Order Policy Analysis for Deteriorating Inventory Model with Trapezoidal Type Demand Rate

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***Abstract*—In this article, we extend Cheng, Zhang and Wang [17] model studied pricing strategies in marketing. The objective is to find the optimal inventory and pricing strategies maximizing the net present value of total profit over the infinite horizon. It is important to control and maintain the inventories of deteriorating items for the modern corporation. We will discuss two models: one is without shortage, and the other is with shortage. By using the subroutine Find Root in commercial software Mathematical 5.2, we obtain the optimal solutions In this paper, we assume that the inventory objective is to minimize the total cost per unit time of the system.**

***Index Terms*—Trapezoidal Type Demand Rate, Deteriorating Items, Backlogging**

I. INTRODUCTION

The effect of deterioration is very important in many inventory systems. Most of the literature assumes that a constant proportion of items will deteriorate per time-unit while they are in storage. Ghare and Schrader were the first proponents for developing a model for an exponentially decaying inventory, to consider continuously decaying inventory for a constant demand [1]. Covert and Philip used a variable deterioration rate of two-parameter Weibull distribution to formulate the model with assumptions of a constant demand rate and no shortages [2]. Shah and Jaiswal presented an order-level inventory model for deteriorating items with a constant rate of deterioration [3]. Dave and Patel first considered the inventory model for deteriorating items with time-varying demand [4]. They considered a linear increasing demand rate over a finite horizon and a constant deterioration rate. Chang and Dye developed an EOQ model for deteriorating items with time-varying demand and partial backlogging [5]. Skouri and Papachristos presented a continuous review inventory model, with deteriorating items, time-varying demand , linear replenishment cost, partially time-varying backlogging [6]. Other researchers, there are many literatures that propose and evaluate the algorithms [7], [8], [9], [10], [11].

In the classical inventory model, the demand rate is assumed to be a constant. In reality, the demand for physical goods may be time-dependent, stock-dependent and price dependent. Hill first considered the inventory models for increasing demand followed by a constant demand [12]. M and al and Pal extended the inventory model with ramp type demand for deterioration items and allowing shortage [13]. Chen, Ouyang and Teng considered an EOQ model with ramp type demand rate and time dependent deterioration rate [14]. P and a, Senapati and Basu developed optimal replenishment policy for perishable seasonal products in a season with ramp-type time dependent demand [15]. Other researchers, there are many literatures that propose and evaluate the algorithms [16], [17], [18], [19], [20], [21], [22], [23], [24].

In this article, we extend Cheng, Zhang and Wang [17] model studied an economic production quantity (EPQ) model and pricing strategies. Assume the demand rate with continuous trapezoidal function of time, which is a positive linear function. The objective is to find the optimal inventory and pricing strategies maximizing the net present value of total profit over the infinite horizon, it is important to control and maintain the inventories of deteriorating items for the modern corporation. We will discuss two models: one is without shortage, and the other is with shortage. By using the subroutine FindRoot in commercial software Mathematica 5.2, we obtain the optimal solutions In this paper, we assume that the inventory objective is to minimize the total cost per unit time of the system.

II. NOTATION AND ASSUMPTIOMS

The mathematical model in this paper is developed on the basis of the following notations and assumptions.

A. Notations

A_0 setup cost per setup.

C_1 unit holding cost per unit time.

C_2 unit deteriorating cost per unit time.

C_3 unit cost of lost sales. (i.e., Model 2).

t_1 point of time when inventory level is maximum.

t_2 point of time when all inventory is consumed.

t_3 the production restarting time when the model with shortage (i.e.,Model 2).

t_4 inventory cycle time when the model with shortage (i.e., Model 2).

$I(t)$ on-h and inventory at time t over $[0, t2]$.

$I_{\max}$ the maximum inventory level for each ordering cycle.

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OC ordering cost per cycle.
HC unit total holding cost per cycle.
DC unit deteriorating cost per cycle.
SC cost of lost sales per cycle.
TC_1 total cost for a production cycle. (i.e., Model 1).
TC_2 total cost for a production cycle. (i.e., Model 2).
TVC_1 total average cost for a production cycle. (i.e., Model 1).
TVC_2 total average cost for a production cycle. (i.e., Model 2).

B. Assumptions

In addition, the following assumptions are used throughout this paper.

(1) A single item is considered and infinite planning horizon.

(2) Lead time is zero.

(3) The initial and final inventory levels are both zero.

(4) There is no replacement.

(5) Demand rate *R = D(t)* is assumed to be a ramp type function of time, where is the function defined as follows:

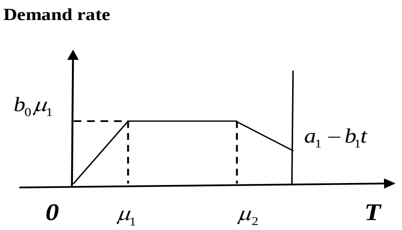

Figure 1. The trapezoidal type demand rate

$$D(t)=\begin{cases} b_0t & t\le\mu_1 \\ b_0\mu_1 & \mu_1\le t\le\mu_2 \\ a_1-b_1t & \mu_2\le t\le T\le\frac{a_1}{b_1}\end{cases}$$

(6) $P(t)=\beta D(t)$ is the production rate where β $(1<\beta<2)$ is a constant.

