Vol.1, No.2 **ISSN:2349-0012**

INNOVATIVE RESRARCH ORGANISATION

International Journal of Advance Research in Education Technology and Management
(Scholarly Peer Review Publishing System)

A stochastic inventory model with price and customer's credit- dependent demand rate under inflation for deteriorating/ameliorating items

Fatemeh Sadat Shafienejad [a], SaraNodoust[a], AbolfazlMirzazadeh[a]
[a]Department of Industrial Engineering, University of Kharazmi, Tehran, Iran,

Abstract
In this paper,the production inventory model is extended to allow not only for general partial backlogging rate but also for inflation. In reality, there are some items whose value, utility or quantity increase with time and those items can be termed as ameliorating. Also, deterioration of many items is usually observed during their normal storage period for damage, spoilage, dryness, vaporization, etc. Therefore, the model considered both ameliorating and deteriorating items.The developed model,also, implicate to finite production rate and finite time horizon.The demand rate is assumed to be a function of both price and the customer's credit period.Consequently,the paper deals with the problem of determining the optimal price,replenishment number and shortage period.The numerical examples are presented to illustrate the proposed models.
Keywords: Inventory;Trade credit; Stochastic; Inflation;Ameliorating;Deteriorating.

1. Introduction

Ameliorating occurs when the value or utility of a product increases overtime. The practical examples can be pickle manufacturing industry and fast growing animals like fish, broiler, sheep, pig, etc. in farming yard. The manufacturers purchase these livestockwhen they are small and raise them. The manufacturers treat these livestocks as the raw materials. When these livestockare kept in the farm, they will increase in value due to their growth, and decrease in value due to feeding expensesand/or diseases. When these livestock have grown up, the manufacturers use the matured livestock to produce thecooked livestock (finished goods). To be more realistic, the livestock's growth is faster in the beginning and declinesat the later stage. Hwang[12]developed a special case of inventory models for items withWeibull ameliorating and deteriorating rates. Mondal et al.[15]developed an inventory model of ameliorating items for a prescribed time period with price-dependent demand rate.

The problem of deteriorating items has received considerable attention in the recent years. These items (e.g., fruits, vegetables, pharmaceuticals, volatile liquids, and,etc.) deteriorate continuously due to evaporation, obsolescence, spoilage, etc. Ghare and Schrader [7] first derived a revised economic order quantity (EOQ) model by assuming exponential decay. Next, Covertand Philip [5] extended Ghare and Schrader's constant deterioration rate to a two-parameter Weibull distribution.Soleimani et al. [18] compared two methods for calculating the optimal total cost in an inventory model with time value of money and inflation for deteriorating items.

Fries [6] extended the EOQ model for a perishable commodity (as known as a deterioratingitem) with the fixed lifetime. Aggarwal [1] and Shah and Jaiswal [17] presented and re-established an orderlevel inventory model with a constant rate of deterioration. Thereafter, numerous works have been devoted to the inventory models with incorporating both the opposite physical characteristics. The model ofMoon et al[16], is worth mentioning in this direction. In these works, researchers considered inflationary inventory systems. Yang [21] studied an inventory model for deteriorating items under inflation.chern et al [3] developed a lot-size model under inflation for deteriorating items.Maity&Maiti[14]considered a multi objective optimal inventory model for deteriorating items under inflation.

The characteristic of the above-mentioned articles is that the unsatisfied demand(due to shortage) is completely backlogged. However, in reality, demands for foods, medicines, etc, are usually lost during the shortage period. Yang et al. [20]considered an inventory model under inflation for deteriorating items with partial backlogging shortages. Mostof the previous inventory management studies have considered variety of demand, such as stock-dependent demand, constant demand rate, time-varying demand rate,etc.

