Global and Stochastic Analysis
Vol. 4 No. 1, January (2017), 127-138

MUK PUBLICATIONS
Open Access Publisher

# ROLE OF INFLATION AND TRADE CREDIT IN STOCHASTIC INVENTORY MODEL

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ABSTRACT. At present, it is impossible to ignore the effects of inflation and it is necessary to consider the effects of inflation on the inventory system. Inflation plays an essential role for the optimal order policy and influences the demand of certain products. We develop stochastic inventory model for non deteriorating items under the effect of inflation and trade credit for two suppliers to determine an optimal ordering policy. In the classical inventory models, it was assumed that the buyer pays for the purchased items as they are received from the seller. In practice, however, the seller allows the buyer to settle the account with a delay period. Such a contract has attracted the attention of many researchers and practitioners in recent years. In case of two suppliers, spectral theory is used to derive explicit expression for the transition probabilities of a four state continuous time Markov chain representing the status of the systems. These probabilities are used to compute the exact form of the average cost expression. We use concepts from renewal reward processes to develop average cost objective function. Optimal solution is obtained using Newton Rapson method in R programming. Numerical examples are also given to demonstrate the presented model. Finally sensitivity analysis of the varying parameter on the optimal solution is done.

## 1. Introduction

In the classical inventory it is assumed that all the costs associated with the inventory system remains constant over time. Since most decision makers think that the inflation does not have significant influence on the inventory policy and most of the inventory models developed so far does not include inflation and time value of money as parameters of the system. But due to large scale of inflation the monetary situation in almost all the countries has changed to an extent during the last thirty years. Nowadays inflation has become a permanent feature in the inventory system. Inflation enters in the picture of inventory only because it may have an impact on the present value of the future inventory cost. Thus the inflation plays a vital role in the inventory system and production management though the decision makers may face difficulties in arriving at answers related to decision making. At present, it is impossible to ignore the effects of inflation and it is necessary to consider the effects of inflation on the inventory system. Inflation plays an essential role for the optimal order policy and influences the demand of certain products. As inflation increases, the value of money goes down and erodes

2000 *Mathematics Subject Classification.* 90B05; 82C31.
*Key words and phrases.* Future supply uncertainty, trade credit, non deteriorating items, inflation, two suppliers.

the future worth of saving and forces one for more current spending. Usually, these spending are on peripherals and luxury items that give rise to demand of those items. As a result, the effect of inflation and time value of the money cannot be ignored for determining the optimal inventory policy. Buzacott (1975) first developed the Economic Order Quantity (EOQ) model taking inflation into account. Misra (1979) developed a discount cost model in which the effects of both inflation and time value of money are considered. Chandra and Bahner (1985) developed models to investigate the effects of inflation and time value of money on optimal order policies. Data and Pal (1991) considered the effects of inflation and time value of money on an inventory model with a linear time-dependent demand rate and shortages. Ray and Chaudhuri (1997) provided an EOQ model with inflation time discounting. Jaggi, Aggarwal and Goel (2006) determine an optimal ordering policy for deteriorating items under inflation induced demand. Sarker, Jamal and Shajunwang (2000) developed Supply Chain Models for Perishable products under inflation and permissible delay in payment. Hou and Lin (2006) proposed an EOQ model for deteriorating items with price and stock-dependent selling rates under inflation and time value of money. Tripathi, Misra and Shukla (2010) developed an inventory model for non deteriorating items and time-dependent demand under inflation when delay in payment is permissible. Guria, Das, Mondal, and Maiti (2013) formulated an inventory policy for an item with inflation induced purchasing price, selling price, and demand with immediate part payment.

