



Inventory of Electronic components model for deteriorating items with warehousing using Genetic Algorithm

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Abstract

In this paper a deterministic Inventory of Electronic components model for deteriorating items with one level of storage with shortage is developed where shortages are fully backlogged with next replenishment order using genetic algorithm under distance-based praetor. Stock is transferred warehousing under continuous release pattern and the transportation cost is taken into account using genetic algorithm under distance-based Pareto. Though the time of transporting items from warehousing is ignored and the transportation cost for transporting items is taken to be dependent on the transported units of commodities. The deterioration rates in both the warehouse of Electronic components are constant but different due to the different preservation procedures using genetic algorithm under distance-based Pareto. We have also discussed some special cases and compared there total relevant Inventory of Electronic components costs using genetic algorithm under distance-based Pareto. The numerical example is presented to demonstrate the development and to validate the model using genetic algorithm under distance-based Pareto.

Keywords:-Deteriorating of Electronic components, warehousing of Electronic components, Inventory of Electronic components costs, Genetic Algorithm under Distance-based Pareto.

1. Introduction

We use a variety of food in our daily life to eat. Some of us may take rice, while others may take wheat in the form of different dishes as our main food vegetables are sometime available easily when we demand and sometime not, but can be obtained with the payment of more cost than during normal availability. But have we ever thought that from where vegetables, the rice paddy or wheat from which these food items are prepared comes. We all know that these food grains are not produced throughout the year but we need to eat them every day throughout the year. So, how are the farmers able to supply these continuously to us? We might be thinking that they store the food grains in a proper place and supply them at the time of need. Yes, we are right. Since the production takes place during a particular season and in specific areas, there is a need to store these food grains systematically. In our home we may keep limited stock for our Won consumption e.g. 4-5 kg of pulses, 20-50 kg of wheat/rice and we need to buy it again form somewhere(shops) after an interval of time. For this purpose i.e. to provide us the desired items when we needed, there are certain places or stores, where these items are stored in huge quantities in a proper and systematic way. We need different types of goods in our day-to-day life. We may buy some of these items in bulk and store them in our house. Similarly, businessmen also need a variety of goods for the business but some of them may not be available all the time. But, they need those items through out the year without any break. For example, in electricity power plant (thermal plant) needed coal through the year for the production of electricity, coal is used as raw material, coal is not available at every place and is to be transported from a particular place which takes time so the power plant needed to store it for the year to use when it required. Since the demand for coal in the factory is continuous process for the production of electricity. Thus, the need for storage arises both for raw material as well as finished products (i.e. electricity). Since storage involves proper arrangement for preserving goods from the time of their production or purchase till the actual use therefore it require proper space for storage. When this storage is done on a large scale and in a specified manner it is called '**Warehousing of Electronic components**'.

An important issue in the Inventory of Electronic components theory is related to how to deal with the unfulfilled demands which occur during shortages or stock outs. In most of the developed models researchers assumed that the shortages are either completely backlogged or completely lost. The first case, known as backordered or backlogging case, represent a situation where the unfulfilled demand is

completely back ordered. In the second case, also known as lost sale case, we assume that the unfulfilled demand is completely lost.

Furthermore, when the shortages occur, some customers are willing to wait for backorder and others would turn to buy from other sellers. In many cases customers are conditioned to a shipping delay and may be willing to wait for a short time in order to get their first choice. For instance, for fashionable commodities and high-tech products with short product life cycle, the willingness of a customer to wait for backlogging is diminishing with the length of the waiting time. Thus the length of the waiting time for the next replenishment would determine whether the backlogging would be accepted or not. In many real life situations, during a shortage period, the longer the waiting time is, the smaller is the backlogging rate would be. Therefore, for realistic business situations the backlogging rate should be variable and dependent on the waiting time for the next replenishment. Many researchers have modified Inventory of Electronic components policies by considering the “time proportional partial backlogging rate”.

2. Genetic Algorithms

The basic concepts were developed by Holland, while the practicality of using the GA to solve complex problems was demonstrated. Genetic Algorithms (GAs) is a soft computing approach. GA is a maximization process. The problem it addresses usually has a very large search space with probable multiple local maxima inside it. The GA process has to ensure that it is not trapped at local maxima, so that at the end of the process it may find the global maxima even if the global maximum is not returned, we may expect a close approximation of it as the outcome of the GA process To achieve this, GA works on a set of solutions to the given problem instance, and evolves it through a number of generations. The evolution process stops when some predefined termination condition is satisfied. At each intermediate stage, the old generation is replaced by the new generation. The individuals of the population of a generation are processed with the help of a number of GA operators in such a way that the quality of the new generation, in general is improved in comparison with old generation. In this way we obtain better and better solution will be returned by the GA process.