Nowadays, severely competitive business environment, entrepreneursare increasingly using trade credit to attract customers.As a result, trade credit plays an important role in modern businessoperation. Manufacturers tend to extend this benefit to customers byoffering a delayed payment period as well. To obtain deeperinsight into trade credit strategy and inventory policy, severalauthors have proposed various analytical models. Goyal [8]established an economic order quantity(EOQ) model with a constant demand rate under the condition ofpermissible delay in payments. More related articles can be foundin the work by Huang[11], Biskup et al. [2], Chung and Huang[4], Teng and Chang[19], Liao[13],Huang and Hsu[10], Ho[9]and,etc.

In this paper, we developed a stochastic inventory model in which (1)demand rate is related both to the product price and the credit period offered by the manufacturer to the costumers,(2) shortages are partial backlogging to reflected that longer the waiting time; the smaller the backlogging rate would be,(3) the inflation rate assumed stochastic with known pdfs over a finite planning horizon with finite production rate. The mentioned situations have not been considered simultaneously in the previous research.

The paper is organized as follows. Assumptions and notations are introduced in Section 2. Section3 discusses the mathematical model. In Section 4,we presented a numerical example. Finally, conclusions and some future research recommendations are given in Section 5.

2. The assumptions and notations

The following assumptions have been used in developing the model:

1. H is taken to be the constant time horizon.
2. The demand rate increased with the customer's credit period N and decreased with the selling price ω which in given by $D(N, \omega) = D_0 N^a \omega^{-b}$ where $D_0 > 0$ is a scaling factor, a>0 is a constant governing the increasing rate of the demand rate, and b > 1 is a price-elasticity coefficient. For notational simplicity, $D(N,\omega)$ and D will be used interchangeably in this paper.
3. The customers are assumed to be impatient and only a fraction B(t) of the demand during the stock-out period is backlogged where $(t_{j+1}-t)$ is the amount of time for which the customer waits before receiving goods and remaining fraction 1 - B(t) is lost. B (t) is given by $B(t) = \frac{k_0}{1+k_1 t}$; $0 < k_0 < 1$; $0 < k_1 < 1$. This is practical because as the waiting time of customers for receiving their goods increases, the backlogging rate decreases.
4. The lead-time is assumed to be negligible.
5. The production rate is finite and constant, greater than the demand rate and the number of units deteriorated per unit time.
6. The inventory system costs are known at the beginning of the time horizon and during this timewill be increased with the inflation rate.
7. The initial and the final inventory levels during the finite planning horizon are both zero.
8. When shortages are lost, the cost of lost sales is the sum of the revenue loss and the cost of lost goodwill. Note that the cost of lost goodwill varies with products and firms. Its value ranges from 0 to the estimated future profit per customer. Hence, the cost of lost sales here is greater than the unit purchase cost.
9. The inflation rate may be stochastic with the Uniform(u_1,u_2) pdf.

For convenience, the following notation is used throughout the entire of paper.

H	The time horizon
I(t)	The inventory level at time t
$D(N, \omega)$	The demand rate
α	A constant fractionof on-hand inventory ameliorates or deteriorates per unit of time. $(0 \le \alpha < 1)$
i	The inflation rate, which is varied by the social economic situations and the company operation status
C_o	The internal fixed purchasing cost per order
C_p	The external variable purchasing cost per unit
C_h	The inventory holding cost per unit per unit time
C_s	The backlogging cost per unit per unit time
C_l	The cost of lost sales per unit

C_{det} The deteriorating item's cost per unit
C_{ame} The ameliorating item's cost per unit, $C_{ame}<0$
kT Duration of inventory cycle when there is positive inventory
λ,Ψ,θ Interim time-span

3. The mathematical model

A typical behavior of the production-inventory in a cycle is depicted in fig.1. The time horizon, H, is divided into n equal cycle each of length T so that T=H/n. Each inventory cycle except the last cycle can be divided into four parts. The production starts with zero inventories at zero time. During λ time period, there is an inventory buildup and hence deterioration becomes effective. At $t_1=\lambda$, production stops which the inventory level achieves to the maximum level. After $t_1=\lambda$ there is no production and the inventory level decreases due to demand and deterioration rates. The inventory level becomes zero at $t_2=kT$. During time period of t_3,part of the shortage is backlogged and anotherpart is lost sales. Only the backlogged items are replaced in the next replenishment. At $t=\Psi$, the production starts again and the inventory level increases until the moment of T. In this moment, the second cycle starts and this behavior continues till the end of the (n-1)T. In the last cycle, shortages are not allowed and each inventory cycle can be divided into two parts. At $t=(n-1)T+\lambda$ production stops and then inventory level decreases until the end of the time horizon.