Trade credit is commonly used by business organizations as a source of short-term financing. By using the trade credits facilities, we can increase our total annual profit and also, this credit is extended by one trader to another for the purchase of goods and services. The suppliers offer delay in payment to the retailers to buy more items and the retailers can sell the item before the closing of the delay time. As a result, the retailers sell the items and earn interests. Usually, there is no interest charge if the outstanding amount is paid within the permissible delay period. This provides opportunities to the retailers to accumulate revenue and earn interest by selling their items during the delay period. This permissible delay in payment provides benefit to the supplier in as much as attracting new customers who consider it to be a type of price reduction and reduction in sells outstanding as some customers make payments on time in order to take advantage of permissible delay more frequently. In this direction, Goyal (1985) extended the EOQ model under the conditions of permissible delay in payments. Shah (1993) developed model for deteriorating items when delay in payments is permissible by assuming deterministic demand. Aggarwal and Jaggi (1995) developed a model to determine the optimum order quantity for deteriorating items under a permissible delay in payment. Liao, Tsai, and Su (2000) developed an inventory model for initial-stock-dependent consumption rate when a delay in payment is permissible.

In most inventory models it is implicitly assumed that the product to be ordered is always available (that is continuous supply availability), that is when an order is placed it is either received immediately or after a deterministic or perhaps random lead time. However if the product is purchased from another company ($as in the JIT deliveries of parts and components$), the supply of the product may sometimes be interrupted due to the suppliers equipment breakdowns, labor strikes or other unpredictable circumstances. Silver (1981) appears to be first author to discuss the need for models that deal with supplier uncertainty. Articles by Parlar and Berkin (1991) consider the supply uncertainty problem for a class of EOQ model with a single supplier where the availability and unavailability periods constitute an alternating Poisson process. Parlar and Berkin (1991) assume that at any time the decision maker is aware of the availability status of the product although he does not know when the ON (available) and OFF (unavailable) periods will start and end. When the inventory level reaches the reorder point of zero and the status is ON, the order is received; otherwise the decision maker must wait until the product becomes available. Parlar and Perry (1996) developed inventory model for non deteriorating items with future supply uncertainty considering demand rate d=1 for two suppliers. Kandpal and Gujarati (2003,2006) has extended the model of Parlar and Perry(1996) by considering demand rate greater than one and for deteriorating items for single supplier. Kandpal and Tinani (2009) developed inventory model for deteriorating items with future supply uncertainty under inflation and permissible delay in payment for single supplier.

In this paper it is assumed that the inventory manager may place his order with any one of two suppliers who are randomly available. Here we assume that the decision maker deals with two suppliers who may be ON or OFF. Here there are three states that correspond to the availability of at least one supplier that is states 0, 1 and 2 whereas state 3 denotes the non-availability of either of them. State 0 indicates that supplier 1 and supplier 2 both are available. Here it is assumed that one may place order to either one of the two suppliers or partly to both. State 1 represents that supplier 1 is available but supplier 2 is not available. State 2 represents that supplier 1 is not available but supplier 2 is available.

## 2. Notations, assumptions and model

The inventory model here is developed on the basis of following assumptions.

(a) Demand rate $d$ is deterministic and it is $d > 1$.
(b) We define $Xi$ and $Yi$ to be the random variables corresponding to the length of ON and OFF period respectively for $i^{th}$ supplier where i=1, 2. We specifically assume that $Xi \sim exp(\lambda_i)$ and $Yi \sim exp(\mu_i)$. Further $X_i$ and $Y_i$ are independently distributed
(c) $q_i$ = order up to level i=0, 1, 2.
(d) $r$ = reorder up to level ; $q_i$ and $r$ are decision variables.
(e) $T_{0i}$ is a credit period allowed by $i^{th}$ supplier where i=1, 2 which is a known constant.
(f) $T_{00}$ is cycle period which is a decision variable.
(g) $ie_i$=Interest rate earned when purchase made from $i^{th}$ supplier where i= 1, 2.
$ic_i$=Interest rate charged by $i^{th}$ supplier where $i = 1, 2$.

(h) $\alpha_i$= Indicator variable for $i^{th}$ supplier where $i = 1, 2$.
$\alpha_i = 0$ if account is settled completely at $T_{0i}$
$\alpha_i = 1$ otherwise.