Procedure Basic GA

- Step 1:- Initialize the population. Call this the current population.
- Step 2:- Repeat step 3 through step 5 till termination condition is satisfied.
- Step 3:- Apply selection operation on the current population to obtain the mating pool.
- Step 4:- Apply crossover and mutation operators n for the mating pool to generate the new population.
- Step 5:- Replace the current population by the new population.
- Step 6:- Return the best solution of the current population.

3. Related Works

Narmadha et. al. (2010) proposed Multi-Product Inventory Optimization using Uniform Crossover Genetic Algorithm. Radhakrishnan et. al. (2009) gives a inventory optimization in Supply Chain Management using Genetic Algorithm. Singh and Kumar (2011) gives a inventory optimization in Efficient Supply Chain Management. Priya and Iyakutti (2011) proposed Web based Multi Product Inventory Optimization using Genetic Algorithm. Thakur and Desai (2013) a study inventory Analysis Using Genetic Algorithm In Supply Chain Management. Khalifehzadeh et. al. (2015) presented a four-echelon supply chain network design with shortage: Mathematical modelling and solution methods. Kannan et. al. (2010) Discuss a genetic algorithm approach for solving a closed loop supply chain model: A case of battery recycling. Jawahar and Balaji (2009) Proposed A genetic algorithm for the two-stage supply chain distribution problem associated with a fixed charge. Zhang et. al. (2013) presented A modified multi-criterion optimization genetic algorithm for order distribution in collaborative supply chain. Che and Chiang (2010)

proposed A modified Pareto genetic algorithm for multi-objective build-to-order supply chain planning with product assembly. Yimer and Demirli (2010) Presented A genetic approach to two-phase optimization of dynamic supply chain scheduling. Wang, et. al. (2011) Proposed Location and allocation decisions in a two-echelon supply chain with stochastic demand – A genetic-algorithm based solution. Humphreys, et. al. (2009) presented Reducing the negative effects of sales promotions in supply chains using genetic algorithms. Sherman et. al. (2010) gives a production modelling with genetic algorithms for a stationary pre-cast supply chain. Ramkumar, et. al. (2011) proposed Erratum to “A genetic algorithm approach for solving a closed loop supply chain model: A case of battery recycling”. Ye et. al. (2010) Proposed Some improvements on adaptive genetic algorithms for reliability-related applications. Guchhait et. al. (2010) presented Multi-item inventory model of breakable items with stock-dependent demand under stock and time dependent breakability rate. Changdar et. al. (2015) gives an improved genetic algorithm based approach to solve constrained knapsack problem in fuzzy environment. Sourirajan et. al. (2009) presented A genetic algorithm for a single product network design model with lead time and safety stock considerations. Jiang et. al. (2015) gives Joint optimization of preventive maintenance and inventory policies for multi-unit systems subject to deteriorating spare part inventory. Dey et. al. (2008) proposed Two storage inventory problem with dynamic demand and interval valued lead-time over finite time horizon under inflation and time-value of money. Jawahar and Balaji (2012) proposed A genetic algorithm based heuristic to the multi-period fixed charge distribution problem. Pasandideh et. al. (2010) gives a parameter-tuned genetic algorithm for multi-product economic production quantity model with space constraint, discrete delivery orders and shortages. Yadav et. al. (2016) proposed a cooperative Two-Warehouse Inventory Model for Deteriorating Items with Variable Holding Cost, Time-Dependent Demand and Shortages. Consider a similar model, Two Warehouse Inventory Model with Ramp Type Demand and Partial Backordering for Weibull Distribution Deterioration. put forward a model, A two-storage model for deteriorating items with holding cost under inflation and Genetic Algorithms. Singh et. al. (2016) proposed a Two-Warehouse Model for Deteriorating Items with Holding Cost under Particle Swarm Optimization. Consider a similar model, A Two-Warehouse Model for Deteriorating Items with Holding Cost under Inflation and Soft Computing Techniques. Yadav et. al. (2016) analyzed a Multi Objective Optimization for Electronic Component Inventory Model & Deteriorating Items with Two-warehouse using Genetic Algorithm. Sharma et. al. (2016) focused an Optimal Ordering Policy for Non-Instantaneous Deteriorating Items with Conditionally Permissible Delay in Payment under Two Storage Management. Yadav et. al. (2016) analyzed a Analysis of Genetic Algorithm and Particle Swarm Optimization for warehouse with Supply Chain management in Inventory control.

