\frac{c_4 D(p)}{r\delta(r+\delta)}\left[(r+\delta)e^{rt_2 - \delta(t_2 - t_1)} - \delta e^{rt_1 - \delta(t_2 - t_1)} - re^{rt_2}\right] \quad \text{..................... (12)}$$

6. The present value of the lost sales cost is LC and is given by

$$LC = c_5 \int_{t_1}^{t_2} D(p)\left[1 - e^{-\delta(t_2 - t)}\right] e^{rt}\,dt$$

$$LC = \frac{c_5 D(p)}{r(r+\delta)}\left[\delta e^{rt_2} - (r+\delta)e^{rt_1} + re^{rt_1 - \delta(t_2 - t_1)}\right] \quad \text{.....................(13)}$$

Case (1): $M \le t_1 \le t_2$

In this case the present value of the interest payable is CI_p and is given by

$$CI_p = c_3 i_p \left[\int_M^{t_1} I(t) e^{rt}\,dt\right]$$

$$CI_p = c_3 i_p D(p) \begin{bmatrix} \frac{1}{r}\left(t_1 + \frac{bt_1^3}{6}\right)\left(e^{rt_1} - e^{rM}\right) + \frac{e^{rM}}{r^2}(rM-1) - \frac{e^{rt_1}}{r^2}(rt_1 - 1) \\ -\frac{b}{2r^3}\left(t_1 + \frac{bt_1^3}{6}\right)\left\{\left(r^2t_1^2 - 2rt_1 + 2\right)e^{rt_1} - \left(r^2M^2 - 2rM + 2\right)e^{rM}\right\} \\ +\frac{b^2}{12r^6}\begin{Bmatrix} \left(r^5t_1^5 - 5r^4t_1^4 + 20r^3t_1^3 - 60r^2t_1^2 + 120rt_1 - 120\right)e^{rt_1} \\ -\left(r^5M^5 - 5r^4M^4 + 20r^3M^3 - 60r^2M^2 + 120rM - 120\right)e^{rM} \end{Bmatrix} \\ +\frac{b}{3r^4}\left\{\left(r^3t_1^3 - 3r^2t_1^2 + 6rt_1 - 6\right)e^{rt_1} - \left(r^3M^3 - 3r^2M^2 + 6rM - 6\right)e^{rM}\right\} \end{bmatrix} \quad \text{.....................(14)}$$

The present value of the interest earned is CI_e and is given by

$$CI_e = pi_e \int_0^M D(p)(M-t)e^{rt}\,dt = \frac{pi_e D(p)}{r^2}\left[e^{rM} - rM - 1\right] \quad \text{...................(15)}$$

Now, the present value of the total average cost in the case when $M \le t_1 \le t_2$ is $TC_1(t_1, t_2)$ and is given by

$$TC_1(t_1,t_2) = \frac{1}{t_2}\left(OC + DC + HC + PC + SC + LC + CI_p - CI_e\right) \quad \text{..................(16)}$$

Our objective is to minimize the total cost function $TC_1(t_1, t_2)$. The necessary conditions for minimizing the total cost are

$$\frac{\partial TC_1(t_1,t_2)}{\partial t_1} = 0 \; and \; \frac{\partial TC_1(t_1,t_2)}{\partial t_2} = 0 \quad \text{(A)}$$

Using the software Mathematica-8.0, from these two equations we can determine the optimum values of t_1^* and t_2^* simultaneously and the optimal value $TC_1(t_1^*, t_2^*)$ of the total average cost can be determined by (16) provided they satisfy the sufficiency conditions for minimizing $TC_1(t_1^*, t_2^*)$ are

$$\frac{\partial^2 TC_1(t_1,t_2)}{\partial t_1^2} > 0, \frac{\partial^2 TC_1(t_1,t_2)}{\partial t_2^2} > 0 \; and \; \frac{\partial^2 TC_1(t_1,t_2)}{\partial t_1^2}\frac{\partial^2 TC_1(t_1,t_2)}{\partial t_2^2} - \left(\frac{\partial^2 TC_1(t_1,t_2)}{\partial t_1 \partial t_2}\right)^2 > 0$$

Numerical Example

To illustrate the theory of the model, we consider the following data on the basis of the previous study.
c_1=50, c_2=0.5, h=0.3, η=0.08, c_3=15, c_4=8, c_5=20, i_p=0.08, i_e=0.05, b=0.5, $\alpha=10^7$, β=3.6, δ=0.3, M=0.5, r=0.15, p=30. Solving equations given in (A) we get t_1^*=0.623576, t_2^*=0.655782, Q*=31.4442 and $TC_1(t_1^*, t_2^*)$ =816.485.

