American Journal of Engineering Research (AJER)
e- ISSN: 2320-0847 p-ISSN : 2320-0936
Volume-02, Issue-09, pp-46-54
www.ajer.org

Research Paper Open Access

An Inflationary Inventory Model for Weibull Deteriorating Items with Constant Demand and Partial Backlogging Under Permissible Delay in Payments

Sushil Kumar, U. S .Rajput
Department of Mathematics & Astronomy, University of Lucknow Lucknow- 226007. U.P. India.

Abstract: - In this paper we developed a general inventory model for Weibull deteriorating items with constant demand under the consideration of time dependent partial backlogging and deterioration. Further it is illustrated with the help of numerical examples by minimizing the total variable inventory cost.

Keywords: - *Weibull-distribution, partial backlogging, inflation and permissible delay in payments.*

I. INTRODUCTION

Many mathematical models have been developed for controlling inventory and in the earlier models many researchers consider the constant demand rate which is a feature of static environment while the dynamic environment nothing is fixed or constant. So in most of the cases the demand for items increases with time and the items that are stored for future use always loose part of their value with passage of time. In inventory this phenomenon is known as deterioration of items. The rate of deterioration is very small in some items like hardware, glassware, toys and steel. The items such as medicine, vegetables, gasoline alcohol, radioactive chemicals and food grains deteriorate rapidly over time so the effect of deterioration of physical goods cannot be ignored in many inventory systems. The deterioration of goods is a realistic phenomenon in many inventory systems and controlling of deteriorating items becomes a measure problem in any inventory system. Due to deterioration the problem of shortages occurs in any inventory system and shortage is a fraction that is not available to satisfy the demand of the customers in a given period of time. The researchers have continuously modified the deteriorating inventory models so as to become more practicable and realistic. Dye [2002] developed an inventory model with partial backlogging and stock dependent demand. Chakrabarty et al. [1998] extended the Philip's model [1974]. Skouri and Papachristors [2003] determine an optimal time of an EOQ model for deteriorating items with time dependent partial backlogging. Manjusri Basu and Sudipta Sinha [2007] extended the Yan and Cheng model [1998] by considering time dependent backlogging rate. Rau et al. [2004] considered an inventory model for determining an economic ordering policy of deteriorating items in a supply chain management system. Teng and Chang [2005] determined an economic production quantity in an inventory model for deteriorating items. Dave and Patel [1983] considered an instantaneous replenishment policy for deteriorating items with time proportional demand and no shortage. Roychowdhury and Chaudhury [1983] considered an order level inventory model with finite rate of replenishment and allowing shortages. Mishra [1975], Dev and Chaudhuri [1986] assumed time dependent deterioration rate in their models. In this regard an extended summary was given by Raafat[1991]. Berrotoni [1962] discussed the difficulties of fitting empirical data to mathematical distributions. Covert and Philip [1973] developed an inventory model for deteriorating items by considering two parameters weibull distribution. Mandal and Phaujdar [1989] developed a production inventory model for deteriorating items with stock dependent demand and uniform rate of production. In this direction some valuable work was also done by Padmanabhan and Vrat [1995]. Ray and Chaudhuri [1997], Mondal and Moiti [1999], Biermans and Thomas [1997], Buzacoh [1975], Chandra and Bahner [1988], Jesse et al. [1983], Mishra [1979] developed their models and show the effect of inflation in inventory models by assuming a constant rate of inflation. Liao et al [2000] developed an inventory model for deteriorating items under inflation and discuss the effect of permissible delay in payment. Bhahmbhatt [1982] developed an EOQ model with price dependent inflation rate. Ray and Chaudhuri [1997] considered an EOQ model with shortages under the effect of inflation and time discount. Goyal [1985] developed an EOQ model under the conditions of permissible delay in payment. Chung et al [2002] and Hung [2003] considered an optimal replenishment policy for EOQ model under permissible delay in payments. Aggarwal and Jaggi [1995] extended the EOQ model with constant rate of deterioration. Hwang and Shinn [1997] determined the lot size policy for the items with exponential demand and permissible delay in payment. Chung and Hung [**2005**] developed an EOQ model in the presence of trade credit policy. Vinod kumar Mishra and Lal sahab singh [2010] developed an inventory model for deteriorating items with time dependent demand and partial backlogging. Mandal [2013] developed an inventory model for random deteriorating items with time dependent demand and partial backlogging. In the present paper we developed an inventory model for weibull deteriorating items with constant demand and time dependent partial backlogging.

