IOSR Journal of Mathematics (IOSR-JM)
e-ISSN: 2278-5728, p-ISSN: 2319-765X. Volume 12, Issue 4 Ver. IV (Jul. - Aug.2016), PP 87-92
www.iosrjournals.org

An EOQ Model with Polynomial of Nth Degree Demand Rate, Constant Deterioration, Linear Holding Cost and Without Shortages under Inflation

Vijay Singh Rajput[1], Yogesh Kumar[2]Amit Kumar vats[3], Ranjeet Kaur[4]
[1,2] *(OPJS University department of mathematics, Churu, Rajasthan)*
[3,4] *(ABES Institute of Technology Ghaziabad, UP)*

Abstract : *In existing literature the inventory models are developed under the assumption of demand rate to be constant or linear or quadratic. In this paper, an inventory model is developed where demand rate is generalized as a polynomial of nth degree with constant deterioration rate. The holding cost is a linear function of time. Shortages are not allowed. A numerical example has been illustrated using MATLAB to describe the model and the sensitivity analysis of various parameters is carried out with graphical and tabular data.*

Keywords: *Constant deterioration; Demand rate is a polynomial of nth degree; Inflation; Inventory; Time dependent holding cost*

I. Introduction

Agrawal, R. (2009) developed the inventory model for integrated inventory system with the effect of inflation and credit period. **Amutha R. et al (2013)** worked on a model for constant demand with shortages under permissible delay in payments. **He, Y. et al (2010)** gave optimal production-inventory model for deteriorating items with multiple-market and **Hou, K.L. et al (2009)** developed the model the cash flow oriented EOQ model with deteriorating items under permissible delay in payments. **Hung, K. (2011)** discussed in inventory model with generalized type demand, deterioration and backorder. **Jaggi, C.K. et al (2008)** proposed a model for Retailer's optimal replenishment decisions with credit-linked demand under permissible delay in payment. **Jain S. et al (2008)** worked on a model with inventory level-dependent demand rate, deterioration, partial backlogging and decrease in demand and **Khanr. S et al (2011)** gave the idea of production model for a deteriorating item with shortage and time- dependent demand. **Kumar Arya. et al (2012)** developed a model for deteriorating items with time dependent demand and partial backlogging and **Kumar M. et al (2012)** gave the idea of deterministic model for deteriorating items with price dependent demand and time varying holding cost under trade credi, issue-1. **Liao, J. (2008)** developed an EOQ model with non instantaneous receipt and exponential deteriorating item under two-level trade credit and **Mahata, G.C. et al (2009)** worked on Optimal retailer's ordering policies in the EOQ model for deteriorating items under trade credit financing in supply chain. **Mandal B. N. et al (1989)** proposed an inventory model for deteriorating items and stock-dependent consumption rate and **Mandal, B. (2010)** developed an EOQ inventory model for Weibull distributed deteriorating items under ramp type demand and shortages. **Meher, M. K. et al (2012)** proposed model with weibull deterioration rate under the delay in payment in demand decling market and **Mishra U. K. et al (2011)** worked on model for weibull deteriorating items with permissible delay in payments under inflation. **Mishra, V. et al (2011**) gave model for ramp type demand, time dependent deteriorating items with salvage value and shortages. **Mishra S. et al (2012)** studied EOQ model with power demand of deteriorating items under the Influence of Inflation and **Ouyang, L.Y. et al (2008)** developed an economic order quantity model for deteriorating items with partially permissible delay in payments linked to order quantity. **Ouyang, L.Y. et al (2009)** proposed an economic order quantity model for deteriorating items with partially permissible delay in payments linked to order quantity. **Panda, S. et al (2008)** discussed an Optimal replenishment policy for perishable seasonal products in a season with ramp-type time dependent demand **Pareek, S. et al (2009)** developed an inventory model for time dependent deteriorating item with salvage value and shortages and **Patra, S.K. et al (2010)** discussed an order level EOQ model for deteriorating items in a single warehouse system with price dependent demand in non-linear (quadratic) form and **Soni, H. et al (2010)** gave inventory models and trade credit a review". **Skouri, K. et al (2009)** developed Inventory models with ramp type demand rate, partial backlogging and weibull deterioration rate and **Singh T. et al (2012)** discussed an eoq model for a deteriorating item with time dependent exponentially declining demand under permissible delay in payment **Tripathi R.P. et al (2010)** A Cash flow oriented EOQ model under permissible delay in payments. **Tripathi R.P., (2011)** worked on Optimal pricing and ordering policy for inflation dependent demand rate under permissible delay in payments .**Tripathy, C. K. et al (2010)** discussed ordering policy for weibull deteriorating items for quadratic demand with permissible delay in payments **Tripathi, R.P. et al (2011)**