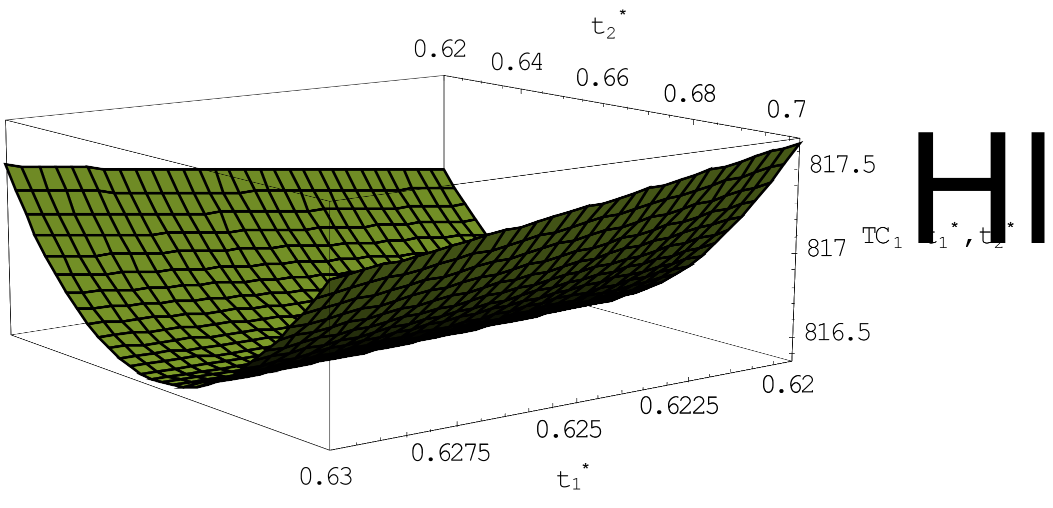

Fig. 2. Convexity of the cost function

Sensitivity Analysis

Table 1. The effect of the changes to the system parameters on the total cost and decision variables is shown as follows

Para-meter	% change	Change in t_1^*	Change in t_2^*	Change in Q^*	Change in $TC_1(t_1^*, t_2^*)$
c_1	-10	0.601409	0.626674	30.1781	808.693
	-05	0.612707	0.641474	30.8220	812.636
	+05	0.634051	0.669640	32.0465	820.265
	+10	0.644167	0.683084	32.6306	823.954
c_2	-10	0.624230	0.656218	31.4757	816.408
	-05	0.623902	0.656000	31.4599	816.448
	+05	0.623250	0.655565	31.4286	816.528
	+10	0.622925	0.655348	31.4130	816.569
H	-10	0.625669	0.656905	31.5409	815.998
	-05	0.624621	0.656343	31.4925	816.263
	+05	0.622534	0.655223	31.3961	816.720
	+10	0.621495	0.654667	31.3482	816.936
c_3	-10	0.640980	0.676477	32.4125	741.580
	-05	0.631944	0.665810	31.9103	779.051
	+05	0.615805	0.646324	31.0102	853.884
	+10	0.608573	0.637376	30.6050	891.247
c_4	-10	0.622681	0.656950	31.4265	816.455
	-05	0.623142	0.656348	31.4356	816.468
	+05	0.623984	0.655249	31.4523	816.507
	+10	0.624368	0.654746	31.4599	816.518
c_5	-10	0.622914	0.656647	31.4311	816.465
	-05	0.623252	0.656204	31.4378	816.478
	+05	0.623885	0.655378	31.4504	816.503
	+10	0.624180	0.654992	31.4562	816.513
i_p	-10	0.626050	0.657742	31.5676	816.412
	-05	0.624801	0.656753	31.5053	816.456
	+05	0.622373	0.654829	31.3843	816.525
	+10	0.621192	0.653894	31.3255	816.562
i_e	-10	0.627497	0.660962	31.6694	817.891
	-05	0.625543	0.658380	31.5571	817.194
	+05	0.621595	0.653169	31.3306	815.782
	+10	0.619601	0.650541	31.2164	815.089
B	-10	0.642810	0.668557	32.2637	814.089
	-05	0.632919	0.661966	31.8422	815.309
	+05	0.614727	0.649964	31.9439	817.710
	+10	0.606329	0.644477	30.7100	818.730
A	-10	0.646369	0.686019	29.4822	742.303
	-05	0.634593	0.670358	30.4738	779.439
	+05	0.613234	0.642166	32.3947	853.458
	+10	0.603497	0.629404	33.3265	890.346
M	-10	0.622338	0.659395	31.4482	819.899
	-05	0.622993	0.657631	31.4482	818.206
	+05	0.624084	0.653844	31.4361	814.752
	+10	0.624515	0.651815	31.4236	812.997
R	-10	0.619801	0.663870	31.4143	816.051
	-05	0.621658	0.659724	31.4267	816.283
	+05	0.625551	0.652033	31.4666	816.658
	+10	0.627583	0.648467	31.4938	816.797
P	-10	0.551720	0.562492	40.0090	1157.44
	-05	0.587378	0.608402	35.3413	966.897
	+05	0.660193	0.704509	28.1547	696.249
	+10	0.697136	0.754488	25.3515	599.022

