TEST Engineering & Management

March - April 2020
ISSN: 0193-4120 Page No. 6583 - 6591

Inventory System of Automobile for Stock Dependent Demand & Inflation with Two-Distribution Center Using Genetic Algorithm

Neha Chauhan
Research Scholar, SRM Institute of Science and Technology, Modinagar
Ghaziabad.nehac9133@gmail.com

Ajay Singh Yadav
Department of Mathematics, SRM Institute of Science and Technology, Modinagar
Ghaziabad.ajay29011984@gmail.com

Article Info
Volume 83
Page Number: 6583 - 6591
Publication Issue:
March - April 2020

Article History
***Article Received**: 24 July 2019*
***Revised**: 12 September 2019*
***Accepted**: 15 February 2020*
***Publication**: 04 April 2020*

Abstract:
An inventory model of automobile distribution center has been developed for commodity declines, whose demand depends on inflation-impacting stocks with double storage facilities. Own-distribution center (ODC) has a fixed capacity of units; Rented-distribution center (RDC) has limitless potential to use genetic algorithms. Here we assume that the cost of holding shares in RDC is higher than that of ODC. Stock shortages are permissible and partially overdue, and it is assumed that stocks will deteriorate over time with variable loss rates using genetic algorithms. Inflation effects were also engaged into account for various costs associated with the inventory system of automobile distribution center using a genetic algorithm. A numerical example is also used to examine the behavior of a model using a genetic algorithm. Cost reduction techniques are used to derive the expression of total costs and other parameters using a genetic algorithm.

***Keywords**: Distribution centers, deterioration cost, Stock dependent Demand, inflation, shortages, Transportation cost, advertising costs and Genetic algorithm*

1. Introduction

Distribution centers are a new consideration at the advent of logistics and supply chain management, primarily referring to a dynamic, full-service warehouse related to the market. It emphasizes the movement of goods rather than their warehousing and other customer-centric logistics services such as sales, market intelligence, traffic, credit, and other sales services of the manufacturer. In other words, the emphasis of distribution centers is the rapid pace of goods and logistics services, such as providing goods as per the requirement of retailers, documentation, classification, exchange of information, uninterrupted delivery of goods, credit facilities, etc. Distribution centers are usually called distribution warehouses which should be located near the markets. The critical problem with inventory management of automobile distribution center is deciding where to store products. This problem has not attracted the notice of researchers in this meadow. Breathing literature suggests that traditional inventory models of automobile distribution center usually refer to a single storage service. The basic supposition in these models is that administration consists of storage with limitless capacity. In the meadow of inventory management of automobile distribution center, this is not forever the case. If discounts are offered at attractive wholesale prices or the cost of purchasing goods exceeds the other costs associated with inventory of automobile distribution center, then management decides to buy (or produce) large quantities of goods at that time. Not all these items can be stored in an existing distribution center, that is, in a limited capacity-related distribution center (ODC). From an economic point of view, they usually rent a distribution center in addition to building a new one. Therefore, the excess quantity is stored in a rented distribution center (RDC). It may be near or slightly away from the RDC. Storage costs (including maintenance and degradation) in RDC are generally higher than ODC due to additional maintenance, material handling, etc. at a lower rate of degradation of goods. To reduce storage costs, it is inexpensive to get through RDC products as soon as possible. Therefore, the items are first stored in the ODC and only the additional stocks are stored in the RDC. In addition, RDC items are moved to ODC in a nonstop let go model to get together demand until RDC and ODC items are released.