(i) $r_1$= discount rate representing the time value of money.
(j) $f$ = inflation rate.
(k) $R = f - r_1$ = present value of the nominal inflation rate.
(l) $t_1$ = time period with inflation.
(m) $c_0$ = present value of the inflated price of an item $Rs.$/unit $=ce^{(f-r_1)t_1}$ $=ce^{Rt_1}$
(n) $I_e(1_i)$ =Interest earned over period (0 to $T_{0i}$) $=dce^{Rt_1}T_{00}T_{0i}ie_i$
(o) $I_e(2_i)$=Interest earned over period ($T_{0i}$ to$T_{00}$) upon interest earned previously.
$I_e(2_i) = (dce^{Rt_1}T_{00} + I_e(1_i))(T_{00} - T_{0i})ie_i$
(p) Interest charged by the $i^{th}$ supplier clearly ($ic_i > ie_i$) i= 1, 2.
$Ic_i = \alpha_i dce^{Rt_1}ic_i(T_{00} - T_{0i})$

A Supplier allows a fixed period $T_{0i}$ to settle the account. During this fixed period no interest is charged by the $i^{th}$ supplier but beyond this period, interest is charged by the $i^{th}$ supplier under the terms and conditions agreed upon. Interest charged is usually higher than interest earned. The account is settled completely either at the end of the credit period or at the end of the cycle. During the fixed credit period $T_{0i}$, revenue from sales is deposited in an interest bearing account.
For inflation rate $f$, the continuous time inflation factor for the time period $t_1$ is $e^{ft_1}$ which means that an item that costs Rs. $c$ at time $t_1 = 0$, will cost $ce^{ft_1}$ at time $t_1$. For discount rate $r_1$, representing the time value of money, the present value factor of an amount at time $t_1$ is $e^{-r_1t_1}$. Hence the present value of the inflated amount $ce^{ft_1}$ (net inflation factor) is $ce^{ft_1}e^{-r_1t_1}$. For an item with initial price $c$ (Rs. per unit) at time $t_1 = 0$ the present value of the inflated price of an item is given by $c_0 = ce^{(f-r_1)t_1} = ce^{Rt_1}$, $R = f - r_1$ in which $c$ is inflated through time $t_1$ to $ce^{ft_1}$, $e^{-r_1t_1}$ is the factor deflating the future worth to its present value and $R$ is the present value of the inflation rate.

## 3. Optimal policy decision for the model

The policy we have chosen is denoted by $(q_0, q_1, q_2, r)$. An order is placed for $q_i$ units $i = 0, 1, 2$, whenever inventory drops to the reorder point r and the state found is $i = 0, 1, 2$.When both suppliers are available, $q_0$ is the total ordered from either one or both suppliers. If the process is found in state 3 that is both the suppliers are not available nothing can be ordered in which case the buffer stock of r units is reduced. If the process stays in state 3 for longer time then the shortages start accumulating at rate of d units/time. When the process leaves state 3 and supplier becomes available, enough units are ordered to increase the inventory to $q_i + r$ units where $i = 0, 1, 2$. The cycle of this process start when the inventory goes up to a level of $q_0 + r$ units. Once the cycle is identified, we construct the average cost objective function as a ratio of the expected cost per cycle to the expected cycle length.

$$Ac(q_0, q_1, q_2, r) = \frac{C_{00}}{T_{00}}$$

where, $C_{00} = E$(cost per cycle) and $T_{00} = E$(length of a cycle).

Analysis of the average cost function requires the exact determination of the transition probabilities $P_{ij}(t)$ , $i, j = 0, 1, 2, 3$ for the four state $CTMC$. The solution is provided in the lemma (refer Parlar and Perry [1996]).