II. ASSUMPTIONS AND NOTATIONS

we consider the following assumptions and notations

1. The demand rate D is constant.
2. The replenishment rate is instantaneous.
3. The inventory system involves only one item.
4. The deterioration rate is $\theta(t) = \alpha\beta\, t^{\beta-1}, where\ \ 0 < \alpha << 1 and\ \beta \geq 1.$
5. Shortages are allowed and backlogging rate is defined by $R(t) = \dfrac{D}{1+\delta(T-t)}$ where backlogging parameter δ is a positive constant.
6. I(t) is the inventory level at any time t.
7. I(0) is the stock level at the beginning of each cycle after fulfilling back orders.
8. H is the length of planning horizon.
9. r is the inflation rate.
10. $C(t) = c_0 e^{rT}$ is the unit purchase cost of an item at any time t.
11. c_2 is the shortage cost $ per unit per time.
12. c_3 is the ordering cost per cycle.
13. i_e is the interest earned $ per time.
14. i_p is the interest charged $ per time.
15. T is the cycle length.
16. M is the permissible delay in setting the account.
17. T_1 is the time at which shortages start.
18. $TC(T, T_1)$ is the average total inventory cost per unit time.

III. MATHEMATICAL FORMULATION

The instantaneous inventory level at any time t in $[0, T_1]$ is given by the differential equations

$$\frac{dI}{dt} + \alpha\beta t^{\beta-1} = -D, \quad 0 \leq t \leq T_1. \qquad \text{………} (1)$$

Where $0 < \alpha << 1\ and\ \ \beta \geq 1$

With the Boundary Condition $I(T_1) = 0$, ……….. (2)

Again the instantaneous inventory level at any time t in $[T_1, T]$ is given by the differential equation

$$\frac{dI}{dt} = -\frac{D}{1+\delta(T-t)}, \quad T_1 \leq t \leq T. \qquad \text{……….} (3)$$

With the Boundary Condition $I(T_1) = 0$, ……… (4)

The solution of equation (1) is

$$I(t) = D[1 - t - \alpha t^{\beta} + \frac{\alpha\beta t^{\beta+1}}{(\beta+1)} + \frac{\alpha T_1^{\beta+1}}{(\beta+1)}] \qquad \text{……….. } (5)$$

Neglecting the powers of α higher than one
And the solution of equation (3) is

$$I(t)=\frac{D}{\delta}[\log\{1+\delta(T-t)\}-\log\{1+\delta(T-T_1)\}], \quad \text{..........} (6)$$

The ordering cost is per unit time is

$$O_C=\frac{C_3}{T}[\sum_{n=0}^{m-1}C(nT)]$$

$$=\frac{C_3}{T}[C(0)+C(T)+C(2T)+........+C(n-1)T]$$

$$=\frac{C_0C_3}{T}(\frac{e^{rH}-1}{e^{rT}-1}), \quad \text{where H= nT}$$

$$\text{...............} (7)$$

The holding cost per unit time

$$H_C=\frac{h}{T}\sum_{n=0}^{m-1}C(nT)\int_0^{T_1}I(t)dt$$

$$=\frac{hDc_0}{T}(\frac{e^{rH}-1}{e^{rT}-1})[T_1-\frac{T_1^2}{2}-\frac{\alpha T_1^{\beta+1}}{(\beta+1)}+\frac{2\alpha T_1^{\beta+2}}{(\beta+2)}], \text{.........} (8)$$