Yang (2004) “developed two inventory models for the decline of commodities with a constant demand rate under inflation”. Zhou and Yang (2005) “proposed an inventory model with two warehouses and an inventory-dependent demand rate. No bottlenecks were allowed in the model, and transportation costs for the transfer of goods from RW to OW were assumed to depend on the volume transported”. Lee (2006) “developed two inventory models with lifetime and Pando shipping guidelines”. *Hsieh et al.* (2008) “proposed a deterministic inventory model for the decline of two stock items while reducing the present value of the total cost”. Yadav and Swami (2018, 2019)“Partially different backlog production-inventory lot size model with weibull deteriorating and integrated supply chain model for different holding costs and deteriorating commodities with weibull declines and linear stock dependent demand under a haphazard and inflationary environment”. “Developed a volume resilient two-warehouse model with demand fluctuations and an inventory model for cost under inflation and non-instantaneously deteriorating goods with variable holding costs under two-storage”. Yadav, et.al. (2019)“Proposed supply chain inventory model for deteriorating goods with warehouses and distribution centers under inflation”. Yadav, et.al. (2019) “Designed the supply chain of the chemical industry for warehousing with distribution centers using an artificial bee colony algorithm”. Yadav, et.al. (2017) “Proposed an inflation inventory model for deteriorating goods under two storage systems”. *Yadav, et.al.* (2016) “Designed a two-warehouse electronic component inventory model using a genetic algorithm and multi-objective optimization for deteriorating objects”. *Yadav, et.al.* (2017)“Proposed a fuzzy-based two-warehouse inventory model for non-instantaneous deteriorating goods with conditionally permissible delays in payment”. *Yadav, et.al.* (2020)“Series of electronic industrial development for warehouse electronic components supply chain management and its impact on the environment using particle swarm optimization algorithm”. *Yadav et. al.* (2017)“Ready supply chain inventory model for two warehouses with soft computing optimization”. *Yadav, et.al.* (2017)“Proposed effect of inflation on the two-warehouse inventory model for deteriorating commodities over time and demand”. Saho, A.T. (2012) “developed a genetic algorithm-based multi-objective reliability optimization in interval environments”.

2. Assumptions and Notations

Assumptions

1. A particular item is measured over an agreed stage T unit of time.
2. The replenishment cost is unlimited.
3. Lead-time is zero.

4. No replacement of deteriorated items is finished at some stage in a given cycle.

Notations

- $\Psi^{ODC}(t)$ = The Inventory of automobile own-distribution center.
- $\Psi^{RDC}(t)$ = The inventory of automobile rented-distribution center.
- ϕ_0 = The capacity of automobile own-distribution center.
- Q = The Ordering Quantity per cycle of automobile distribution center.
- T = Planning horizon.
- $D(t)$ = The Stock dependent demand cost. $D(t) = (A_0 + A_1)e^{-[\alpha+1]t}$, $(A_0 + A_1) > 0$, $[\alpha+1] > 0$
- ϕ_1 = Inflation Rate of automobile distribution center.
- $(\mu_0 + 1)$ = The variable rate of deterioration in both distribution center
- $(\chi_0 + 1)$ = The Backlogging Rate
- Ω_0 = The replenishment cost.
- Ω_2 = The Holding Cost of own-distribution center.
- Ω_3 = The holding cost of rented-distribution center.
- Ω_1 = The deterioration cost of automobile distribution center.
- Ω_4 = The Shortage Cost of automobile distribution center.
- Ω_5 = The opportunity cost of automobile distribution center.
- Ω_6 = Inbound Transportation cost of automobile distribution center.
- Ω_7 = Outbound Transportation cost of automobile distribution center.
- Ω_8 = online advertising cost of automobile distribution center.
- Ω_9 = offline advertising costs of automobile distribution center.
- $T^{ACDC}[T_2, T_n]$ = The Total average Cost of automobile two-distribution center.

3. Formulation & Solution of two-Distribution center inventory Model of automobile

ODC & RDC is govern by the following differential equations

$$\frac{d\Psi^{ODC}\{t\}}{dt} = -(\mu_0+1)\{t\}\,\Psi\{t\} \qquad 0 \le t < T_1 \qquad (1)$$

$$\frac{d\Psi^{ODC}\{t\}}{dt} + (\mu_0+1)\{t\}\,\Psi\{t\} = -(A_0+A_1)e^{-[\alpha+1]T_1} \qquad T_1 \le t \le T_2 \qquad (2)$$

$$\frac{d\Psi^{ODC}\{t\}}{dt} = -(A_0+A_1)e^{-[\alpha+1]T_1}e^{-(\chi_0+1)t}, \quad T_2 \le t \le T_n \qquad (3)$$

With the boundary conditions,

$\Psi^{ODC}(0) = \phi_0$ And $\Psi^{ODC}(T_2) = 0$ (4)