$A(q_i, r)$=cost of ordering+cost of holding inventory during a single interval that starts with an inventory of $(q_i + r)$ units and ends with $r$ units.

$$A(q_i, r) = k + \frac{hq_i^2 e^{Rt_1}}{2d} + \frac{hrq_i e^{Rt_1}}{d}, i = 0, 1, 2.$$

$P_{ij}(t) = P$ (Being in state $j$ at time $t$/starting in state $i$ at time 0) , $i, j = 0, 1, 2, 3$ ;
$p_i$ =long run probabilities, $i = 0, 1, 2, 3$

**Lemma 3.1.**

$$C_{i0} = P_{i0}(\frac{q_i}{d})A(q_i, r) + \Sigma_{j=1}^3 P_{ij}(\frac{q_i}{d})[A(q_i, r) + C_{j0}]i = 0, 1, 2$$

*and*

$$C_{30} = \overline{C} + \Sigma_{i=1}^2 \rho_i C_{i0}$$

*where* $\rho_i = \frac{\mu_i}{\delta}$ *with* $\delta = \mu_1 + \mu_2$

$$\overline{C} = \frac{e^{\frac{-r\delta}{d}} e^{Rt_1}}{\delta^2}[he^{\frac{\delta r}{d}}(\delta r - d) + (\pi \delta d + hd) + \hat{\pi}) - c\delta]$$

*(refer Parlar and Perry[1996])*

**Theorem 3.2.** *The Average cost objective function for two suppliers under inflation and permissible delay in payments for non deteriorating items is given by*

$$Ac = \frac{C_{00}}{T_{00}}$$

*where*

$$C_{00} = A(q_0, r) + P_{01}(C_{10} - (I_e(11) + I_e(21) + Ic_1) + P_{02}(C_{20} - (I_e(12) + I_e(22) + Ic_2)$$

$$+P_{03}(\overline{C} + \rho_1(C_{10} - (I_e(11) + I_e(21) + Ic_1) + \rho_2(C_{20} - (I_e(12) + I_e(22) + Ic_2)$$

*and*

$$T_{00} = \frac{q_0}{d} + P_{01}T_{10} + P_{02}T_{20} + P_{03}(\overline{T} + \rho_1 T_{10} + \rho_2 T_{20})$$

*Proof.* Proof follows using Renewal reward theorem (RRT). The optimal solution for $q_0, q_1, q_2$ and $r$ is obtained by using Newton Rapson method in $R$ programming.

## 4. Numerical Examples

Case-I: inflation rate is less than interest charged.
In this section we verify the results by a numerical example. We assume that

(i) $k$ =Rs. 5/order, $c$=Rs.1/unit, $d$=20/units, $h$=Rs. 5/unit/time, $\pi = Rs.350/unit/time$, $\hat{\pi} = Rs.25/unit/time$, $ic_1 = 0.11$, $ie_1 = 0.02$, $ic_2 = 0.13$, $ie_2 = 0.04$, $R = 0.05$, $t_1 = 6$, $T_{01} = 0.6$, $T_{02} = 0.8$, ($\alpha_1 = 1$ and $\alpha_2 = 1$) that is businessmen do not settle the account at the respective credit time given by both the suppliers, $\lambda_1 = 0.58$, $\lambda_2 = 0.45$, $\mu_1 = 3.4$, $\mu_2 = 2.5$. The last four parameters indicate that the expected lengths of the ON and OFF periods for first and second supplier are $1/\lambda_1 = 1.72413794$, $1/\lambda_2 = 2.2222$, $1/\mu_1 = .2941176$ and $1/\mu_2 = .4$ respectively. The long run probabilities are obtained as $p_0 = 0.7239588$, $p_1 = 0.1303126$, $p_2 = 0.1234989$ and $p_3 = 0.02222$. The optimal solution is obtained as $q_0 = 3.10667$, $q_1 = 30.1287$, $q_2 = 29.56780$, $r = 0.81358$ and $Ac = 6.2456$.

(ii) Keeping other parameters as it is, we consider ($\alpha_1 = 0$ and $\alpha_2 = 0$) that is businessmen settle the account at the respective credit time given by both the suppliers. The optimal solution is obtained as $q_0 = 5.10684$, $q_1 = 34.9777$, $q_2 = 33.8575$, $r = 1.026170$ and $Ac = 4.35071$.