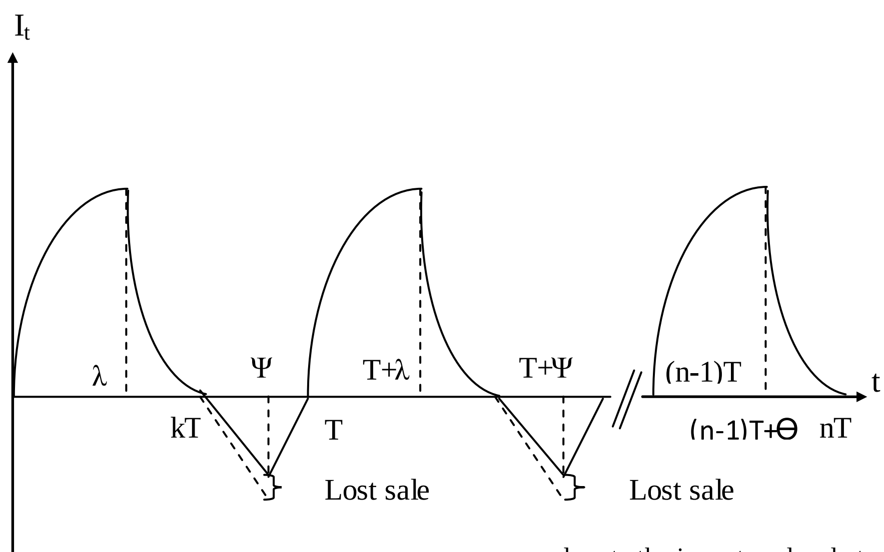

Figure 1.Graphical representation of the inventory system

Let $I_i(t_i)$ denote the inventory level at any time t_i in the ith part of cycle (i=1,2,3,4).Then, $I_i(t_i)$ are governed by the following differential equations:

$$\frac{dI_1(t_1)}{dt_1} = P - D - \alpha I_1(t_1) \qquad 0 < t_1 < \lambda \tag{1}$$

$$\frac{dI_2(t_2)}{dt_2} = -D - \alpha I_2(t_2) \qquad 0 < t_2 < kT - \lambda \tag{2}$$

$\frac{dI_3(t_3)}{dt_3} = -DB(\Psi - kT - t_3)$ $\quad 0 < t_3 < \Psi - kT$ (3)

$\frac{dI_4(t_4)}{dt_4} = P - D$ $\quad 0 < t_4 < T - \Psi$ (4)

In the last cycle, shortages are not allowed and the inventory level is governed by the following differential equations (i=5,6)

$\frac{dI_5(t_5)}{dt_5} = P - D - \alpha I_5(t_5)$ $\quad 0 < t < \theta$
(5)

$\frac{dI_6(t_6)}{dt_6} = -D - \alpha I_6(t_6)$ $\quad 0 < t < T - \theta$ (6) The solutions of the above differential equations after applying the following boundary conditions: $I_1(0)=0$, $I_2(kT-\lambda)=0$, $I_3(0)=0$, $I_4(T-\Psi)=0$, $I_5(0)=0$, $I_6(T-\theta)=0$, are

$I_1(t) = \frac{(e^{-\alpha t}-1)(D-P)}{\alpha} 0 < t_1 < \lambda$ (7)

$I_2(t) = -\frac{D(-e^{\lambda(t+kT)}+1)}{\alpha} 0 < t_2 < kT - \lambda$ (8)