The solutions of equations (1), (2) and (3) are given by

March - April 2020
ISSN: 0193-4120 Page No. 6583 - 6591

$$\Psi^{ODC}(t)=\phi_0\, e^{-(\mu_0+1)t^2/2},\quad 0\le t<T_1 \tag{5}$$

$$\Psi^{ODC}(t)=(a+b)e^{-[\alpha+1]T_1}\left\{(T_1-t)+\frac{(\mu_0+1)(T_2^3-t^3)}{6}\right\}e^{-(\mu_0+1)t^2/2},\quad T_1\le t\le T_2 \tag{6}$$

And $$\Psi^{ODC}(t)=\frac{(A_0+A_1)}{(\chi_0+1)}e^{-[\alpha+1]T_1}\left\{e^{-(\chi_0+1)\,t}-e^{-(\chi_0+1)\,T_2}\right\},\, T_2\le t\le T_n \tag{7}$$

$$\frac{d\Psi^{RDC}\{t\}}{dt}+(\mu_0+1)\{t\}\,\Psi\{t\}=-(A_0+A_1)e^{-[\alpha+1]\,t}\quad 0\le t<T_1 \tag{8}$$

$\Psi^{RDC}(0)=0$ (8)'

$$\Psi^{RDC}(t)=(A_0+A_1)\left\{\begin{aligned}&(T_1-t)-\frac{[\alpha+1]}{2}\left(T_1^2-t^2\right)\\&+\frac{(\mu_0+1)}{6}(T_2^3-t^3)\end{aligned}\right\}e^{-(\mu_0+1)t^2/2},\ \mu\le t\le t_1 \tag{9}$$

$\Psi^{ODC}(t)$ At point $t=T_1$,

$$\phi_0 e^{-(\mu_0+1)T_1^2/2}=(A_0+A_1)e^{-[\alpha+1]\,T_1}\left\{(T_2-T_1)+\frac{(\mu_0+1)(T_2^3-T_1^3)}{6}\right\}e^{-(\mu_0+1)T_1^2/2}$$

$$\phi_0=(A_0+A_1)e^{-[\alpha+1]T_1}\left\{(T_1-T_1)+\frac{(\mu_0+1)(T_2^3-T_1^3)}{6}\right\} \tag{10}$$

"The total average cost consists of the following elements"

- Ordering Cost of automobile Both distribution center

  $$\text{O.C.}=\Omega_0 \tag{11}$$

- "Holding cost of automobile own-distribution center "

$$H.C.O.D.C.=\Omega_2\left[\int_0^{T_1}\Psi^{ODC}(t)e^{-\phi_1 t}dt+\int_{T_1}^{T_2}\Psi^{ODC}(t)e^{-\phi_1(T_1+t)}dt\right]$$

$$H.C.O.D.C.=\Omega_2\left[\begin{aligned}&\rho\left(T_1-\frac{\phi_1T_1^2}{2}-\frac{(\mu_0+1)T_1^3}{6}\right)+\\&(A_0+A_1)e^{-[\alpha+1](T_1+\phi_1)}\left\{\begin{aligned}&\frac{T_2^2}{2}-\frac{\phi_1T_2^3}{6}+\frac{(\mu_0+1)T_2^4}{12}-\frac{U_0(\mu_0+1)}{20}T_2^5\\&-\frac{T_1}{2}\left(2T_2-T_1\right)-\frac{(\mu_0+1)T_1}{24}\left(4T_2^3-T_1^3\right)\\&+\frac{\phi_1T_1^2}{6}\left(3T_2-2T_1\right)+\frac{\phi_1(\mu_0+1)T_1^2}{30}\left(5T_2^3-3T_1^3\right)\\&+\frac{(\mu_0+1)T_1^3}{24}\left(4T_2-3T_1\right)\end{aligned}\right\}\end{aligned}\right] \tag{12}$$