(iii) Keeping other parameters as it is, we consider ($\alpha_1 = 1$ and $\alpha_2 = 0$) that is businessmen do not settle the account at the credit time given by the $1^{st}$ supplier but they settle the account at the credit time given by the $2^{nd}$ supplier. The optimal solution is obtained as $q_0 = 4.12907$, $q_1 = 30.8006$, $q_2 = 0.92594$ $r = 0.95295$ and $Ac = 5.59943$.

(iv) Keeping other parameters as it is, we consider ($\alpha_1 = 0$ and $\alpha_2 = 1$) that is when the account is settled by businessmen at the credit time given by the $1^{st}$ supplier but they do not settle the account at the credit time given by the $2^{nd}$ supplier. The optimal solution is obtained as $q_0 = 4.384242$, $q_1 = 31.17162$, $q_2 = 30.78432$, $r = 0.95295$ and $Ac = 6.15795$.

Conclusion: From the above numerical example, we conclude that the cost is minimum when account is settled at the credit time given by the $i^{th}$ supplier. So in this situation businessmen are advised to settle the account at the credit time given by the respective suppliers.
Case-II: Inflation rate is greater than interest charged.
In this section we verify the results by a numerical example. We assume that

(i) $k$ =Rs. 5/order, $c$=Rs.1/unit, $d$=20/units, $h$=Rs. 5/unit/time, $\pi = Rs.350/unit/time$, $\hat{\pi} = Rs.25unit/time$, $ic_1 = 0.11$, $ie_1 = 0.02$, $ic_2 = 0.13$, $ie_2 = 0.04$, $R = 0.35$, $t_1 = 6$, $T_{01} = 0.6$, $T_{02} = 0.8$, ($\alpha_1 = 1$ and $\alpha_2 = 1$) that is businessmen do not settle the account at the respective credit time given by both the suppliers, $\lambda_1 = 0.58$, $\lambda_2 = 0.45$, $\mu_1 = 3.4$, $\mu_2 = 2.5$. The last four parameters indicate that the expected lengths of the ON and OFF periods for first and second supplier are $1/\lambda_1 = 1.72413794$, $1/\lambda_2 = 2.2222$, $1/\mu_1 = .2941176$ and $1/\mu_2 = .4$ respectively. The long run probabilities are obtained as $p_0 = 0.7239588$, $p_1 = 0.1303126$, $p_2 = 0.1234989$ and $p_3 = 0.02222$. The optimal solution is obtained as $q_0 = 3.1656$, $q_1 = 31.6287$, $q_2 = 30.8431$, $r = 0.41932$ and $Ac = 19.8167$.

(ii) Keeping other parameters as it is, we consider ($\alpha_1 = 0$ and $\alpha_2 = 0$) that is businessmen settle the account at the respective credit time given by both the suppliers. The optimal solution is obtained as $q_0 = 4.3952$, $q_1 = 29.6213$, $q_2 = 29.8712$, $r = 0.4178$ and $Ac = 26.7916$.

(iii) Keeping other parameters as it is, we consider ($\alpha_1 = 1$ and $\alpha_2 = 0$) that is businessmen do not settle the account at the credit time given by the $1^{st}$ supplier but they settle the account at the credit time given by the $2^{nd}$ supplier. The optimal solution is obtained as $q_0 = 4.3981$, $q_1 = 29.7651$, $q_2 = 29.6190$ $r = 0.48170$ and $Ac = 22.4671$.

(iv) Keeping other parameters as it is, we consider ($\alpha_1 = 0$ and $\alpha_2 = 1$) that is when the account is settled by businessmen at the credit time given by the $1^{st}$ supplier but they do not settle the account at the credit time given by the $2^{nd}$ supplier. The optimal solution is obtained as $q_0 = 3.9831$, $q_1 = 29.9820$, $q_2 = 29.8329$, $r = 0.4175$ and $Ac = 21.8953$.

Conclusion: From the above numerical example, we conclude that the cost is minimum when account is not settled at the credit time given by the $i^{th}$ supplier. So in this situation businessmen are advised not to settle the account at the end of the credit period but settle the account at the end of the cycle period. The reason for this is once the inflation rate is greater than the interest rates charged, we actually see our debt wiped out by inflation.