The number of deteriorated units in $[0,T_1]$ are

$$= I(0) - \int_0^{T_1}Ddt$$

$$=D[1-T_1+\frac{\alpha T_1^{\beta+1}}{(\beta+1)}]$$

The deterioration cost per unit time is

$$D_C=DC_0(\frac{e^{rH}-1}{e^{rT}-1})[1-T_1-\frac{\alpha T_1^{\beta+1}}{(\beta+1)}], \text{............} (9)$$

The shortage cost per unit time

$$S_C=C_0C_2(\frac{e^{rH}-1}{e^{rT}-1})\int_{T_1}^{T}I(t)dt$$

$$=C_0C_2(\frac{e^{rH}-1}{e^{rT}-1})\int_{T_1}^{T}\frac{D}{\delta}[\log\{1+\delta(T-t)\}-\log\{1+\delta(T-T_1)\}]$$

$$=\frac{C_0C_2D}{\delta}(\frac{e^{rH}-1}{e^{rT}-1})[T_1-T+(1-T+\delta T)\log\{1+\delta(T-T_1)\}] \quad \text{.........} (10)$$

Now we consider the following two cases
Case I The permissible delay in payment say M is less than the period of inventory stock in hand say T_1
Case II The permissible delay in payment say M is greater than the period of inventory stock in hand say T_1
Case I Since the permissible delay in payment say M is less than the period of on hand inventory stock say T_1 i.e $M<T_1$ (payment before depletion), Then the interest earned per unit time in $[0,T_1]$ is

$$IE_1=\frac{i_e}{T}\sum_{n=0}^{m-1}C(nT)\int_0^{T_1}(T_1-t)Ddt$$

$$=\frac{Di_eC_0}{T}(\frac{e^{rH}-1}{e^{rT}-1})\frac{T_1^2}{2} \quad , \text{...........} (11)$$

The interest payable per cycle per unit time for the inventory not being sold after due date say M is

$$IP_1 = \frac{i_p}{T}\sum_{n=0}^{m-1} C(nT)\int_M^{T_1} I(t)dt$$

$$= \frac{Di_pC_0}{T}\left(\frac{e^{rH}-1}{e^{rT}-1}\right)[T_1 - M - \frac{(T_1^2 - M^2)}{2} - \frac{\alpha(1+M)T_1^{\beta+1}}{(\beta+1)} + \frac{\alpha M^{\beta+1}}{(\beta+1)}$$

$$+\frac{2\alpha T_1^{\beta+2}}{(\beta+2)} - \frac{\alpha\beta M^{\beta+2}}{(\beta+1)(\beta+2)}], \quad \text{……….} (12)$$

Therefore the average total variable cost per unit time is

$$TC(T,T_1) = \frac{1}{T}[O_C + H_C + D_C + S_C + IP_1 - IE_1]$$

$$= \frac{C_0}{T}\left(\frac{e^{rH}-1}{e^{rT}-1}\right)[C_3 + hD\{T_1 - \frac{T_1^2}{2} - \frac{\alpha T_1^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)}\} + D\{1 - T_1 + \frac{\alpha T_1^{\beta+1}}{(\beta+1)}\}$$

$$+\frac{C_2 D}{\delta}\{T_1 - T + (1 - T + \delta T)\log\{1+\delta(T-T_1)\}\} + Di_p\{T_1 - M - \frac{(T_1^2 - M^2)}{2}$$

$$-\frac{\alpha(1+M)T_1^{\beta+1}}{(\beta+1)} + \frac{\alpha M^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)} - \frac{\alpha\beta M^{\beta+2}}{(\beta+1)(\beta+2)}\} - \frac{Di_eT_1^2}{2}], \quad \text{……….} (13)$$

For the minimization of $TC(T,T_1)$, $\frac{\partial TC(T,T_1)}{\partial T} = 0 \ and \ \frac{\partial TC(T,T_1)}{\partial T_1} = 0$ Give the values of T=T*for which

$$\left(\frac{\partial^2 TC(T,T_1)}{\partial T^2}\right)\left(\frac{\partial^2 TC(T,T_1)}{\partial T_1^2}\right) - \frac{\partial^2 TC(T,T_1)}{\partial T\partial T_1} > 0, and \quad \frac{\partial^2 TC(T,T_1)}{\partial T^2} > 0, \forall T = T^*$$