- "Holding cost of automobile rented-distribution center"

$$H.C.R.W=\Omega_3\left[\int_0^{T_1}\Psi^{RDC}(t)e^{-\phi_1 t}dt\right]$$

$$H.C.R.W=\Omega_3(A_0+A_1)\begin{bmatrix}\dfrac{T_1^{\,2}}{2}-\dfrac{\left(3\left[\alpha+1\right]+\phi_1\right)}{6}T_1^{\,3}\\+\left(\dfrac{(\mu_0+1)}{12}+\dfrac{\left[\alpha+1\right]\phi_1}{8}\right)T_1^{\,4}-\left(\dfrac{\phi_1(\mu_0+1)}{20}-\dfrac{\left[\alpha+1\right](\mu_0+1)}{30}\right)T_1^{\,5}\end{bmatrix}\quad(13)$$

➢ “Deteriorated Cost of automobile distribution center”

$$D.C.=\Omega_1\begin{bmatrix}\int_0^{T_1}(\mu_0+1)t\,\Psi^{RDC}(t)e^{-\phi_1 t}dt+\int_0^{T_1}(\mu_0+1)t\,\Psi^{ODC}(t)e^{-\phi_1 t}dt+\\\int_{T_1}^{T_2}(\mu_0+1)t\,\Psi^{ODC}(t)e^{-\phi_1(t+T_1)}dt\end{bmatrix}$$

$$D.C.=\Omega_1(\mu_0+1)\begin{bmatrix}(A_0+A_1)\begin{pmatrix}\dfrac{1}{6}T_1^{\,3}-\left(\dfrac{\left[\alpha+1\right]}{4}+\dfrac{\phi_1}{12}\right)T_1^{\,4}\\+\left(\dfrac{(\mu_0+1)}{40}+\dfrac{\phi_1\left[\alpha+1\right]}{15}\right)T_1^{\,5}\\-\left(\dfrac{\phi_1(\mu_0+1)}{36}-\dfrac{\left[\alpha+1\right](\phi_1+1)}{24}\right)T_1^{\,6}\end{pmatrix}+\rho\begin{pmatrix}\dfrac{T_1^{\,2}}{2}-\\\dfrac{\phi_1T_1^{\,3}}{3}\,\dfrac{(\mu_0+1)T_1^{\,4}}{8}\end{pmatrix}+\\(A_0+A_1)e^{-T_1(\left[\alpha+1\right]+\phi_1)}\left\{\begin{matrix}\dfrac{T_2^3}{6}-\dfrac{\phi_1T_2^4}{12}+\dfrac{(\mu_0+1)T_2^5}{40}-\dfrac{\phi_1(\mu_0+1)T_2^6}{36}\\-\dfrac{T_1^{\,2}}{6}\left(3T_2-2T_1\right)-\dfrac{(\mu_0+1)T_1^{\,2}}{60}\left(5T_2^3-2T_1^{\,3}\right)\\-\dfrac{\phi_1T_1^{\,3}}{12}\left(4T_2-3T_1\right)-\dfrac{\phi_1(\mu_0+1)T_1^{\,3}}{36}\left(2T_2^3-T_1^{\,3}\right)\\-\dfrac{(\mu_0+1)T_1^{\,4}}{40}\left(5T_2-4T_1\right)\end{matrix}\right\}\end{bmatrix}\quad(14)$$

➢ “Shortage cost of automobile distribution center”

$$S.C.=\Omega_4\left[\int_{T_2}^{T_n}-\Psi^{ODC}(t)e^{-\phi_1(T_2+t)}dt\right]$$

$$S.C.=\frac{-(A_0+A_1)\Omega_4\,e^{-(\phi_1T_2+\left[\alpha+1\right]T_1)}}{\left(\chi_0+1\right)}\left[\int_{T_2}^{T_n}e^{-(\phi_1+\left(\chi_0+1\right))t}dt-e^{-\left(\chi_0+1\right)T_2}\int_{T_2}^{T_n}e^{-\phi_1 t}dt\right]$$

$$S.C.=\frac{(A_0+A_1)\Omega_4\,e^{-(\phi_1T_2+\left[\alpha+1\right]T_1)}}{\left(\chi_0+1\right)\phi_1\left(\left(\chi_0+1\right)+\phi_1\right)}\begin{bmatrix}\left(\chi_0+1\right)e^{-(\left(\chi_0+1\right)+\phi_1)T_2}+\\e^{-\phi_1T_n}\left\{\phi_1e^{-\left(\chi_0+1\right)T_n}-(\left(\chi_0+1\right)+\phi_1)e^{-\left(\chi_0+1\right)T_2}\right\}\end{bmatrix}\quad(15)$$