4. Assumptions and Notations

In developing the mathematical model of the inventory Electronic components system the following assumptions are being made:

- A single item is considered over a prescribed period T units of time.
- The demand rate $D(t)$ at time t is deterministic and taken as a ramp type function of time i.e.

$$D(t) = \eta e^{-\gamma \{t - (t - \psi)H(t - \psi)\}}, \eta > 0, \gamma > 0$$
- The replenishment rate is infinite and lead-time is zero.
- When the demand for goods is more than the supply. Shortages will occur. Customers encountering shortages will either wait for the vender to reorder (backlogging cost involved) or go to other vendors (lost sales cost involved). In this model shortages are allowed and the backlogging rate is $\exp(-\alpha t)$, when Inventory of Electronic components is in shortage. The backlogging parameter α is a positive constant.

- The variable rate of deterioration in both warehouse of Electronic components is taken as $\beta(t) = \beta t$. Where $0 < \beta < 1$ and only applied to on hand Inventory of Electronic components.
- No replacement or repair of deteriorated items is made during a given cycle.
- The warehouse of Electronic components of Electronic components (W) has a fixed capacity of W units;

In addition, the following notations are used throughout this paper:

$I_w(t)$	The Inventory of Electronic components level in W at any time t.
C_w	The capacity of the warehouse of Electronic components of Electronic components.
Q	The ordering quantity of Electronic components per cycle.
T	Planning horizon.
θ	Inflation rate.
H_0	The holding cost of Electronic components per unit per unit time in W.
D_c	The deterioration cost of Electronic components per unit.
S_c	The shortage cost of Electronic components per unit per unit time.
C_1	The opportunity cost of Electronic components due to lost sales.
A	The replenishment cost of Electronic components per order.

5. Formulation and solution of the model

The Inventory of Electronic components levels at W are governed by the following differential equations:

$$\frac{dI_w(t)}{dt} = -\beta(t)I(t), \quad 0 \leq t < \psi \quad (1)$$

$$\frac{dI_w(t)}{dt} + \beta(t)I(t) = -\eta e^{-\gamma\psi}, \quad \psi \leq t \leq t_1 \quad (2)$$

And

$$\frac{dI_w(t)}{dt} = -\eta e^{-\gamma\psi} e^{-\alpha t}, \quad t_1 \leq t \leq T \quad (3)$$

with the boundary conditions,

$$I_w(0) = C_w \text{ and } I(t_1) = 0 \quad (4)$$

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

$$I_w(t) = C_w e^{-\beta t^2/2}, \quad 0 \leq t < \psi \quad (5)$$

$$I_w(t) = \eta e^{-\gamma\psi} \left\{ (t_1 - t) + \beta \frac{(t_1^3 - t^3)}{6} \right\} e^{-\beta t^2/2}, \quad \psi \leq t \leq t_1 \quad (6)$$

$$\text{And } I_w(t) = \frac{\eta}{\alpha} e^{-\gamma\psi} \left\{ e^{-\alpha t} - e^{-\alpha t_1} \right\}, \quad t_1 \leq t \leq T \quad (7)$$

Due to continuity of $I_w(t)$ at point $t = \mu$, it follows from equations (5) and (6), one has

$$C_w e^{-\beta\psi^2/2} = \eta e^{-\gamma\psi} \left\{ (t_1 - \psi) + \beta \frac{(t_1^3 - \psi^3)}{6} \right\} e^{-\beta\psi^2/2} \quad (8)$$

$$C_w = \eta e^{-\gamma\psi} \left\{ (t_1 - \psi) + \beta \frac{(t_1^3 - \psi^3)}{6} \right\}$$

The total average cost consists of following elements:

(i) Ordering cost of Electronic components per cycle = A (9)