proposed an inventory model with shortage, time- dependent demand rate and quantity dependent permissible delay in payment **Tripathi, R.P. et al (2010)** gave credit financing in economic ordering policies of non-deteriorating items with time-dependent demand rate **Tripathy P.K, et al (2011)** discussed an integrated partial backlogging model having weibull demand and variable deterioration rate with the effect of trade credit **Yadav R. K. et al (2014)** discussed deteriorating inventory model for quadratic demand and constant holding cost with partial backlogging and inflation **Yadav R. K et al (2015)** also proposed An Inventory model for variable demand, constant holding cost and without shortages **Yadav, R.K et al (2013).**

The rest of this paper is organized as follows. Section II describes the assumptions used throughout this paper. In section III notations used in paper are listed. The mathematical formulation is given in section IV. Section V describes the mathematical solution of the problem formulated in section IV. The algorithm of the solution is provided in section VI. Concluding remarks and suggestions for future research are provided in Section VII while a numerical solution is mentioned in section VIII.

II. Assumptions

The following assumptions are made in developing the model.

- The inventory system considers a single item only.
- The demand rate is deterministic and a polynomial of n^{th} degree is time dependent.
- The deterioration rate is constant.
- The inventory system is considered over a finite time horizon.
- Holding cost is time dependent linear function $(p+qt)$
- Lead time is zero.
- Shortages are not allowed.

III. Notations

The following notations use for inventory model.

A :	Setup cost.
$D(t)$:	A polynomial of n^{th} degree in a period [0,T]
θ :	Deteriorating cost is constant.
Qo :	Initial ordering quantity
TD :	Total demand in a cycle period [0, T]
DU :	Deteriorating unit in a cycle period [0, T]
C_d :	Deteriorating cost per unit
DC :	Deteriorating cost
HC :	Holding cost
$TC(T)$:	Total inventory cost
T^* :	Optimal length size
Q_0^* :	Optimal initial order quantity
$TC^*(T^*)$:	Optimal total cost in the period [0, T]

IV. Mathematical Formulation

Consider the inventory model of constant deteriorating items with demand rate is a polynomial of n^{th} degree. As the inventory reduces due to demand rate as well as deterioration rate during the interval, the differential representing the inventory status is governed by [0,T]

$$\frac{dI(t)}{dt}+\theta I(t)=-D(t)\,,0\le t\le T \qquad (1)$$

$D(t)=\sum_{i=0}^{n}a_i t^i$, where $a_0,\ a_1,\ a_2,$ ……….. a_n, are n^{th} constants and $a_n\neq 0,$.

V. Mathematical Solution

The solution with boundary condition $I(T)=0$, of the Equation

$$\frac{dI(t)}{dt}+\theta I(t)=-\sum_{i=0}^{n}a_i t^i\,,0\le t\le T \qquad (2)$$

$$I(t)=\sum_{i=0}^{n}a_i\left[\frac{T^{i+1}-t^{i+1}}{i+1}+\theta\frac{T^{i+2}-t^{i+2}}{i+2}+\theta^2\frac{T^{i+3}-t^{i+3}}{i+3}\right]e^{-\theta t} \qquad (3)$$

Where use the expansion $e^{-\alpha t}\approx 1-\alpha t+\frac{(\alpha t)^2}{2}$ ..., α is small and positive.