➢ “Opportunity cost of automobile distribution center”

TEST Engineering & Management

March - April 2020
ISSN: 0193-4120 Page No. 6583 - 6591

$$O.C.=\Omega_5\int_{T_2}^{T_n}(A_0+A_1)(1-e^{-(\chi_0+1)t})e^{-[\alpha+1]T_1}e^{-\phi_1(T_2+t)}dt$$

$$O.C.=\frac{\Omega_5(A_0+A_1)e^{-([\alpha+1]T_1+rT_2)}}{\phi_1((\chi_0+1)+\phi_1)}\begin{bmatrix}e^{-\phi_1T_2}\left\{((\chi_0+1)+\phi_1)-\phi_1e^{-(\chi_0+1)T_2}\right\}\\-e^{-\phi_1T_n}\left\{((\chi_0+1)+\phi_1)-\phi_1e^{-(\chi_0+1)T_n}\right\}\end{bmatrix}\quad(16)$$

- Inbound Transportation cost of automobile distribution center

$$\text{IB.T.C.}=\Omega_6+D(t)$$

$$\text{IB.T.C.}=\Omega_6+(A_0+A_1)e^{-[\alpha+1]t}\quad(17)$$

- Inbound Transportation cost of automobile distribution center

$$\text{OB.T.C.}=\Omega_7+D(t)$$

$$\text{OB.T.C.}=\Omega_7+(A_0+A_1)e^{-[\alpha+1]t}\quad(18)$$

- online advertising costs of automobile distribution center

$$\text{online.A.C.}=\Omega_8+D(t)$$

$$\text{online.A.C.}=\Omega_8+(A_0+A_1)e^{-[\alpha+1]t}\quad(19)$$

- Offline advertising costs of automobile distribution center

$$\text{OffLine.A.C.}=\Omega_9+D(t)$$

$$\text{OffLine.A.C.}=\Omega_9+(A_0+A_1)e^{-[\alpha+1]t}\quad(20)$$

- The total average cost of automobile distribution center our model is obtained as follows

$$T^{ACDC}[T_2,T_n]=\frac{1}{T}\begin{bmatrix}\text{O.C + H.C.O.D.C + H.C.R.D.C + D.C.+ S.C.+ O.C.+ IB.T.C.+ OB.T.C.}\\ +\text{ online.A.C.}+\text{offline.A.C.}\end{bmatrix}$$

4. Genetic Algorithm

[1]:→ {"Set Population Size (p_size)", "Probability of Crossover (p_cross)", "Probability of mutation (P_mute)", "Maximum generation (m_gen)" And bounds of the variables.}

[2]: → {[$t = 0$["t represents the number of current generation"}

[3]: → {"Initialize the chromosomes of the population" "$P(t)$[$P(t)$ *represents the population at tth generation*"].}

[4]:→ {"Evaluate the ðtness function of each chromosome of P(t) considering the objective function as the ðtness function".}

[5]: → {"Find the best Chromosome from the population P(t)".}

[6]: → {"t Is increased by unity".}

[7]: → {"If the termination criterion is satisðed go to Step-14, otherwise, go to next step".}

[8]: → {"Select the population P(t) from the population P(t-1) of earlier generation by tournament selection process".}

[9]: → {"Alter the population P (t) by crossover, mutation and elitism operators".}

[10]: → {"Evaluate the ðtness function value of each chromosome of P(t)".}

[11]: → {"Find the best chromosome from P(t)".}

[12]: → {"Compare the best chromosome of P (t) and P (t-1) store better one".}

[13]: → {"Go to Step-6".}

[14]: → {"Print the best chromosome" (which is the solution of the optimization problem).}

[15]: → {"End".}

March - April 2020
ISSN: 0193-4120 Page No. 6583 - 6591

5. Numerical Illustration

To illustrate the model numerically the following parameter values are considered.