(ii) Holding cost of Electronic components per cycle (H_1) in W

$$H_1 = H_O \left[\int_0^{\psi} I_w(t) e^{-\theta t} dt + \int_{\psi}^{t_1} I_w(t) e^{-\theta(\psi+t)} dt \right]$$

$$H_1 = H_O \left\{ C_W \left(\psi - \frac{\theta \psi^2}{2} - \frac{\beta \psi^3}{6} \right) + \eta e^{-\gamma(\psi+\theta)} \left[\frac{t_1^2}{2} - \frac{\theta t_1^3}{6} + \frac{\beta t_1^4}{12} - \frac{\theta \beta}{20} t_1^5 \right. \right. \\ \left. \left. - \frac{\psi}{2} (2t_1 - \psi) - \frac{\beta \psi}{24} (4t_1^3 - \psi^3) + \frac{\theta \psi^2}{6} (3t_1 - 2\psi) + \frac{\theta \beta \psi^2}{30} \right. \right. \\ \left. \left. (5t_1^3 - 3\psi^3) + \frac{\beta \psi^3}{24} (4t_1 - 3\psi) \right] \right\} \quad (10)$$

(iv) deteriorated Cost of Electronic components units per cycle (C_D)

$$= D_C \left[\int_0^{\psi} \beta t I_w(t) e^{-\theta t} dt + \int_{\psi}^{t_1} \beta t I_w(t) e^{-\theta(t+\psi)} dt \right]$$

$$= D_C \beta \left[C_W \left(\frac{\psi^2}{2} - \frac{\theta \psi^3}{3} - \frac{\beta \psi^4}{8} \right) + \eta e^{-\psi(\gamma+\theta)} \left(\frac{t_1^3}{6} - \frac{\theta t_1^4}{12} + \frac{\beta t_1^5}{40} - \frac{\theta \beta t_1^6}{36} - \frac{\psi^2}{6} \right. \right. \\ \left. \left. (3t_1 - 2\psi) - \frac{\beta \psi^2}{60} (5t_1^3 - 2\psi^3) - \frac{\theta \psi^3}{12} (4t_1 - 3\psi) - \frac{\theta \beta \psi^3}{36} (2t_1^3 - \psi^3) \right. \right. \\ \left. \left. - \frac{\beta \psi^4}{40} (5t_1 - 4\psi) \right) \right] \quad (11)$$

(v) Electronic components Shortage cost per cycle (C_S)

$$= S_C \left[\int_{t_1}^T -I_w(t) e^{-\theta(t_1+t)} dt \right]$$

$$= \frac{-\eta S_C e^{-(\theta t_1 + \gamma \psi)}}{\alpha} \left[\int_{t_1}^T e^{-(\theta+\alpha)t} dt - e^{-\alpha t_1} \int_{t_1}^T e^{-\theta t} dt \right]$$

$$= \frac{\eta S_C e^{-(\theta t_1 + \gamma \psi)}}{\alpha \theta (\alpha + \theta)} \left[\alpha e^{-(\alpha+\theta)t_1} + e^{-\theta T} \left\{ \theta e^{-\alpha T} - (\alpha + \theta) e^{-\alpha t_1} \right\} \right] \quad (12)$$

(vi) Opportunity cost of Electronic components due to lost sales per cycle (C_0)

$$= C_1 \int_{t_1}^T \eta (1 - e^{-\alpha t}) e^{-\gamma \psi} e^{-\theta(t_1+t)} dt$$

$$= \frac{C_1 \eta e^{-(\gamma \mu + \theta t_1)}}{\theta(\alpha + \theta)} \left[e^{-\theta t_1} \{ (\alpha + \theta) - \theta e^{-\beta t_1} \} - e^{-\theta T} \{ (\alpha + \theta) - \theta e^{-\alpha T} \} \right] \quad (13)$$

Therefore, the total average cost per unit time of our model is obtained as follows

$$K(t_1, T) = \frac{1}{T} [\text{Ordering Cost of Electronic components} + \text{Holding cost in Warehouse of Electronic components} + \text{Deterioration cost of Electronic components} + \text{Shortage cost of Electronic components} + \text{Opportunity cost of Electronic components}] \quad (14)$$