(7) θ unit deterioration rate during time-span is $[0,t_2]$.

(8) Shortages are allowed to occur. (i.e., Model 2).

III. Mathematical Model and Solution

In this section, we will discuss two models: Model 1 is without shortage, and the Model 2 is with shortage. Here the trapezoidal type demand of an item is dependent on the relative size of μ_1,μ_2.

A. Model 1: Model without Shortage.

In this model 1, the production starts with zero stock level at time $t=0$ and the production stops at time t_1. Due to the combined effects of demand and deterioration of items, the inventory level gradually diminishes during the period $[t_1;t_2]$ and ultimately falls to zero at time $t=t_2$.

The whole process is repeated and the behavior of the inventory system is depicted in “Fig. 2,” The inventory cycle here has the following four phases:

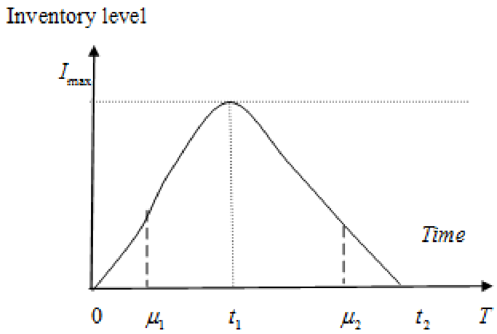

Figure 2. The inventory model without shortage

Phase1. During the time interval $[0,\mu_1]$ the demand rate is b_0t, the production rate is βb_0t and the deterioration rate is $\theta I_1(t)$ at time t. Therefore, the inventory level at time t, is governed by

$$\frac{dI_1(t)}{dt}+\theta I(t)=(\beta-1)b_0t,\ 0\le t\le\mu_1 \quad (1)$$

with the boundary condition. $I_1(0)=0$.

Phase2. During the time interval $[\mu_1,t_1]$, from assumptions (5) and Figure 1 and Figures 2, we know that the demand rate is b_0 the production rate is βb_0, and the deterioration rate is $\theta I_2(t)$ at time t. Therefore, the inventory level at time t, is governed by

$$\frac{dI_2(t)}{dt}+\theta I_2(t)=(\beta-1)b_0\mu_1,\ \mu_1\le t\le t_1 \quad (2)$$

with the boundary condition. $I_2(\mu_1)=I_1(\mu_1)$.

Phase3. In the time interval $[t_1,\mu_2]$, the system is affected by the combined the demand and deterioration. Hence, the inventory level at time t, is governed by

$$\frac{dI_3(t)}{dt}+\theta I_3(t)=-b_0\mu_1,\ t_1\le t\le\mu_2 \quad (3)$$

with the boundary conditions
$I_3(t_1)=I_2(t_1)$, $I_3(\mu_2)=I_4(\mu_2)$

Phase4. In the time interval $[\mu_2,t_2]$ the system is affected by the combined the demand and add the product expires accelerate the deteriorating of items into the model. Hence, the inventory level at time t, is governed by

$$\frac{dI_4(t)}{dt}+\theta I_4(t)=-(a_1-b_1t),\ \mu_2\le t\le t_2 \quad (4)$$

with the boundary conditions $I_4(t_2)=0$.

The solution to “(1),” is

$$I_1(t)=\frac{e^{-t\theta}(\beta-1)(1-e^{t\theta}+e^{t\theta}t\theta)b_0}{\theta^2},\ 0\le t\le\mu_1 \quad (5)$$

The solution to “(2),” with

$$I_1(\mu_1)=\frac{e^{-\mu_1\theta}(\beta-1)(1-e^{\mu_1\theta}+e^{\mu_1\theta}\mu_1\theta)b_0}{\theta^2}$$ is

$$I_2(t)=\frac{e^{-t\theta}(\beta-1)(1+e^{t\theta}\theta\mu_1-e^{\mu_1\theta})b_0}{\theta^2},\ \mu_1\le t\le t_1 \qquad (6)$$

The solution to "(4)," is

$$I_4(t)=\frac{(-1+e^{(-t+t_2)\theta})a_1\theta+(-1+t\theta+e^{(-t+t_2)\theta}(1-t_2\theta))b_1}{\theta^2}$$

$$\mu_2\le t\le t_2 \qquad (7)$$

The solution to "(3)," with

$$I_4(\mu_2)=\frac{(-1+e^{(-\mu_2+t_2)\theta})a_1\theta+(-1+\mu_2\theta+e^{(-\mu_2+t_2)\theta}(1-t_2\theta))b_1}{\theta^2}$$, is

$$I_3(t)=\frac{1}{\theta^2}e^{-t\theta}((e^{t_2\theta}-e^{\mu_2\theta})a_1\theta-(e^{t\theta}-e^{\theta\mu_2})\mu_1b_0\theta + b_1(e^{t_2\theta}(1-t_2\theta)+e^{\theta\mu_2}(-1+\mu_2\theta))),t_1\le t\le\mu_2 \qquad (8)$$