$I_3(t) = \frac{Dk_0}{k_1}\log\left(\frac{1+k_1(\Psi-kT-t)}{1+k_1(\Psi-kT)}\right) 0 < t_3 < \Psi - kT$ (9)

$I_4(t) = (P-D)(t - T + \Psi) 0 < t_4 < T - \Psi$ (10)

$I_5(t) = \frac{(P-D)(1-e^{-t_5\alpha})}{\alpha} 0 < t < \theta$ (11)

$I_6(t) = \frac{-D(1-e^{(T-\gamma-t_6)\alpha})}{\alpha} 0 < t < T - \theta$ (12)

We can calculate Ψ ,λ,θ by using the above equations.Solving $I_1(\lambda) = I_2(0)$ for λ we have:

$$\lambda = \frac{-\ln[(e^{-\alpha kT}+1)\frac{D}{P-D}+1]}{\alpha} \quad (13)$$

Similarly Ψ and θ are:

$$\Psi = \frac{-P+D+Pk_1kT}{(-P+D)K_1} \quad (14)$$

$$\theta = \frac{1}{\alpha}\ln\left(\frac{P-D(1-e^{\alpha T})}{P}\right) \quad (15)$$

The total system costs over the time horizon for a given value of H, are including: ordering, holding, production, backordering, lost sale, deterioration and amelioration costs. As a result, we obtain the present value of the total ordering cost during H as:

$$c_o = c_o\left[1 + \sum_{j=0}^{n-1} e^{-R(jT+\Psi)}\right] \quad (16)$$

The present value of the total inventory holding cost during H is as follow:

$$c_h = \sum_{j=1}^{n-1} c_h \left[\int_0^{\lambda} \frac{(e^{-\alpha t}-1)(D-P)}{\alpha} e^{Rt_1} d_t + \int_0^{kT-\lambda} -\frac{D(-e^{-\alpha(t-kT+\lambda)}+1)}{\alpha} e^{-Rt_2} d_{t_2} e^{-\lambda R}\right] \times e^{-(j-1)RT} + c_h(\int_0^{\theta} \frac{P-D}{\alpha}(1 -$$

e−αte−Rtdte−Rn−1T+0T−θ−Dα(1−eαT−θ−t)e−tRe−Rn−1T+θ) (17)

The present value of the total inventory production (purchasing) cost during H is:

$$c_p = \sum_{j=1}^{n-1} c_p\left[\alpha e^{-(j-1)RT} + (T-\Psi)e^{-[\Psi+(j-1)T]R}\right] \quad (18)$$

The present value of the total inventory backordering cost during H is:

$$c_s = \sum_{j=1}^{n-1} c_s\left[\int_0^{\Psi-KT}\left[-\left(\frac{Dk_0\ln(1+k_1\Psi-k_1kT-k_1t)}{k_1} + \frac{Dk_0\ln(1+k_1\Psi-2k_1kT)}{k_1}\right)e^{-Rt_3}d_{t_3}e^{-KTR}\right] +$$

0T−Ψ(Dt+Dk0ln1+k1Ψ−k1kT−k1tk1−Pt−DT−Dk0ln1+k1Ψ−k1kT−k1Tk1+PT)e−Rt4dt4e−ΨR×e−j−1RT
(19)

The present value of the total inventory lost sale cost during H is:

$$C_{L_s} = \sum_{j=1}^{n-1} c_{l_s}\int_0^{\Psi-kT}\left[1 - \frac{k_0}{1+k_1.t}\right]De^{-Rt}e^{-(j-1)RT}d_t \quad (20)$$

The present value of the total inventory deterioration cost during H is:

c_{det} =
$\sum_{j=1}^{n-1} \alpha . c_{det} \left[\int_0^{\lambda} \frac{(e^{-\alpha t}-1)(D-P)}{\alpha} e^{Rt_1} d_t + \int_0^{kT-\lambda} - \frac{D(-e^{-\alpha(t-kT+\lambda)}+1)}{\alpha} e^{-Rt_2} d_{t_2} e^{-\lambda R}\right] \times e^{-(j-1)RT} + \alpha(c_h(\int_0^{\theta} \frac{P-D}{\alpha}(1-$
e−αte−Rtdte−Rn−1T+0T−θ−Dα(1−eαT−θ−t)e−tRe−Rn−1T+θ)) (21)