Case II Since the permissible delay in payment say M is greater than the period of on hand inventory stock say T_1 i.e $M > T_1$ (payment after depletion),then the interest payable per unit time per cycle is zero for $T < M < T_1$, because the supplier paid in full at M so the interest earned per unit time per cycle is

$$IE_2 = \frac{i_eC_0}{T}\left(\frac{e^{rH}-1}{e^{rT}-1}\right)[\int_0^{T_1}(T_1 - t)Ddt + (M - T_1)\int_0^{T_1} Ddt]$$

$$= \frac{C_0Di_e}{T}\left(\frac{e^{rH}-1}{e^{rT}-1}\right)[MT_1 - \frac{T_1^2}{2}], \quad \text{………..} (14)$$

Therefore the average total variable cost per unit time is

$$TC(T,T_1) = \frac{C_0}{T}\left(\frac{e^{rH}-1}{e^{rT}-1}\right)[C_3 + hD\{T_1 - \frac{T_1^2}{2} - \frac{\alpha T_1^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)}\} + D\{1 - T_1 + \frac{\alpha T_1^{\beta+1}}{(\beta+1)}\}$$

$$+\frac{C_2 D}{\delta}\{T_1 - T + (1 - T + \delta T)\log\{1+\delta(T-T_1)\}\} - Di_e(MT_1 - \frac{T_1^2}{2})] \quad \text{………..} (15)$$

For the minimization of the $TC(T,T_1)$, $\frac{\partial TC(T,T_1)}{\partial T} = 0 \ and \ \frac{\partial TC(T,T_1)}{\partial T_1} = 0$ give the values of T = T* for which $\left(\frac{\partial^2 TC(T,T_1)}{\partial T^2}\right)\left(\frac{\partial^2 TC(T,T_1)}{\partial T_1^2}\right) - \frac{\partial^2 TC(T,T_1)}{\partial T\partial T_1} > 0, and \quad \frac{\partial^2 TC(T,T_1)}{\partial T^2} > 0, \forall T = T^*$

IV. THEORETICAL RESULTS

For a I st order approximation of $e^{rT} = 1 + rT$ and $e^{rH} = 1 + rH$

Then from equation (13)

$$TC(T,T_1) = \frac{C_0 H}{T^2}[C_3 + hD\{T_1 - \frac{T_1^2}{2} - \frac{\alpha T_1^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)}\} + D\{1 - T_1 + \frac{\alpha T_1^{\beta+1}}{(\beta+1)}\}$$

$$+ \frac{C_2 D}{\delta}\{T_1 - T + (1 - T + \delta T)\log\{1 + \delta(T - T_1)\}\} + Di_p\{T_1 - M - \frac{(T_1^2 - M^2)}{2} - \frac{\alpha(1+M)T_1^{\beta+1}}{(\beta+1)}$$

$$+ \frac{\alpha M^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)} - \frac{\alpha\beta M^{\beta+2}}{(\beta+1)(\beta+2)}\} - Di_e \frac{T_1^2}{2}], \quad \text{............ (16)}$$

$$\frac{\partial TC(T,T_1)}{\partial T} = -\frac{2C_0 H}{T^3}[C_3 + hD\{T_1 - \frac{T_1^2}{2} - \frac{\alpha T_1^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)}\} + D\{1 - T_1 + \frac{\alpha T_1^{\beta+1}}{(\beta+1)}\}$$

$$+ \frac{C_2 D}{\delta}\{T_1 - T + (1 - T + \delta T)\log\{1 + \delta(T - T_1)\}\} + Di_p\{T_1 - M - \frac{(T_1^2 - M^2)}{2} - \frac{\alpha(1+M)T_1^{\beta+1}}{(\beta+1)}$$