So the initial order quantity is obtained by putting the boundary condition in Equation (3) $I(0)=Q_0$. Therefore,

$$Q_0=\sum_{i=0}^{n}a_i\left[\frac{T^{i+1}}{i+1}+\theta\frac{T^{i+2}}{i+2}+\theta^2\frac{T^{i+3}}{i+3}\right] \qquad (4)$$

The total demand during the cycle period [0, T] is

$$TD=\int_0^T D(t)dt$$

$$=\int_0^T\sum_{i=0}^{n}a_i t^i dt$$

$$=\sum_{i=0}^{n}a_i\frac{T^{i+1}}{i+1} \qquad (5)$$

Then the number of deterioration units is

$$DU=Q_0-TD$$

$$=-\sum_{i=0}^{n}a_i\left[\theta\frac{T^{i+2}}{i+2}+\theta^2\frac{T^{i+3}}{i+3}\right] \qquad (6)$$

The deterioration cost for the cycle [0, T]

$DC=C_d$ * (Number of deterioration units)

$$=-C_d\sum_{i=0}^{n}a_i\left[\theta\frac{T^{i+2}}{i+2}+\theta^2\frac{T^{i+3}}{i+3}\right] \qquad (7)$$

Holding Cost for the cycle [0,T] is

$$HC=\int_0^T(p+qt)e^{-rt}I(t)dt$$

$$=\int_0^T(p+qt)e^{-rt}e^{-\theta t}\sum_{i=0}^{n}a_i\left[\frac{T^{i+1}-t^{i+1}}{i+1}+\theta\frac{T^{i+2}-t^{i+2}}{i+2}+\theta^2\frac{T^{i+3}-t^{i+3}}{i+3}\right]dt$$

$$=\sum_{i=0}^{n}a_i\int_0^T(p+qt)[1-(r+\theta)t]\left[\frac{T^{i+1}-t^{i+1}}{i+1}+\theta\frac{T^{i+2}-t^{i+2}}{i+2}+\theta^2\frac{T^{i+3}-t^{i+3}}{i+3}\right]dt$$

$$=\sum_{i=0}^{n}a_i\left\{\int_0^T\left[p-(pr+p\theta-q)t-q(r+\theta)t^2\right]\left[\frac{T^{i+1}-t^{i+1}}{i+1}+\theta\frac{T^{i+2}-t^{i+2}}{i+2}+\theta^2\frac{T^{i+3}-t^{i+3}}{i+3}\right]dt\right\}$$

$$=\sum_{i=0}^{n}a_i\left\{\begin{array}{l}\left[p-(pr+p\theta-q)T-q(r+\theta)T^2\right]\left[\frac{T^{i+2}}{i+2}+\theta\frac{T^{i+3}}{i+3}+\theta^2\frac{T^{i+4}}{i+4}\right]\\ -\left[(pr+p\theta-q)+2q(r+\theta)T\right]\left[\frac{(i+4)T^{i+1}}{2(i+2)(i+3)}+\theta\frac{(i+5)T^{i+2}}{2(i+3)(i+4)}+\theta^2\frac{(i+6)T^{i+3}}{2(i+4)(i+5)}\right]\\ +\left[2q(r+\theta)T\right]\left[\frac{(i+6)T^{i+1}}{6(i+2)(i+4)}+\theta\frac{(i+7)T^{i+2}}{6(i+3)(i+5)}+\theta^2\frac{(i+8)T^{i+3}}{6(i+4)(i+6)}\right]\end{array}\right\} \qquad (8)$$