$$K(t_1, T) = \frac{1}{T} \left[A + H_O \left\{ C_W \left(\psi - \frac{\theta \psi^2}{2} - \frac{\beta \psi^3}{6} \right) + \eta e^{-\gamma(\psi + \theta)} \left[\frac{t_1^2}{2} - \frac{\theta t_1^3}{6} + \frac{\beta t_1^4}{12} - \frac{\theta \beta t_1^5}{20} \right. \right. \right. \\ \left. \left. - \frac{\psi}{2} (2t_1 - \psi) - \frac{\beta \psi}{24} (4t_1^3 - \psi^3) + \frac{\theta \psi^2}{6} (3t_1 - 2\psi) + \frac{\theta \beta \psi^2}{30} (5t_1^3 - 3\psi^3) + \frac{\beta \psi^3}{24} (4t_1 - 3\psi) \right] \right\} \\ + D_C \beta \left[C_W \left(\frac{\psi^2}{2} - \frac{\theta \psi^3}{3} - \frac{\beta \psi^4}{8} \right) + \eta e^{-\gamma(\psi + \theta)} \left(\frac{t_1^3}{6} - \frac{\theta t_1^4}{12} + \frac{\beta t_1^5}{40} - \frac{\theta \beta t_1^6}{36} - \frac{\psi^2}{6} \right. \right. \\ \left. \left. (3t_1 - 2\psi) - \frac{\beta \psi^2}{60} (5t_1^3 - 2\psi^3) - \frac{\theta \psi^3}{12} (4t_1 - 3\psi) - \frac{\theta \beta \psi^3}{36} (2t_1^3 - \psi^3) - \frac{\beta \psi^4}{40} (5t_1 - 4\psi) \right) \right. \\ \left. + \frac{\eta S_C e^{-(\theta t_1 + \gamma \psi)}}{\alpha \theta (\alpha + \theta)} \left[\alpha e^{-(\alpha + \theta)t_1} + e^{-\theta T} \{ \theta e^{-\alpha T} - (\alpha + \theta) e^{-\alpha t_1} \} \right] \right. \\ \left. + \frac{C_1 \eta e^{-(\gamma \mu + \theta t_1)}}{\theta(\alpha + \theta)} \left[e^{-\theta t_1} \{ (\alpha + \theta) - \theta e^{-\beta t_1} \} - e^{-\theta T} \{ (\alpha + \theta) - \theta e^{-\alpha T} \} \right] \right] \quad (15)$$

Therefore, numerical solution of these equations is obtained by using the software **MATLAB 7.0.1**.

6. Distance-based Pareto-GA

To explain its principle let us consider multi-objective optimization problems involving q objective and each objective is a function of m variables.

$$\text{Minimize } f_i(H), i = 1, 2, \dots, q \quad (16)$$

Subject to

$$H^{\min} \leq H \leq H^{\max}$$

Where $H = (h_1, h_2, \dots, h_m)^T$

Step 1: generate an initial population of solutions of size N at random the first solution is assigned a fitness Ω arbitrarily and copied into the Pareto-optimal/non-dominated set. Thus the population of solutions of size N is divided into two sub-populations: non-dominated set N_1 by the symbol: Π_j (where $j=1, 2, 3, \dots, J$) which has q objective function values represented by $\Pi_{j1}, \Pi_{j2}, \dots, \Pi_{jq}$.

Step 2: To decide whether a particular solution H will be put in the non-dominated set N_1 , its distance is calculated from the existing non-dominated solutions(s)

$$d_{j,H} = \sqrt{\sum_{\omega=1}^q \left(\frac{\Pi_{j\omega} - f_{\omega}(x)}{\Pi_{j\omega}} \right)^2} \quad (17)$$

The values of $d_{j,h}$ are calculated and then compared. The minimum of $d_{j,h}$ values is represented by $d_{\min}$ and the corresponding value of j is denoted by j^*

If the solution H is found to be non-dominated with respect to the present non-dominated set of solution it is included in the pareto-optimal set of solutions and its fitness (Ω) is calculated as follows:

$$\Omega(H) = \Omega(\Pi_{j^*}) + d_{\min} \quad (18)$$

The non-dominated set of solutions is then update by deleting the solutions dominated by H .

However if the solution H is seen to be dominated by the present non-dominated set of solutions it is not selected for Pareto-optimal set and it is assigned a fitness of $\Omega(\Pi_{j^*}) - d_{\min}$. As this fitness cannot be negative it is set equal to 0.0, if $(\Omega(\Pi_{j^*}) - d_{\min})$ is found to be negative.

Step 3: The fitness values are thus calculated for the whole population of solutions. The maximum value of fitness ($\Omega_{\max}$) is then determined for all the existing solutions of non-dominated set. All the non-dominated solutions are then assigned the fitness equal to $F_{\max}$

Step 4: The population of solutions is modified using the operators namely reproduction crossover and mutation. One generation of the GA is thus completed and it continues till it reaches the termination criterion.