$$+ \frac{\alpha M^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)} - \frac{\alpha\beta M^{\beta+2}}{(\beta+1)(\beta+2)}\} - \frac{Di_e T_1^2}{2}] + \frac{C_0 H}{T^2}[\frac{C_2 D}{\delta}\{-1 + (\delta - 1)\log\{1 + \delta(T - T_1)\}$$

$$+ \frac{(1 - T + \delta T)\delta}{(1 + \delta(T - T_1)}\}] \quad \text{............ (17)}$$

$$\frac{\partial TC(T,T_1)}{\partial T_1} = \frac{C_0 HD}{T^2}[\{1 + \delta(T - T_1)\}\{(h - 1 + \frac{C_2}{\delta} + i_p) - (h + i_p + i_e)T_1 + \{1 - h - i_p(1+M)\}\alpha T_1^{\beta}$$

$$+ 2\alpha(h + i_p)T_1^{\beta+1}\} - C_2(1 - T + \delta T)], \quad \text{............... (18)}$$

$$\frac{\partial^2 TC(T,T_1)}{\partial T^2} = \frac{6C_0 H}{T^4}[C_3 + hD\{T_1 - \frac{T_1^2}{2} - \frac{\alpha T_1^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)}\} + D\{1 - T_1 + \frac{\alpha T_1^{\beta+1}}{(\beta+1)}\}$$

$$+ \frac{C_2 D}{\delta}\{T_1 - T + (1 - T + \delta T)\log\{1 + \delta(T - T_1)\} + Di_p\{T_1 - M - \frac{(T_1^2 - M^2)}{2}$$

$$- \frac{\alpha(1+M)T_1^{\beta+1}}{(\beta+1)} + \frac{\alpha M^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)} - \frac{\alpha\beta M^{\beta+2}}{(\beta+1)(\beta+2)}\} - \frac{Di_e T_1^2}{2}]$$

$$- \frac{2C_0 H}{T^3}[\frac{C_2 D}{\delta}\{-1 + (\delta - 1)\log\{1 + \delta(T - T_1)\} + \frac{(1 - T + \delta T)\delta}{1 + \delta(T - T_1)}]$$

$$+ \frac{C_0 H}{T^2}[\frac{C_2 D}{\delta}\{\frac{\delta(\delta - 1)}{1 + \delta(T - T_1)} - \frac{\delta(1 - \delta T_1 + \delta^2 T_1)}{\{1 + \delta(T - T_1)\}^2}\}], \quad \text{.............. (19)}$$

From the equation (15)

$$TC(T,T_1) = \frac{C_0 H}{T^2}[C_3 + hD\{T_1 - \frac{T_1^2}{2} - \frac{\alpha T_1^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)}\} + D\{1 - T_1 + \frac{\alpha T_1^{\beta+1}}{(\beta+1)}\}$$

$$+\frac{C_2 D}{\delta}\{T_1 - T + (1 - T + \delta T)\log\{1+\delta(T-T_1)\}\} - Di_e(MT_1 - \frac{T_1^2}{2})]$$

…………. (20)

$$\frac{\partial TC(T,T_1)}{\partial T} = \frac{-2C_0 H}{T^3}[C_3 + hD\{T_1 - \frac{T_1^2}{2} - \frac{\alpha T_1^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)}\} + D\{1 - T_1 + \frac{\alpha T_1^{\beta+1}}{(\beta+1)}\} + \frac{C_2 D}{\delta}\{T_1 - T$$

$$+(1 - T + \delta T)\log\{1+\delta(T-T_1)\}\} - Di_e(MT_1 - \frac{T_1^2}{2})]$$

$$+\frac{C_0 H}{T^2}[\frac{C_2 D}{\delta}\{-1 + (\delta - 1)\log\{1+\delta(T-T_1)\} + \frac{(1-T+\delta T)\delta}{1+\delta(T-T_1)}\}], \quad \text{……… (21)}$$