The total inventory cost TC (T)= Ordering cost (A) + Deterioration cost (DC) + Holding cost (HC). Therefore the total variable cost per unit time

$$TC(T)=\frac{A}{T}-C_d\sum_{i=0}^{n}a_i\left[\theta\frac{T^{i+1}}{i+2}+\theta^2\frac{T^{i+2}}{i+3}\right]$$
$$+\sum_{i=0}^{n}a_i\left\{\begin{array}{l}\left[\frac{p}{T}-(pr+p\theta-q)-q(r+\theta)T\right]\left[\frac{T^{i+2}}{i+2}+\theta\frac{T^{i+3}}{i+3}+\theta^2\frac{T^{i+4}}{i+4}\right]\\ -\left[\frac{(pr+p\theta-q)}{T}+2q(r+\theta)\right]\left[\frac{(i+4)T^{i+1}}{2(i+2)(i+3)}+\theta\frac{(i+5)T^{i+2}}{2(i+3)(i+4)}+\theta^2\frac{(i+6)T^{i+3}}{2(i+4)(i+5)}\right]\\ +\left[2q(r+\theta)\right]\left[\frac{(i+6)T^{i+1}}{6(i+2)(i+4)}+\theta\frac{(i+7)T^{i+2}}{6(i+3)(i+5)}+\theta^2\frac{(i+8)T^{i+3}}{6(i+4)(i+6)}\right]\end{array}\right\} \quad (9)$$

The necessary and sufficient conditions for minimize cost a given value T are

$\frac{dTC(T)}{dT}=0$ And $\frac{d^2TC(T)}{dT^2}>0$ then differentiation with respect to T of (9), we get

$$\frac{dTC(T)}{dT}=-\frac{A}{T^2}-C_d\sum_{i=0}^{n}a_i\left[\theta\frac{(i+1)T^{i}}{i+2}+\theta^2\frac{(i+2)T^{i+1}}{i+3}\right]$$
$$+\sum_{i=0}^{n}a_i\left\{\begin{array}{l}\left[-\frac{p}{T^2}-q(r+\theta)\right]\left[\frac{T^{i+2}}{i+2}+\theta\frac{T^{i+3}}{i+3}+\theta^2\frac{T^{i+4}}{i+4}\right]\\ +\left[\frac{p}{T}-(pr+p\theta-q)-q(r+\theta)T\right]\left[T^{i+1}+\theta T^{i+2}+\theta^2T^{i+4}\right]\\ +\frac{(pr+p\theta-q)}{T^2}\left[\frac{(i+4)T^{i+1}}{2(i+2)(i+3)}+\theta\frac{(i+5)T^{i+2}}{2(i+3)(i+4)}+\theta^2\frac{(i+6)T^{i+3}}{2(i+4)(i+5)}\right]\\ -\left[\frac{(pr+p\theta-q)}{T}+2q(r+\theta)\right]\left[\frac{(i+1)(i+4)T^{i}}{2(i+2)(i+3)}+\theta\frac{(i+2)(i+5)T^{i+1}}{2(i+3)(i+4)}+\theta^2\frac{(i+3)(i+6)T^{i+2}}{2(i+4)(i+5)}\right]\\ +\left[2q(r+\theta)\right]\left[\frac{(i+1)(i+6)T^{i}}{6(i+2)(i+4)}+\theta\frac{(i+2)(i+7)T^{i+1}}{6(i+3)(i+5)}+\theta^2\frac{(i+3)(i+8)T^{i+2}}{6(i+4)(i+6)}\right]\end{array}\right\} \quad (10)$$