The present value of the total inventory ameliorated cost during H is:

$c_{ame} = \sum_{j=1}^{n-1} \alpha . c_{ame} \left[\int_0^{\lambda} \frac{(e^{-\alpha t}-1)(D-P)}{\alpha} e^{Rt_1} d_t + \int_0^{kT-\lambda} - \frac{D(-e^{-\alpha(t-kT+\lambda)}+1)}{\alpha} e^{-Rt_2} d_{t_2} e^{-\lambda R}\right] \times e^{-(j-1)RT} +$
$\alpha(c_h(\int_0^{\theta} \frac{P-D}{\alpha}(1-e^{-\alpha t})e^{-Rt} dt e^{-R(n-1)T} + \int_0^{T-\theta} \frac{-D}{\alpha}(1-e^{\alpha(T-\theta-t)})e^{-tR} e^{-R((n-1)T+\theta)}))$ (22)

The distribution of R is continuous uniform. Because of the R is stochastic parameter, we must calculate the expected present value (EPV) of those equations. Then we have:

$EPV\ (c_o) = c_o[1 + \sum_{j=0}^{n-1}(e^{-.07(jT+\Psi)} - e^{-.06(jT+\Psi)})/(.01(-jT-\Psi)]$ (23)

$EPV(c_p) = \sum_{j=1}^{n-1} c_p [\alpha(e^{-(j-1).07T} - e^{-(j-1).06T})/((-j+1).01T) + (T-\Psi)(e^{-[\Psi+(j-1)T].07} - e^{-[\Psi+(j-1)T].06})/$
$(-.01\Psi+j-1T)$ (24)

$EPV(c_h) =$
$\sum_{j=1}^{n-1} 100c_h \left[\int_{.06}^{.07}\int_0^{\lambda} \frac{(e^{-\alpha t}-1)(D-P)}{\alpha} e^{Rt} e^{-(j-1)RT} d_t d_R + \int_{.06}^{.07}\int_0^{kT-\lambda} - \frac{D(-e^{-\alpha(t-kT+\lambda)}+1)}{\alpha} e^{-Rt} d_t e^{-(j-1)RT} e^{-\lambda R} d_R\right] +$
$100c_h(\int_{.06}^{.07}\int_0^{\theta} \frac{P-D}{\alpha}(1-e^{-\alpha t})e^{-Rt} dt e^{-R(n-1)T} d_R + \int_{.06}^{.07}\int_0^{T-\theta} \frac{-D}{\alpha}(1-e^{\alpha(T-\theta-t)})e^{-tR} e^{-R((n-1)T+\theta)} d_t d_R)$ (25)

$EPV(c_s) = \sum_{j=1}^{n-1} 100 c_s \left[\int_{.06}^{.07}\int_0^{\Psi-KT}\left[(-\frac{Dk_0}{k_1}\log(\frac{1+k_1(\Psi-kT-t)}{1+k_1(\Psi-kT)}))e^{-Rt} d_t e^{-KTR}\right] e^{-(j-1)RT} d_R + \int_{.06}^{.07}\int_0^{T-\Psi}[(-P+\right.$
D(t− T+Ψ)e−Rtdte−ΨRe−j−1RTdR (26)

$EPV(C_{L_s}) = \sum_{j=1}^{n-1} 100c_{l_s} \int_{.06}^{.07}\int_0^{\Psi-kT}\left[1 - \frac{k_0}{1+k_1.t}\right] De^{-Rt} e^{-(j-1)RT} d_t d_R$ (27)