A_0=70 units, A_1=70 units, $[\alpha+1]$=0.5 units, ϕ_1=0.07 units, (μ_0+1)=0.005 units, (χ_0+1)=0.3 units, T_1=0.4 year, T_n=2 year, R_0=€ 300 per order, R_2=€ 7.0/year, R_3=€ 30.0 per unit, R_4=€ 27.0/year, R_5=€ 9.0 per unit.T_2= 0.944224 year, S = 64.597 units and $T^{PC}[T_2,T_n]$= $ 74.375 per year.

"In the proposed GA, the following values of GA parameters have been used":
p_size=80, m_gen=500, p_cross=0.29, p_mute=0.3

6. Sensitivity analysis

Table-1: A Sensitivity analysis all parameters rate

		T_1	T_2	T_n	$T^{PC}[T_2,T_n]$
A_0	15	5.43140	11.4340	14.1431	340801
	20	5.43141	11.4341	14.1432	340804
A_1	15	5.43142	11.4342	14.1435	340805
	20	5.43145	11.4345	14.1434	340806
$[\alpha+1]$	15	5.43146	11.4344	14.1434	340810
	20	5.43147	11.4345	14.1435	340820
ϕ_1	15	5.43148	11.4346	14.1436	340850
	20	5.43143	11.4347	14.1437	340840
Ω_0	15	5.43118	11.4310	14.1468	340810
	20	5.43128	11.4320	14.1478	340820
Ω_1	15	5.43158	11.4350	14.1488	340850
	20	5.43148	11.4340	14.1438	340840
Ω_2	15	5.12148	61.0340	84.1438	640800
	20	5.14555	61.1730	84.1507	641858
Ω_3	15	5.15005	61.5447	84.5844	642340
	20	5.16774	61.5374	84.6553	645455
Ω_4	15	5.43148	61.4340	84.1438	640800
	20	5.54555	62.5730	85.0507	645858
Ω_5	15	5.55005	65.5447	86.5844	644340
	20	5.56774	64.0374	82.4553	645455
Ω_6	15	2.03148	20.4340	50.1438	200800
	20	2.54555	22.5730	50.2507	215858
Ω_7	15	2.45005	25.5447	50.5844	224340
	20	2.56774	24.0374	51.4553	225455
Ω_8	15	2.43148	21.4340	54.1438	240800
	20	2.54555	22.5730	55.0507	245858
Ω_9	15	2.55005	25.5447	56.5844	244340
	20	2.56774	24.0374	52.4553	245455

Table-2: Sensitivity analysis with Genetic algorithm

Function	Algorithm	Best	Worst	Mean	Standard Deviation
Ω_0	GA	0.50608	54.0900	74.6098	040800
Ω_1	GA	0.51488	59.4764	70.6807	043436
Ω_2	GA	0.52477	50.7060	74.0498	047604
Ω_3	GA	0.53468	60.6809	84.0600	037570
Ω_4	GA	0.54605	63.0333	83.6067	038080
Ω_5	GA	0.55477	50.7060	74.0498	047604
Ω_6	GA	0.56468	60.6809	84.0600	037570
Ω_7	GA	0.57605	63.0333	83.6067	038080
Ω_8	GA	0.57605	63.0333	83.6067	038080
Ω_9	GA	0.50073	68.6083	80.7003	030730

7. Conclusion

This paper presents another model to determine the most favourable replenishment series for an inventory problem of two stocks underneath inflation, where the inventory level deteriorates at a constant rate in excess of time and constraints are authorized using the genetic algorithm. We conclude that if the inflation rate is larger than zero, then using the planned model is cheaper than the conventional model using genetic algorithms. Conversely, if the rate of inflation is zero, the cost per unit of time relevant to both models is the same using the genetic algorithm. The two-Distribution center model can be applied in many no-nonsense situations. Currently, commercial competition is becoming very strong owing to the opening of an open market rule to gain more profits in the sales market using genetic algorithms. For this reason, a department store should provide customers with a better shopping environment to attract more customers, for example, a well-decorated showroom with contemporary lighting and electronic actions and sufficient for item selection empty space. Outstanding to the increasing market conditions, again, there is a space catastrophe in the market, particularly in supermarkets, in the corporate market, etc. using the genetic algorithm. As a result, department store management has to rent a separate distribution center at a remote location rental location to store additional items using genetic algorithms.