7. Numerical Illustration

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

$\eta = 100$ units, $A = \text{Rs. } 200$ per order, $\theta = 1.05$ unit, $H_0 = \text{Rs. } 9.0$ per unit per year, $\gamma = 1.2$ unit, $\beta = 0.012$ unit, $S_c = \text{Rs. } 32.0$ per unit per year, $\Psi = 1.2$ year, $C_1 = \text{Rs. } 8.0$ per unit, $\alpha = 1.1$ unit, $T = 1$ year,

Then for the minimization of total average cost and with help of software. the optimal policy can be obtained such as:

$t_1 = 1.8592$ year, $S = 68.597235$ units and $K = \text{Rs. } 458.115354$ per year.

Genetic Algorithms

Real coded, population=95, generations=660, crossover probability=0.20, mutation probability=0.4.

Implementation of system

In the proposed algorithm steps is applied on mathematical results obtained from the mathematical inventory model. It provides best cost solution and optimizes the results. MATLAB is used to implement the proposed work. MATLAB stands for matrix programming language which was developed by Math Works. It is a programming language that makes algebra programming simple. MATLAB is a fourth-generation high level programming language that provides an interactive environment for computation, visualization and programming. Functions of MATLAB that are used in proposed work are:

- Zeros: it will create an array of all zeros.
- Rand: It will generate array of random numbers.
- Sum: Sum of array elements..
- Ones: Create an array of all ones.
- Cumsum: It returns cumulative sum of all elements.
- Cost function: This function is used to optimize the results.
- Floor: Rounds the elements to the nearest integers less than or equal to value.
- plot: To plot graphs.

Table: - 1 Best results of purpose function by different algorithms for Maximum demand

Algorithms	Product's Maximum inventory Level	Maximum
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	1	2	3	4	5	profit (Rs.)
Genetic Algorithm	125	205	351.5	451.1	550	399.25

Table: - 2 Best results of purpose function by different algorithms for Standard demand.

Algorithms	Product's Maximum inventory Level					Maximum profit (Rs.)
	1	2	3	4	5	
Genetic Algorithm	124	201	371.5	421.1	540	390.25

Table: - 3 Best results of purpose function by different algorithms for Average demand.

Algorithms	Product's Maximum inventory Level					Maximum profit (Rs.)
	1	2	3	4	5	
Genetic Algorithm	124	208	375.5	422.1	545	391.25

Table: - 4 Best results of purpose function by different algorithms for Minimum demand.

Algorithms	Product's Maximum inventory Level					Maximum profit (Rs.)
	1	2	3	4	5	
Genetic Algorithm	120	201	301.5	401.1	501	351.25

8. Conclusion

This study incorporates some realistic features that are likely to be associated with the Inventory of Electronic components of any material. Decay (deterioration) overtime for any material product and occurrence of shortages in Inventory of Electronic components are natural phenomenon in real situations. Inventory of Electronic components shortages are allowed in the model. In many cases customers are conditioned to a shipping delay, and may be willing to wait for a short time in order to get their first choice. Generally speaking, the length of the waiting time for the next replenishment is the main factor for deciding whether the backlogging will be accepted or not. The willingness of a customer to wait for backlogging during a shortage period declines with the length of the waiting time. Thus, Inventory of Electronic components shortages are allowed and partially backordered in the present chapter and the backlogging rate is considered as a decreasing function of the waiting time for the next replenishment. Demand rate is taken as exponential ramp type function of time, in which demand decreases exponentially for the some initial period and becomes steady later on. Since most decision makers think that the inflation does not have significant influence on the Inventory of Electronic components policy, the effects of inflation are not considered in some Inventory of Electronic components models. However, from a financial point of view, an Inventory of Electronic component represents a capital investment and must complete with other assets for a firm's limited capital funds. Thus, it is necessary to consider the effects of inflation on the Inventory of Electronic components system. Therefore, this concept is also taken in this model. From the numerical illustration of the model, it is observed that the period in which Inventory of Electronic components holds increases with the increment in backlogging and ramp parameters while Inventory of Electronic components period decreases with the increment in deterioration and inflation parameters. Initial Inventory of Electronic components level decreases with the increment in deterioration, inflation and ramp parameters while Inventory of Electronic components level increases with the increment in backlogging parameter. The total average cost of the system goes on increasing with the increment in the backlogging and deterioration parameters while it decreases with the increment in inflation and ramp parameters. The proposed model can

be further extended in several ways. For example, we could extend this deterministic model in to stochastic model. Also, we could extend the model to incorporate some more realistic features, such as quantity discount or the unit purchase cost, the Inventory of Electronic components holding cost and others can also taken fluctuating with time.

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