$$\frac{\partial TC(T,T_1)}{\partial T_1} = \frac{C_0 H}{T^2}[hD\{1 - T_1 - \alpha T_1^{\beta} + 2\alpha T_1^{\beta+1}\} + D\{-1 + \alpha T_1^{\beta}\} + \frac{C_2 D}{\delta}\{1 - \frac{(1-T+\delta T)\delta}{1+\delta(T-T_1)}\}$$

$$-Di_e(M - T_1)]$$

…………….. (22)

$$\frac{\partial^2 TC(T,T_1)}{\partial T^2} = \frac{6C_0 H}{T^4}[C_3 + hD\{T_1 - \frac{T_1^2}{2} - \frac{\alpha T_1^{\beta+1}}{(\beta+1)} + \frac{2\alpha T_1^{\beta+2}}{(\beta+2)}\} + D\{1 - T_1 + \frac{\alpha T_1^{\beta+1}}{(\beta+1)}\} + \frac{C_2 D}{\delta}\{T_1 - T$$

$$+(1 - T + \delta T)\log\{1+\delta(T-T_1)\}\} - Di_e(MT_1 - \frac{T_1^2}{2})]$$

$$-\frac{2C_0 H}{T^3}[\frac{C_2 D}{\delta}\{-1 + (\delta - 1)\log\{1+\delta(T-T_1)\} + \frac{(1-T+\delta T)\delta}{1+\delta(T-T_1)}\}]$$

$$-\frac{2C_0 H}{T^3}[\frac{C_2 D}{\delta}\{-1 + (\delta - 1)\log\{1+\delta(T-T_1)\} + \frac{(1-T+\delta T)\delta}{1+\delta(T-T_1)}\}]$$

$$+\frac{C_0 H}{T^2}[\frac{C_2 D}{\delta}\{\frac{\delta(\delta-1)}{1+\delta(T-T_1)} - \frac{\delta(1-\delta T_1 + \delta^2 T_1)}{\{1+\delta(T-T_1)\}^2}], \quad \text{………. (23)}$$

Numerical example: Let us consider the following parameters in the appropriate unit as

$[\alpha, \beta, \delta, C_0, C_2, C_3, i_e, i_p, h, D, M]$ = [0.005, 1, 5.0, 0.5, 0.8, 50, 0.10, 0.20, 2.0, 500, 0.2]

And H= 0.08219(1 year)

Case I Payment before depletion

Table 1

	Change in Parameters	T	T_1	TC
α	0.005	0.24283 0.88262 66.4718	0.139305 1.45469 103.7260	472.3465 -41.9297 -56.0082
	0.010	0.24282 0.89116 32.9398	0.13923 1.46777 51.4409	472.38169 -42.2403 -56.2829
	0.020	0.242804 0.909455 16.1603	0.13907 1.49582 25.2773	472.46852 -42.8623 -56.2592

β	1.00	0.24283 0.88262 66.4718	0.139305 1.45469 103.7260	472.3465 -41.9297 -56.0082
	2.00	0.242836 0.88582 6.15291	0.139372 1.45999 9.76629	472.3078 -42.2045 -66.6267
	3.00	0.24294 0.953874 8.7476 66.3587	0.139987 1.57309 11.9131 68.4851	471.86770 -48.49855 211.062950 28974.3164
M	0.2	0.24283 0.88262 66.4718	0.13931 1.45469 103.7260	472.3465 -41.9297 -56.0082
	0.4	0.23822 0.87729 66.5374	0.13824 1.4497 103.7340	477.9967 -42.6808 -55.8870
δ	5.00	0.24283 0.88262 66.4718	0.139305 1.45469 103.7260	472.3465 -41.9297 -56.0082
	8.00	0.15471 0.79988 58.25610	0.06497 1.50021 103.6180	1096.8469 -107.0528 -113.56188

Increase in the parametric values of α, M and δ also increases the value of TC.

Increase in the parametric values of β also decreases the value of TC.