## 5. Sensitivity Analysis

Case-I: Inflation rate is less than interest charged.

(i) To observe the effect of varying parameter values on the optimal solution, we have conducted sensitivity analysis by varying the value of inflation rate R keeping other parameter values fixed where ($\alpha_1 = 1$ and $\alpha_2 = 1$). Inflation rate $R$ is assumed to take values 0.05, 0.08, 0.1, 0.12, 0.15. We resolve the problem to find optimal values of $q_0$, $q_1$, $q_2$, $r$ and $Ac$.

Table 5.1.1

Sensitivity Analysis Table by varying the parameter values of R ($\alpha_1 = 1$ and $\alpha_2 = 1$)

| R | $q_0$ | $q_1$ | $q_2$ | $r$ | $Ac$ |
|---|---|---|---|---|---|
| 0.05 | 3.10667 | 30.1287 | 29.5678 | 0.81888 | 6.2456 |
| 0.08 | 2.77982 | 29.0031 | 28.2686 | 0.7625 | 7.18984 |
| 0.1 | 2.59919 | 28.3961 | 27.5549 | 0.72583 | 8.5173 |
| 0.12 | 2.2585 | 27.8708 | 26.9295 | 0.69054 | 9.2590 |
| 0.15 | 2.05473 | 27.1996 | 26.1194 | 0.64053 | 11.2162 |

We see that as inflation rate $R$ increases values of $q_0$, $q_1$, $q_2$ and value of reorder quantity $r$ decreases and hence average cost increases.

(ii) To observe the effect of varying parameter values on the optimal solution, we have conducted sensitivity analysis by varying the value of inflation rate R keeping other parameter values fixed where ($\alpha_1 = 0$ and $\alpha_2 = 0$). Inflation rate $R$ is assumed to take values 0.05, 0.08, 0.1, 0.12, 0.15. We resolve the problem to find optimal values of $q_0$, $q_1$, $q_2$, $r$ and $Ac$.

Table 5.1.2

Sensitivity Analysis Table by varying the parameter values of R ($\alpha_1 = 0$ and $\alpha_2 = 0$)

| R | $q_0$ | $q_1$ | $q_2$ | $r$ | $Ac$ |
|---|---|---|---|---|---|
| 0.05 | 5.10684 | 34.9777 | 36.8578 | 1.02617 | 4.35071 |
| 0.08 | 4.46811 | 30.6747 | 34.2617 | 1.01785 | 6.60664 |
| 0.1 | 3.80797 | 29.4459 | 28.8683 | 0.97442 | 8.1315 |
| 0.12 | 3.32578 | 28.5693 | 27.8497 | 0.92544 | 9.13682 |
| 0.15 | 2.79119 | 27.6076 | 26.7053 | 0.85213 | 10.1168 |

We see that as inflation rate $R$ increases values of $q_0$, $q_1$, $q_2$ and value of reorder quantity $r$ decreases and hence average cost increases.

(iii) To observe the effect of varying parameter values on the optimal solution, we have conducted sensitivity analysis by varying the value of inflation rate R keeping other parameter values fixed where ($\alpha_1 = 1$ and $\alpha_2 = 0$). Inflation rate $R$ is assumed to take values 0.05, 0.08, 0.1, 0.12, 0.15. We resolve the problem to find optimal values of $q_0$, $q_1$, $q_2$, $r$ and $Ac$.

Table 5.1.3

Sensitivity Analysis Table by varying the parameter values of R ($\alpha_1 = 1$ and $\alpha_2 = 0$)

| R | $q_0$ | $q_1$ | $q_2$ | $r$ | $Ac$ |
|---|---|---|---|---|---|
| 0.05 | 4.12907 | 30.8006 | 30.3623 | 0.92594 | 5.59943 |
| 0.08 | 3.39002 | 29.3407 | 28.6986 | 0.86341 | 7.34255 |
| 0.1 | 3.02527 | 28.6195 | 27.8568 | 0.82053 | 9.3676 |
| 0.12 | 2.72496 | 28.0219 | 27.1484 | 0.7788 | 10.5063 |
| 0.15 | 2.35853 | 27.286 | 26.2617 | 0.7198 | 11.4583 |

We see that as inflation rate $R$ increases values of $q_0$, $q_1$, $q_2$ and value of reorder quantity $r$ decreases and hence average cost increases.