And the again differentiation with respect to T of (10), we get

$$\frac{d^2TC(T)}{dT^2}=\frac{2A}{T^3}-C_d\sum_{i=0}^{n}a_i\left[\theta\frac{i(i+1)T^{i-1}}{i+2}+\theta^2\frac{(i+1)(i+2)T^{i}}{i+3}\right]$$
$$+\sum_{i=0}^{n}a_i\left\{\begin{array}{l}\frac{2p}{T^3}\left[\frac{T^{i+2}}{i+2}+\theta\frac{T^{i+3}}{i+3}+\theta^2\frac{T^{i+4}}{i+4}\right]-\left[\frac{p}{T^2}+q(r+\theta)\right]\left[T^{i+1}+\theta T^{i+2}+\theta^2T^{i+4}\right]\\ -\left[\frac{p}{T^2}+q(r+\theta)T\right]\left[T^{i+1}+\theta T^{i+2}+\theta^2T^{i+4}\right]\\ +\left[\frac{p}{T}-(pr+p\theta-q)-q(r+\theta)T\right]\left[(i+1)T^{i}+\theta(i+2)T^{i+1}+\theta^2(i+4)T^{i+3}\right]\\ -\frac{2(pr+p\theta-q)}{T^3}\left[\frac{(i+4)T^{i+1}}{2(i+2)(i+3)}+\theta\frac{(i+5)T^{i+2}}{2(i+3)(i+4)}+\theta^2\frac{(i+6)T^{i+3}}{2(i+4)(i+5)}\right]\\ +\frac{(pr+p\theta-q)}{T^2}\left[\frac{(i+1)(i+4)T^{i}}{2(i+2)(i+3)}+\theta\frac{(i+2)(i+5)T^{i+1}}{2(i+3)(i+4)}+\theta^2\frac{(i+3)(i+6)T^{i+2}}{2(i+4)(i+5)}\right]\\ -\left[\frac{(pr+p\theta-q)}{T}+2q(r+\theta)\right]\left[\begin{array}{l}\frac{i(i+1)(i+4)T^{i-1}}{2(i+2)(i+3)}+\theta\frac{(i+1)(i+2)(i+5)T^{i}}{2(i+3)(i+4)}\\ +\theta^2\frac{(i+2)(i+3)(i+6)T^{i}}{2(i+4)(i+5)}\end{array}\right]\\ +\left[2q(r+\theta)\right]\left[\frac{i(i+1)(i+6)T^{i-1}}{6(i+2)(i+4)}+\theta\frac{(i+1)(i+2)(i+7)T^{i}}{6(i+3)(i+5)}+\theta^2\frac{(i+2)(i+3)(i+8)T^{i+1}}{6(i+4)(i+6)}\right]\end{array}\right\} \quad (11)$$

VI. Algorithm

To find out the solution following algorithm used

Step1: Find derivative $\frac{dTC(T)}{dT}$ and put $\frac{dTC(T)}{dT}=0$

Step2: Solve equation (10) for T

Step3: Find the derivative $\frac{d^2TC(T)}{dT^2}$ and check $\frac{d^2TC(T)}{dT^2}>0$ for T^* optimal length

Step4: Find optimal total cost $TC^*(T^*)$ and initial order quantity $Q^*(T^*)$

VII. Conclusion

In the present paper, we developed an inventory model for variable deteriorating item with inflation, exponential declaring demand and without shortages give analytical solution, numerical solution and the effect of parameters of the model that minimize the total inventory cost. The deterioration factor taken into consideration in this model, as almost all items undergo either direct spoilage or physical decay in the course time, deterioration is natural feature in the inventory system. The model is very practical for the industries in which the demand rate is depending upon the time and holding cost is linear function with inflation. This model can further be extended by taking more realistic assumptions such as finite replenishment rate, probabilistic demand rate etc.

VIII. Numerical Solution

Consider an inventory system with the following parameter in proper units A = 100, θ=0.02, p=0.5, q=0.3, C_d = 5, and parameter r = 0.001, for consideration five constants are taken into account randomly with values $a_0 = 1.2, a_1 = 0.1, a_2 = 0.5, a_3 = 0.3, a_4 = 0.4$ The computer output of the program by using Mat lab software is T^*=4.125 , Q_o* =5823.72 and TC^* =10658.22 . The analysis shows that as the value of constants $a_i^{'}s$ increases then Total Cost TC^* and Q_o* increases highly whereas if the inflation rate is increased then Total Cost TC^* and Q_o* decreases.

References

[1]. **Agrawal, R., Rajput, D., Varshney, N.K.,(2009)** "Integrated inventory system with the effect of inflation and credit period" International Journal of Applied Engineering Research, Vol. 4, No. 11, pp. 2334-2348.

[2]. **Amutha R. and Chandrasekaran E. (2013)** "An Inventory Model for Constant Demand with Shortages under Permissible Delay in Payments" in IOSR Journal of Mathematics (IOSR-JM) e-ISSN: 2278-5728,p-ISSN: 2319-765X, Volume 6, Issue 5

[3]. **He, Y., Wang, S., and Lai, K. (2010)** "An optimal production-inventory model for deteriorating items with multiple-market demand" European Journal of Operational Research, 203(3), pp 593–600.