$EPV(c_{det}) =$
$\sum_{j=1}^{n-1} 100(\alpha.c_{det})\left[\int_{.06}^{.07}\int_0^{\lambda} \frac{(e^{-\alpha t}-1)(D-P)}{\alpha} e^{Rt} e^{-(j-1)RT} d_t d_R + \int_{.06}^{.07}\int_0^{kT-\lambda} - \frac{D(-e^{-\alpha(t-kT+\lambda)}+1)}{\alpha} e^{-Rt} d_t e^{-(j-1)RT} e^{-\lambda R} d_R\right] +$
$100(\alpha.c_{det})(\int_{.06}^{.07}\int_0^{\theta} \frac{P-D}{\alpha}(1-e^{-\alpha t})e^{-Rt} dt e^{-R(n-1)T} d_R + \int_{.06}^{.07}\int_0^{T-\theta} \frac{-D}{\alpha}(1-e^{\alpha(T-\theta-t)})e^{-tR} e^{-R((n-1)T+\theta)} d_t d_R)$(28)

$EPV(c_{ame}) =$
$\sum_{j=1}^{n-1} 100(\alpha.c_{ame})\left[\int_{.06}^{.07}\int_0^{\lambda} \frac{(e^{-\alpha t}-1)(D-P)}{\alpha} e^{Rt} e^{-(j-1)RT} d_t d_R + \int_{.06}^{.07}\int_0^{kT-\lambda} - \frac{D(-e^{-\alpha(t-kT+\lambda)}+1)}{\alpha} e^{-Rt} d_t e^{-(j-1)RT} e^{-\lambda R} d_R\right] +$
$100(\alpha.c_{ame})(\int_{.06}^{.07}\int_0^{\theta} \frac{P-D}{\alpha}(1-e^{-\alpha t})e^{-Rt} dt e^{-R(n-1)T} d_R + \int_{.06}^{.07}\int_0^{T-\theta} \frac{-D}{\alpha}(1-e^{\alpha(T-\theta-t)})e^{-tR} e^{-R((n-1)T+\theta)} d_t d_R)$(29)

Finally, the total expected present value of all of the system costs are

$TEPV = EPV\ (c_o) + EPV\ (c_p) + EPV\ (c_h) + EPV\ (c_s) + EPV\ (c_{ls}) + EPV\ (c_{det}) + EPV\ (c_{ame})$(30)

Some formulations have been used for simplifying the model and then, the solution is obtained by a solver in MATLAB source code.

4.Insights for Practitioners

The following numerical example is provided to clarify how the proposed model is applied. Let

Table 1.Data for numerical example

PARAMETERS	VALUS	UNIT
D_0	5000000	Unit/year
c_o	80	D/order
c_p	5	D/unit
c_{det}	8	D/unit /year
c_{ame}	−10	D/unit /year
H	10	year
c_{ls}	8	D/unit /year
c_h	0.4	D/unit /year

c_s	0.8	D/unit /year
P	5000	Unit/year
N	10	day
k_1	0.1	-
k_0	0.9	-
α	0.1	-
a	1.5	-
b	1.5	-
u_1	0.6	-
u_2	0.7	-

According to the above-mentioned values of the system parameters, the optimal solution is: $n^*=2$, $k^*=0.99$, $\omega^*=1.8 \times 10^8$ and $TC^* (n,k,\omega)=182.9$.

5. Conclusion

Astochastic inventory model is developed here with considering both ameliorating and deteriorating items, under stochastic inflation, partial backlogging and finite production rate. Although, many inventory researchers developed models with considering variable demands.We assumed that the demand rate is linked both to the price and the credit period.The contribution of this paper to the ameliorating/deteriorating items is to add this type of demand.We formulated the model as a nonlinear mixed integer programming problem to determine the optimal shortage period, number of production and the selling price. One of the future research directions is to extend the study to more general distributions forplanning horizon or other inventory policies (e.g., two-level trade credit). Moreover, in this paper, we assume that the price is a decision variable. It might be useful to employ other pricing policies (e.g., mark-up pricing).