Case II Payment after depletion

Table II

	Change in Parameters	T	T_1	TC
α	0.005	0.06883 135.940	0.35403 95.4690	4695.0255 16.5064
	0.010	0.06895 68.2756	0.35405 47.9690	4679.9299 16.62630
	0.020	0.06918 34.44205	0.35408 24.2191	4667.21736 16.8667
β	1.00	0.06883 135.940	0.35403 95.4690	4695.0255 16.5064
	2.00	0.06876 14.3009	0.35402 9.98745	4705.4034 16.43740
	3.00	0.06873 6.76414	0.35402 4.72757	4708.8323 17.38170
M	0.2	0.06883 135.940	0.35403 95.4690	4695.0255 16.5064
	0.4	0.06289 135.9350	0.35196 95.4646	5596.9645 16.5045
δ	5.00	0.06883 135.940	0.35403 95.4690	4695.0255 16.5064
	8.00	0.08539 129.0880	0.29330 95.4319	2989.09957 2.65941

Increase in the parametric values of β and M also increases the valves of TC.

Increase in the parametric values of α and δ also decreases the value of TC.

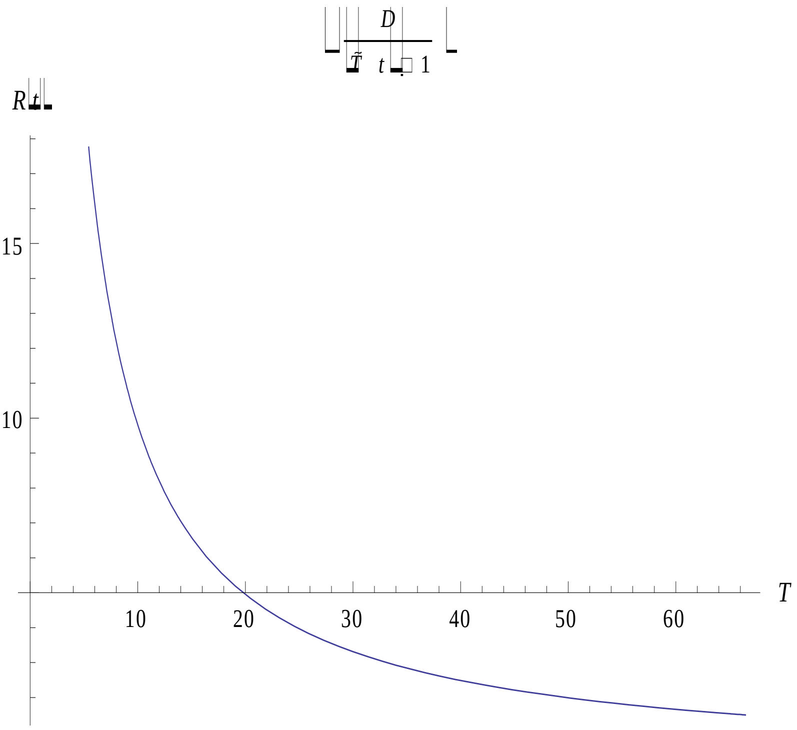

Figure I Backlogging rate at t=0, with respect to α

V. CONCLUSION

In the present paper we developed an inflationary inventory model for Weibull deteriorating items with constant demand and time dependent partial back-logging. We discussed the model by considering two cases namely case I payment before depletion and case II payment after depletion. We make a decision to determine the optimum cycle time for minimizing the total average inventory cost. From the table I it is obvious that the increases in the deterioration parameters α, M and δ also increase the total variable inventory cost and increases in the deterioration parameter β also decrease the total variable cost. From the table II it is obvious that the increases in the deterioration parameters β and M also increase the total variable cost and increases in the deterioration parameters α and δ also decrease the total variable inventory cost. From these results it is obvious as we increase the time of permissible delay in payment then the total variable inventory cost increases and the purchaser earn more by investing the resources.

REFERENCES

[1] Aggarwal, S.P. and Jaggi, C.K. (1995), Ordering policies of deteriorating items under permissible delay in payments. Journal of Operational Research Society 46, 658-662.