[4]. **Hou, K.L., Lin, L.C., (2009)** "A cash flow oriented EOQ model with deteriorating items under permissible delay in payments" Journal of Applied Sciences, Vol. 9, No. 9, pp. 1791-1794.

[5]. **Hung, K. (2011)** "An inventory model with generalized type demand, deterioration and backorder rates" European Journal of Operational Research, 208(3), pp 239–242.

[6]. **Jaggi, C.K., Goyal, S.K., Goel, S.K., (2008)** "Retailer's optimal replenishment decisions with credit-linked demand under permissible delay in payments" European Journal of Operational Research, Vol. 190, pp. 130-135

[7]. **Jain S., Kumar M. (2008)** "An Inventory Model with Inventory Level-Dependent Demand Rate, Deterioration, Partial Backlogging and Decrease in Demand" International Journal of Operations Research, Vol.5, No.3, 154-159

[8]. **Khanr. S, Chaudhuri, K.S. (2011)** "A Production – Inventory Model for a Deteriorating Item with Shortage and Time- Dependent Demand", Yugoslav Journal of Operations Research 21 Number 1, 29-45.

[9]. **Kumar Arya.R, and S.Kumar Shakya, (2012)** "An Inventory Model for Deteriorating Items with Time Dependent Demand and Partial Backlogging" Int. J. of Appl. Math and Mech. 8 (8): 55-71,.

[10]. **Kumar M., Chauhan A., Kumar R. (2012)** "A Deterministic Inventory Model for Deteriorating Items with Price Dependent Demand and Time Varying Holding Cost under Trade Credit", International Journal of Soft Computing Engineering (IJSCE), ISSN: 2231-2307, Volume – 2, Issue-1.

[11]. **Liao, J. (2008)** "An EOQ model with non instantaneous receipt and exponential deteriorating item under two-level trade credit" International Journal of Production Economics, 113:852–861.

[12]. **Mahata, G.C., Mahata, P., (2009)** Optimal retailer's ordering policies in the EOQ model for deteriorating items under trade credit financing in supply chain. International Journal of Mathematical, Physical and Engineering Sciences, Vol. 3, No. 1, pp.1-7

[13]. **Mandal B. N. and Phaujdar,S. (1989)** "An inventory model for deteriorating items and stock-dependent consumption rate[J]," Journal of the Operational Research Society, Vol. 40,pp. 483–488.

[14]. **Mandal, B. (2010)** An EOQ inventory model for Weibull distributed deteriorating items under ramp type demand and shortages. Opsearch, 47(2):158–165.

[15]. **Meher, M. K., Panda G.C., Sahu, S.K. (2012)** "An Inventory Model with Weibull Deterioration Rate under the Delay in Payment in Demand Dealing Market" Applied Mathematical Sciences, Vol. 6, no.23, 1121 -1133.

[16]. **Mishra U. K. Sahu S.K. (2011)** "An inventory model for weibull deteriorating items with permissible delay in payments under inflation" IJRRAS volume 6, Issue 1,02.