Reference

[1] Aggarwal, S.P., "A note on an order level inventory model for a system with constant rate of deterioration", *Opsearch*, 15: 184–187, 1978.
[2] Biskup, D., Simons, D., and Jahnke, H.,"The effect of capital lockup and customer trade credits on the optimal lot size – a confirmation of the EPQ", *Computers& Operations Research*, 30: 1509-1524, 2003.
[3] Chern, M. S., Yang, H. L., Teng, J. T., Papachristos, S., "Partial backlogging inventory lot-size models for deteriorating items with fluctuating demand under inflation", *European Journal of Operational Research*,191: 127-141, 2008.
[4] Chung, K. J., and Huang, T. S., "The optimal retailer's ordering policies for deteriorating items with limited storage capacity under trade credit financing", *International Journal of Production Economics*, 106: 127–145, 2007.
[5] Covert, R.B., and Philip, G.S., "An EOQ model with Weibull distribution deterioration", *AIIE Transactions*, 5: 323–326, 1973.
[6] Fries, B.E., "Optimal ordering policy for a perishable commodity with fixed lifetime", *Operations Research*, 23 (1): 46–61, 1975.
[7] Ghare, P.M., Schrader, G.F., "A model for exponentially decaying inventory", *Journal of Industrial Engineering*, 15: 238–243, 1963.
[8] Goyal, S. K., "Economic order quantity under conditions of permissible delay in payments", *Journal of the Operational Research Society*, 36: 335–338, 1985.
[9] Ho. C., "The optimal integrated inventory policy with price-and-credit-linked demand under two-level trade credit", *Computers & Industrial Engineering*, 60: 117-126, 2011.
[10] Huang, Y. F., and Hsu, K. H., "An EOQ model under retailer partial trade credit policy in supply chain", *International Journal of Production Economics*, 112: 655–664, 2008.
[11] Huang, Y. F., "Optimal retailer's ordering policies in the EOQ model under trade credit financing", *Journal of the Operational Research Society*, 54: 1011–1015, 2003.
[12] Hwang, H.S., "Inventory models for both deteriorating and ameliorating items", *Computers and Industrial Engineering*, 37: 257–260, 1999.
[13] Liao, J. J., "An EOQ model with noninstantaneous receipt and exponentially deteriorating items under two-level trade credit", *International Journal of Production Economics*, 113: 852–861, 2008.
[14] Maity, K., Maiti, M., "A numerical approach to a multi-objective optimal inventory control problem for deteriorating multi-items under fuzzy inflation and discounting", *Computers and Mathematics with Applications*, 55: 1794-1807, 2008.

[15] Mondal, B., Bhunia, A.K., and Maiti, M., "An inventory system of ameliorating items for price dependent demand rate", *Computers and Industrial Engineering*, 45: 443–456, 2003.
[16] Moon, I., Giri, B., Ko, B., "Economic order quantity models for ameliorating/deteriorating items under inflation and time discounting", *European Journal of Operational Research*, 162: 773-785, 2005.
[17] Shah, Y.K., Jaiswal, M.C., "An order level inventory model for a system with constant rate of deterioration", *Opsearch*, 14: 174–184, 1997.
[18] Soleimani-Amiri, M., Nodoust, S., Mirzazadeh A., and Mohammadi, M., "The average annual cost and discounted cost mathematical modeling methods in the inflationary inventory systems- A comparison analysis", *SOP Transactions on applied Mathematics*, vol. 1, No. 1, 2013.
[19] Teng, J. T., and Chang, C. T., "Optimal manufacturer's replenishment policies in the EPQ model under two levels of trade credit policy", *European Journal of Operational Research*, 195: 358–363, 2009.
[20] Yang, H., Teng, J., Chern, M., "An inventory model under inflation for deteriorating items with stock-dependent consumption rate and partial backlogging shortages", *Int. J. Production Economics*, 123: 8-19, 2010.
[21] Yang, H., "Two-warehouse partial backlogging inventory models for deteriorating items under inflation", *Int. J. Production Economics*, 103: 362-370, 2006.