(iv) To observe the effect of varying parameter values on the optimal solution, we have conducted sensitivity analysis by varying the value of inflation rate R keeping other parameter values fixed where ($\alpha_1 = 0$ and $\alpha_2 = 1$). Inflation rate $R$ is assumed to take values 0.05, 0.08, 0.1, 0.12, 0.15. We resolve the problem to find optimal values of $q_0$, $q_1$, $q_2$, $r$ and $Ac$.

Table 5.1.4

Sensitivity Analysis Table by varying the parameter values of R ($\alpha_1 = 0$ and $\alpha_2 = 1$)

| R | $q_0$ | $q_1$ | $q_2$ | $r$ | $Ac$ |
|---|---|---|---|---|---|
| 0.05 | 4.38424 | 31.17162 | 30.78432 | 0.95295 | 6.15795 |
| 0.08 | 3.57047 | 29.5611 | 28.9627 | 0.8954 | 7.28645 |
| 0.1 | 3.17314 | 28.7834 | 28.0601 | 0.85285 | 9.3106 |
| 0.12 | 2.84871 | 28.1486 | 27.3108 | 0.8104 | 10.4489 |
| 0.15 | 2.45606 | 27.3774 | 26.3844 | 0.74903 | 11.4003 |

We see that as inflation rate $R$ increases values of $q_0$, $q_1$, $q_2$ and value of reorder quantity $r$ decreases and hence average cost increases.

Case-II: Inflation rate is greater than interest charged.

(i) To observe the effect of varying parameter values on the optimal solution, we have conducted sensitivity analysis by varying the value of inflation rate R keeping other parameter values fixed where ($\alpha_1 = 1$ and $\alpha_2 = 1$). Inflation rate $R$ is assumed to take values 0.2, 0.25, 0.27, 0.3, 0.35. We resolve the problem to find optimal values of $q_0$, $q_1$, $q_2$, $r$ and $Ac$.

Table 5.2.1

Sensitivity Analysis Table by varying the parameter values of R ($\alpha_1 = 1$ and $\alpha_2 = 1$)

| R | $q_0$ | $q_1$ | $q_2$ | $r$ | $Ac$ |
|---|---|---|---|---|---|
| 0.2 | 6.9874 | 40.3471 | 38.6431 | 0.61732 | 9.1453 |
| 0.25 | 4.6983 | 39.7219 | 36.8327 | 0.5872 | 11.9874 |
| 0.27 | 4.1832 | 35.7301 | 34.7651 | 0.5328 | 13.5613 |
| 0.3 | 3.6321 | 33.7328 | 32.8732 | 0.4705 | 16.2565 |
| 0.35 | 3.1656 | 31.6287 | 30.8431 | 0.41932 | 19.8167 |

We see that as inflation rate $R$ increases values of $q_0$, $q_1$, $q_2$ and value of reorder quantity $r$ decreases and hence average cost increases.

(ii) To observe the effect of varying parameter values on the optimal solution, we have conducted sensitivity analysis by varying the value of inflation rate R keeping other parameter values fixed where ($\alpha_1 = 0$ and $\alpha_2 = 0$). Inflation rate $R$ is assumed to take values 0.2, 0.25, 0.27, 0.3, 0.35. We resolve the problem to find optimal values of $q_0$, $q_1$, $q_2$, $r$ and $Ac$.