[2] Berrotoni, J.N. (1962) Practical Applications of Weibull distribution. ASQC. Tech. Conf. Trans. 303-323.

[3] Biermans, H. and Thomas, J. (1977) Inventory decisions under inflationary conditions. Decision Sciences 8, 151-155.

[4] Buzacott, J.A. (1975) Economic order quantities with inflation. Operational Research Quarterly 26, 1188-1191.

[5] Bhahmbhatt, A.C. (1982) Economic order quantity under variable rate inflation and mark-up prices. Productivity 23, 127-130.

[6] Chakrabarty, T., Giri, B.C. and Chaudhuri, K.S. (1998) An EOQ model for items with weibull distribution deterioration, shortages and trended demand. An extension of Philip's model Computers and Operations Research 25, (7/8), 649-657.

[7] Chandra, J.M. and Bahner, M.L. (1988) The effects of inflation and the value of money or some inventory systems. International Journal of Production Economics 23, (4) 723-730.

[8] Chung, K.J., Huang, Y.F. and Huang, C.K. (2002) The replenishment decision for EOQ inventory model under permissible delay in payments. Opsearch 39, 5 & 6, 327-340.

[9] Chung, K.J. and Huang, T-S. (2005) The algorithm to the EOQ model for Inventory control and trade credit. Journal of Operational Research Society 42, 16-27.

[10] Chung, K.J. and Hwang, Y.F. (2003) The optimal cycle time for EOQ inventory model under permissible delay in payments. International Journal of Production Economics 84, 307-318.

[11] Covert, R.P. and Philip, G.C. (1973) An EOQ model for deteriorating items with weibull distributions deterioration. AIIE Trans 5, 323-332.

[12] Dave, U. and Patel, L.K. (1983) (T.So.) policy inventory model for deteriorating items with time proportional demand. J. Opl. Res. Soc. 20, 99-106.

[13] Deb, M. and Chaudhuri K.S. (1986) An EOQ model for items with finite of production and variable rate of deterioration. Opsearch 23, 175-181.

[14] Dye, C.Y. (2002) a deteriorating inventory model with stock dependent demand and partial backlogging under condition of permissible delay in payments. Opsearch 39, (3 & 4).

[15] Goyal, S.K. (1985) Economic order quantity under conditions of permissible delay in payments. Journal of Operational Research Society 36, 335-338.

[16] Hwang, H. Shinn, S.W. (1997) Retailer's pricing and lot sizing policy for exponentially deteriorating products under condition of permissible delay in payments. Computers and Operations research 24, 539-547.

[17] Jamal, A.M. , Sarkar, B.R. and Wang, S. (1997) An ordering policy for deteriorating items with allowable shortage and permissible delay in payment. Journal of Operational Research Society 48, 826-833.

[18] Jesse, R.R., Mitra, A. and Cox, J.F. (1983) EOQ formula : Is it valid under inflationary conditions? Decision Sciences 14(3), 370-374.

[19] Liao, H.C., Tsai, C.H. and SU, C.T.(2000) An inventory model with deteriorating items under inflation when a delay in payment is permissible. International Journal of Production Economics 63, 207-214.

[20] Mandal, B.N. and Phaujdar, S. (1989) An inventory model for deteriorating items and stock dependent consumption rate. Journal of Operational Research Society 40, 483-488.

[21] Mishra, R.B. (1975) Optimum production lot- size model for a system with deteriorating inventory. Int. J. Prod. Res. 13, 161-165.

[22] Mondal, M. and Motti, M. (1999) Inventory of damageable items with variable replenishment rate, stock dependent demand and some units in hand. Applied Mathematical Modeling 23, 799-807.

[23] Mishra, V.K. and Singh, L.S. (2010) Deterministic inventory model for deteriorating items with shortage and partial backlogging Applied Mathematical Sciences 4, no-72, 3611-3619.

[24] Mandal, Biswarajan (2013) Inventory model for random deteriorating items with a linear trended in demand and partial backlogging. 2(3), 48-52.