8. References

[1] Hsieh, T.P., Dye, C.Y. and Ouyang, L.Y. (2008): Determining optimal lot size for a two-warehouse system with deterioration and shortages using net present value. E.J.O.R., 191 (1), 180-190.

[2] Lee, C.C. (2006): Two-warehouse inventory model with deterioration under FIFO dispatching policy. E.J.O.R., 174 (2), 861-873.

[3] Sahooa, L., Bhuniab, A.K. and Kapur, P.K (2012) Genetic algorithm based multi-objective reliability optimization in interval environment, Computers & Industrial Engineering. 62, 152-160

[4] Yadav, A.S. and Swami, A. (2018). A partial backlogging production-inventory lot-size model with time-varying holding cost and weibull deterioration. International Journal Procurement Management, Volume 11, No. 5.

[5] Yadav, A.S. and Swami, A. (2018). Integrated Supply Chain Model for Deteriorating Items With Linear Stock Dependent Demand Under Imprecise And Inflationary Environment. International Journal Procurement Management, Volume 11 No 6.

[6] Yadav, A.S. and Swami, A. (2019). A Volume Flexible Two-Warehouse Model with Fluctuating Demand and Holding Cost under Inflation. International Journal Procurement Management Volume 12 No 4.

[7] Yadav, A.S., and Swami, A. (2019). An inventory model for non-instantaneous deteriorating items with variable holding cost under two-storage. International Journal Procurement Management, Volume 12 No 6.

[8] Yadav, A.S., Bansal, K.K., Kumar, J. and Kumar, S. (2019). Supply Chain Inventory Model For Deteriorating Item With Warehouse & Distribution Centres Under Inflation. International Journal of Engineering and Advanced Technology, Volume-8, Issue-2S2.

[9] Yadav, A.S., Kumar, J., Malik, M. and Pandey, T. (2019). Supply Chain of Chemical Industry For Warehouse With Distribution Centres Using Artificial Bee Colony Algorithm, International Journal of Engineering and Advanced Technology, Volume-8, Issue-2S2.

[10] Yadav, A.S., Mahapatra, R. P., Sharma, S. and Swami, A. (2017). An Inflationary Inventory Model for Deteriorating items under Two Storage Systems. International Journal of Economic Research, Volume 14 No.9.

[11] Yadav, A.S., Mishra, R., Kumar, S. and Yadav, S. (2016). Multi Objective Optimization for Electronic Component Inventory Model & Deteriorating Items with Two-warehouse using Genetic Algorithm. International Journal of Control Theory and applications, Volume 9 No.2

[12] Yadav, A.S., Sharma, S. and Swami, A. (2017). A Fuzzy Based Two-Warehouse Inventory Model For Non instantaneous Deteriorating Items With Conditionally Permissible Delay In Payment. International Journal of Control Theory And Applications, Volume 10 No.11.

[13] Yadav, A.S., Swami, A., Ahlawat, N., Bhatt, D. and Kher, G. (2020). Electronic components supply chain management of Electronic Industrial development for warehouse and its impact on the environment using Particle Swarm Optimization Algorithm International Journal Procurement Management. Optimization and Inventory Management (Book Chapter), Springer, 2020.

[14] Yadav, A.S., Swami, A., Kher, G. and Kumar, S. (2017). Supply Chain Inventory Model for Two Warehouses with Soft Computing Optimization International Journal of Applied Business and Economic Research, Volume 15 No 4.

[15] Yadav, A.S., Taygi, B., Sharma, S. and Swami, A. (2017). Effect of inflation on a two-warehouse inventory model for deteriorating items with time varying demand and shortages. International Journal Procurement Management, Volume 10, No. 6.

[16] Yang, H.L. (2004): Two warehouse inventory models for deteriorating items with shortages under inflation, E.J.O.R., 157, 344-356.

[17] Zhou, Y.W. and Yang, S.L. (2005): A two-warehouse inventory model for items with stock-level-dependent demand rate. I.J.P.E., 95 (2), 215-228.