[17]. **Mishra, V. and Singh, L. (2011**). "Inventory model for ramp type demand, time dependent deteriorating items with salvage value and shortages" International Journal of Applied Mathematics & Statistics, 23(D11):84–91.
[18]. **Mishra S., Misra U.K. and Misra G. (2012)** "A Study of EOQ Model with Power Demand of Deteriorating Items under the Influence of Inflation" Gen. Math. Vol.10, No.1pp: 41-50, ISSN 2219-7184.
[19]. **Ouyang, L.Y. Teng, J.T. ,Goyal, S. K. and Yang, C.T.(2008)** "An economic order quantity model for deteriorating items with partially permissible delay in payments linked to order quantity [J]," European Journal of Operational Research,.
[20]. **Ouyang, L.Y., Teng, J.T., Goyal, S.K., Yang, C.T., (2009)** "An economic order quantity model for deteriorating items with partially permissible delay in payments linked to order quantity" European Journal of Operational Research, Vol. 194, pp. 418-431.
[21]. **Panda, S., Senapati, S. and Basu, M. (2008)** "Optimal replenishment policy for perishable seasonal products in a season with ramp-type time dependent demand" Computers & Industrial Engineering, Vol. 54, pp. 301–314.
[22]. **Pareek, S., Mishra, V., and Rani, S. (2009)** "An Inventory Model for time dependent deteriorating item with salvage value and shortages" Mathematics Today, 25, pp-31–39
[23]. **Patra, S.K., Lenka,T.K. and Ratha,P.C. (2010)** "An order level EOQ model for deteriorating items in a single warehouse system with price dependent demand in non-linear (quadratic) form" International Journal of Computational and Applied Mathematics, Vol. 5, No. 3, pp. 277-288.
[24]. **Soni, H., Shan N. H.and Jaggi C. K. (2010)** "Inventory models and trade credit a review" Control and Cybernetics, Vol39, No.3.
[25]. **Skouri, K., Konstantaras, S., and Ganas, I. (2009)** "Inventory models with ramp type demand rate, partial backlogging and weibull deterioration rate" European Journal of Operational Research, 192:79–92.
[26]. **Singh T., Pattanayak H. (2012)** "An EOQ Model for A Deteriorating Item with Time Dependent Exponentially Declining Demand Under Permissible Delay In payment" IOSR Journal of Mathematics (IOSRJM) ISSN: 2278 -5728 Volume 2, Issue 2, pp 30 -37.
[27]. **Tripathi R.P., Misra S.S., Shukla H.S. (2010)** "A Cash flow oriented EOQ model under permissible delay in payments" International Journal of Engineering, Science and Technology Vol.2, No.11, pp.123-131.
[28]. **Tripathi R.P., (2011)** "Optimal pricing and ordering policy for inflation dependent demand rate under permissible delay in payments" International Journal of Business, Management and Social sciences, vol. 2, No.4,pp 35-43.
[29]. **Tripathi, R.P. and Kumar, M. (2011)** "Credit Financing in economic ordering policies of time-dependent deteriorating items" International Journal of Business, Management and Social Sciences, Vol. 2, No. 3, pp. 75-84.
[30]. **Tripathy, C. K., and Mishra,U. (2010)** "Ordering Policy for Weibull Deteriorating Items for Quadratic Demand with Permissible Delay in Payments" Applied Mathematical Sciences, Vol.4, no.44, pp 2181-2191.
[31]. **Tripathi, R.P. and Misra, S.S. (2011)** "An inventory model with shortage, time- dependent demand rate and quantity dependent permissible delay in payment" Global Journal of Pure and Applied Mathematics, Vol. 7, No. 1, pp. 47-55.
[32]. **Tripathi, R.P., Misra, S.S., (2010)** "Credit financing in economic ordering policies of non-deteriorating items with time-dependent demand rate" International Review of Business and Finance, Vol. 2, No. 1, pp. 47-55
[33]. **Tripathy P.K, S. Pradhan (2011)** "An Integrated Partial Backlogging Inventory Model having Weibull Demand and Variable Deterioration rate with the Effect of Trade Credit." International Journal of Scientific & Engineering Research Volume 2, Issue 4, ISSN 2229-5518.
[34]. **Yadav R. K. , Vats A.K. (2014)** "A Deteriorating inventory model for quadratic demand and constant holding cost with partial backlogging and inflation" IOSR Journal of Mathematics (IOSR-JM), Vol.10, Issue 3, pp.47-52.
[35]. **Yadav R. K. , Vats A.K, (2015)** "An Inventory model for variable demand, constant holding cost and without shortages" IOSR Journal of Mathematics (IOSR-JM), Vol.11, Issue 1, pp. 49-55.
[36]. **Yadav, R.K and Trivedi, R. (2013)** "A multi Echolen inventory models for deteriorating with partial backlogging " International journal of applied science and technology, pp 24-31.