Table 5.2.2

Sensitivity Analysis Table by varying the parameter values of R ($\alpha_1 = 0$ and $\alpha_2 = 0$)

| R | $q_0$ | $q_1$ | $q_2$ | $r$ | $Ac$ |
|---|---|---|---|---|---|
| 0.2 | 7.10684 | 39.8721 | 39.6548 | 0.7541 | 11.75073 |
| 0.25 | 6.1819 | 37.6431 | 36.2326 | 0.6326 | 15.8066 |
| 0.27 | 5.6078 | 35.3789 | 34.9081 | 0.5793 | 17.1456 |
| 0.3 | 5.32431 | 32.9863 | 31.0431 | 0.4943 | 20.7651 |
| 0.35 | 4.3952 | 29.6213 | 29.8712 | 0.4178 | 26.7916 |

We see that as inflation rate $R$ increases values of $q_0$, $q_1$, $q_2$ and value of reorder quantity $r$ decreases and hence average cost increases.

(iii) To observe the effect of varying parameter values on the optimal solution, we have conducted sensitivity analysis by varying the value of inflation rate R keeping other parameter values fixed where ($\alpha_1 = 1$ and $\alpha_2 = 0$). Inflation rate $R$ is assumed to take values 0.2, 0.25, 0.27, 0.3, 0.35. We resolve the problem to find optimal values of $q_0$, $q_1$, $q_2$, $r$ and $Ac$.

Table 5.2.3

Sensitivity Analysis Table by varying the parameter values of R ($\alpha_1 = 1$ and $\alpha_2 = 0$)

| R | $q_0$ | $q_1$ | $q_2$ | $r$ | $Ac$ |
|---|---|---|---|---|---|
| 0.2 | 7.1569 | 38.8006 | 37.8328 | 0.7931 | 10.3491 |
| 0.25 | 5.9543 | 36.2059 | 35.9327 | 0.6839 | 13.3476 |
| 0.27 | 5.2783 | 34.7194 | 33.8501 | 0.6182 | 15.3676 |
| 0.3 | 4.7821 | 31.9831 | 31.8471 | 0.5910 | 17.8729 |
| 0.35 | 4.3981 | 29.7651 | 29.6190 | 0.4817 | 22.4671 |

We see that as inflation rate $R$ increases values of $q_0$, $q_1$, $q_2$ and value of reorder quantity $r$ decreases and hence average cost increases.

(iv) To observe the effect of varying parameter values on the optimal solution, we have conducted sensitivity analysis by varying the value of inflation rate R keeping other parameter values fixed where ($\alpha_1 = 0$ and $\alpha_2 = 1$). Inflation rate $R$ is assumed to take values 0.2, 0.25, 0.27, 0.3, 0.35. We resolve the problem to find optimal values of $q_0$, $q_1$, $q_2$, $r$ and $Ac$.

Table 5.2.4

Sensitivity Analysis Table by varying the parameter values of R ($\alpha_1 = 0$ and $\alpha_2 = 1$)

| R | $q_0$ | $q_1$ | $q_2$ | $r$ | $Ac$ |
|---|---|---|---|---|---|
| 0.2 | 7.9361 | 37.4821 | 36.6301 | 0.7391 | 10.9795 |
| 0.25 | 5.8270 | 35.8218 | 34.8276 | 0.6930 | 12.8647 |
| 0.27 | 4.9591 | 33.9831 | 33.9921 | 0.6173 | 14.3109 |
| 0.3 | 4.1081 | 31.9484 | 31.7620 | 0.5929 | 18.4484 |
| 0.35 | 3.9831 | 29.9820 | 29.8320 | 0.4175 | 21.8953 |

We see that as inflation rate $R$ increases values of $q_0$, $q_1$, $q_2$ and value of reorder quantity $r$ decreases and hence average cost increases.

## 6. Conclusion

By comparing two cases that is when inflation rate is less than interest charged we conclude that the cost is minimum when account is settled at the credit time given by the $i^{th}$ supplier. So in this situation also businessmen are advised to settle the account at the credit time given by the respective suppliers. However when inflation rate is higher than interest charged we conclude that the cost is minimum when account is not settled at the credit time given by the $i^{th}$ supplier. So in this situation businessmen are advised not to settle the account at the end of the credit period but settle the account at the end of the cycle period. The reason for this is that once the inflation rate is greater than the interest rates charged, we actually see our debt wiped out by inflation. Debtors are benefitted by inflation due to the reduction of real value of debt burden.

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