Observations

1. The optimal cost increases or decreases with an increment or decrement in ordering cost c_1, deteriorating cost c_2, holding cost parameter h, purchasing cost c_3, shortage cost c_4 and lost sales cost c_5 respectively.
2. As the interest payable i_p decreases or increases the optimal cost decreases or increases correspondingly.
3. The optimal cost increases as the rate of interest earned i_e decreases and the cost decreases as this rate increases.
4. As the deterioration factor b decreases or increases the optimal cost decreases or increases correspondingly.
5. As the demand parameter α increases or decreases the optimal cost increases or decreases respectively.
6. The optimal cost increases or decreases respectively as the delay period M decreases or increases.
7. As the rate of inflation r increases or decreases the optimal cost increases or decreases respectively.
8. The cost increases or decreases respectively as the selling price p decreases or increases.

Case (2): $M \geq t_1$

The interest payable for this cycle, CI_p in this case is equal to zero because the supplier can paid in full at the end of the permissible delay period, M and so

$$CI_p = 0 \quad (17)$$

Now, the interest earned for the cycle is the interest earned during the positive inventory plus the interest earned from the cash invested during the time period (t_1, M) after the inventory exhausted at t_1.

Thus, the present value of the interest earned is CI_e and is given by

$$CI_e = i_e p\left[\int_0^{t_1} D(p)(t_1 - t)e^{rt}dt + D(p)t_1(M - t_1)e^{rM}\right]$$

$$CI_e = \frac{i_e pD(p)}{r^2}\left[r^2 t_1(M - t_1)e^{rM} + e^{rt_1} - rt_1 - 1\right] \quad \text{.....................................(18)}$$

Thus, the present value of the total average cost in the case when $M \geq t_1$ is $TC_2(t_1, t_2)$ and is given by

$$TC_2(t_1,t_2) = \frac{1}{t_2}\left(OC + DC + HC + PC + SC + LC + CI_p - CI_e\right) \quad \text{.....................................(19)}$$

Our objective is to minimize the total cost function $TC_2(t_1, t_2)$. The necessary conditions for minimizing the total cost are

$$\frac{\partial TC_2(t_1,t_2)}{\partial t_1} = 0 \, and \, \frac{\partial TC_2(t_1,t_2)}{\partial t_2} = 0 \quad \text{(B)}$$

Using the software Mathematica-8.0, from these two equations we can determine the optimum values of t_1^* and t_2^* simultaneously and the optimal value $TC_2(t_1^*, t_2^*)$ of the total average cost can be determined by (19) provided they satisfy the sufficiency conditions for minimizing $TC_2(t_1^*, t_2^*)$ are

$$\frac{\partial^2 TC_2(t_1,t_2)}{\partial t_1^2} > 0, \frac{\partial^2 TC_2(t_1,t_2)}{\partial t_2^2} > 0 \, and \, \frac{\partial^2 TC_2(t_1,t_2)}{\partial t_1^2}\frac{\partial^2 TC_2(t_1,t_2)}{\partial t_2^2} - \left(\frac{\partial^2 TC_2(t_1,t_2)}{\partial t_1 \partial t_2}\right)^2 > 0$$

Numerical Example

To illustrate the theory of the model we consider the following data on the basis of the previous study.
c_1=50, c_2=0.5, h=0.3, η=0.08, c_3=15, c_4=8, c_5=20, i_p=0.08, i_e=0.05, b=0.5, α=10^7, β=3.6, δ=0.3, M=1.95, r=0.15, p=30. Solving equations given in (B) we get t_1^*=1.78903, t_2^*=2.46935, Q*=117.943 and $TC_2(t_1^*, t_2^*)$ =1814.36.

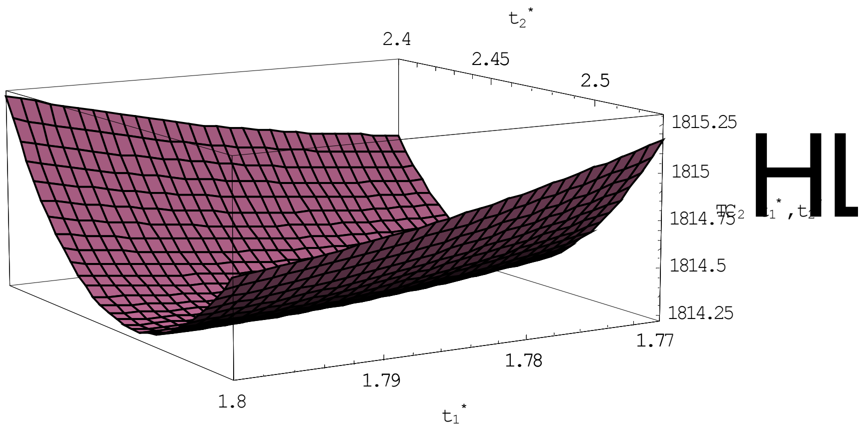

Fig. 3. Convexity of the cost function

Sensitivity Analysis

Table 2. The effect of the changes to the system parameters on the total cost and decision variables is shown as follows:

Parameter	% change	Change in t_1^*	Change in t_2^*	Change in Q^*	Change in $TC_2(t_1^*,t_2^*)$
c_1	-10	1.78732	2.46574	117.773	1812.33
	-05	1.78818	2.46755	117.859	1813.33
	+05	1.78988	2.47116	118.028	1815.36
	+10	1.79073	2.47296	118.113	1816.37
c_2	-10	1.79252	2.47087	118.223	1813.69
	-05	1.79077	2.47011	118.083	1814.02
	+05	1.78730	2.46860	117.805	1814.68
	+10	1.78557	2.46785	117.667	1815.00
H	-10	1.79281	2.47039	118.239	1813.13
	-05	1.79092	2.46987	118.091	1813.74
	+05	1.78714	2.46883	117.796	1814.96
	+10	1.78525	2.46832	117.649	1815.56
c_3	-10	1.85060	2.51405	123.161	1721.47
	-05	1.81901	2.49106	120.463	1768.06
	+05	1.76050	2.44881	115.583	1860.36
	+10	1.73329	2.42934	113.366	1906.12
c_4	-10	1.72853	2.39455	112.611	1725.54
	-05	1.75919	2.43290	115.300	1770.14
	+05	1.81811	2.50408	120.547	1858.19
	+10	1.84649	2.53725	123.116	1901.70
c_5	-10	1.77695	2.48825	117.263	1810.78
	-05	1.78313	2.47858	117.611	1812.60
	+05	1.79468	2.46053	118.263	1816.03
	+10	1.80008	2.45208	118.569	1817.65
i_e	-10	1.79551	2.4813	118.570	1820.59
	-05	1.79226	2.47532	118.256	1817.47
	+05	1.78583	2.46339	117.634	1811.22
	+10	1.78265	2.45743	117.326	1808.08
B	-10	1.85889	2.49735	121.030	1798.71
	-05	1.82286	2.48274	119.443	1806.73
	+05	1.75717	2.45703	116.522	1821.59
	+10	1.72708	2.44565	115.172	1828.49
A	-10	1.79092	2.47336	106.319	1634.95
	-05	1.78992	2.47125	112.131	1724.65
	+05	1.78822	2.46763	123.756	1904.05
	+10	1.78748	2.46607	129.568	1993.75
M	-10	1.78298	2.4819	117.638	1827.89
	-05	1.78597	2.47573	117.790	1821.23
	+05	1.79215	2.46276	118.099	1807.24
	+10	1.79534	2.45595	118.258	1799.89
R	-10	1.75623	2.48040	115.638	1716.66
	-05	1.77320	2.47595	116.841	1765.35
	+05	1.80379	2.46091	118.953	1863.67
	+10	1.81755	2.45088	119.875	1913.31
P	-10	1.79010	2.46990	172.472	2650.98
	-05	1.78938	2.46923	141.893	2181.95
	+05	1.78908	2.47032	98.9574	1522.74
	+10	1.78956	2.47219	83.7393	1288.85

Observations

1. The optimal cost increases or decreases with the increment or decrement of the ordering cost c1, deteriorating cost c2, holding cost h, purchasing cost c3, shortage cost c4 and lost sales cost c5 respectively.
2. The optimal cost increases as the rate of interest earned ie decreases and the cost decreases as this rate increases.
3. As the deterioration factor b decreases or increases the optimal cost decreases or increases correspondingly.
4. As the demand parameter α increases or decreases the optimal cost increases or decreases respectively.
5. The optimal cost increases or decreases respectively as the delay period M decreases or increases.
6. As the rate of inflation r increases or decreases the optimal cost increases or decreases respectively.
7. The cost increases or decreases respectively as the selling price p decreases or increases.

Conclusion

In this study, an inventory model is developed under the situation in which a delay period is offered by the supplier to the purchaser. There arise two cases of dealings such as: Case (1) The credit period is less than or equal to the cycle time for settling the account. Case (2) The credit period is greater than the cycle time for settling the account. In developing the model the effects of price dependent demand rate, time proportional deterioration and holding cost, inflation are also taken into consideration. Both the cases are discussed through the examples. From sensitivity tables it is observed that the proposed model is moderately sensitive with respect to the changes in system parameters.

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