We have the maximum inventory level is given by $I_{\max}=I_3(t_1)=I_2(t_1)$.

$$\frac{e^{-t_1\theta}(\beta-1)(1+e^{t_1\theta}\theta\mu_1-e^{\mu_1\theta})b_0}{\theta^2} = \frac{e^{-t_1\theta}((e^{t_2\theta}-e^{\mu_2\theta})a_1\theta-(e^{t_1\theta}-e^{\theta\mu_2})\mu_1b_0\theta+b_1(e^{t_2\theta}(1-t_2\theta)+e^{\mu_2\theta}(-1+\mu_2\theta)))}{\theta^2} \qquad (9)$$

From "(9)," it is obvious that t_2 is a function of t_1. As a result, the problem here has only one decision variable t_1. That is

$$t_1=\frac{1}{\theta}[Log[\frac{1}{\beta\theta\mu_1b_0\theta}(e^{t_2\theta}-e^{\theta\mu_2})a_1\theta + b_0((-1+e^{\mu_1\theta})(-1+\beta)+e^{\theta\mu_2}\theta\mu_1) + b_1(e^{t_2\theta}(1-t_2\theta)+e^{\mu_2\theta}(-1+\theta\mu_2)) \qquad (10)$$

The total cost per cycle consists of the following three elements:

(a) The setup cost is OC= A_0.

(b) The inventory holding cost is

$$HC_1=C_1[\int_0^{\mu_1}I(t)dt+\int_{\mu_1}^{t_1}I(t)dt+\int_{t_1}^{\mu_2}I(t)dt+\int_{\mu_2}^{t_2}I(t)dt]$$
$$=\frac{1}{2\theta^3}(e^{-t_1\theta}C_1(2a_1\theta(e^{t_2\theta}-e^{\theta\mu_2}-e^{t_1\theta}\theta(t_2-\mu_2)) + b_1(-2e^{t_2\theta}(-1+t_2\theta)+2e^{\mu_2\theta}(-1+\mu_2\theta) + e^{t_1\theta}\theta^2(t_2{}^2-\mu_2{}^2))+b_0(2(-1+e^{\mu_1\theta})(-1+\beta) + \theta\mu_1(2e^{\mu_2\theta}+e^{t_1\theta}(-2\beta+2t_1\beta\theta) + (\theta-\beta\theta)\mu_1-2\mu_2\theta))))) \qquad (11)$$

(c) The inventory deteriorating cost is

$$DC_1=C_2[\beta\int_0^{\mu_1}b_0tdt+\beta\int_{\mu_1}^{t_1}b_0\mu_1dt-\int_0^{\mu_1}b_0tdt -\int_{\mu_1}^{t_1}b_0\mu_1dt-\int_{t_1}^{\mu_2}b_0\mu_1dt-\int_{\mu_2}^{t_2}(a-bt)dt]$$
$$=\frac{1}{2}C_3(b_0\mu_1(2t_1\beta+\mu_1-\beta\mu_1-2\mu_2) -2a_1(t_2-\mu_2)+b_1(t_2{}^2-\mu_2^2)) \qquad (12)$$

Therefore, the total cost per unit time during time-span $\left[0,t_2\right]$ is

$$TVC_1(t_1,t_2)=\frac{TC_1(t_1,t_2)}{t_2} \qquad (13)$$

where

$$TC_1(t_1,t_2)=A_0+HC_1+DC_1 \qquad (14)$$

Hence, the total relevant cost per unit time is a function of one variable t_2 because of "(13)," The necessary condition for TVC_1 to be minimum is the optimal solution satisfies:

$$\frac{dTVC_1}{dt_2}\Big|(t_2)=0 \qquad (15)$$

provided they satisfy the sufficient conditions

$$\frac{d^2TVC_1}{dt_2{}^2}\Big|(t_2)>0. \qquad (16)$$

Due to the fact that t_1 is a function of t_2, thus $TVC_1(t_1;t_2)$ in "(13)," can be reduced as a function of t_2, we denoted it by $TVC_1(t_2)$, i.e., $TVC_1(t_2)=TVC_1(t_1;t_2)$. Hence, the problem faced by the vendor in Model 1 is

Minimize $TVC_1(t_2)$, $0\le t_1\le t_2$.

To minimize the total cost per unit time, taking the first derivative of $TVC_1(t_2)$ with respect to t_1, and setting the result to be zero, we obtain

$$\frac{dTVC_1(t_2)}{dt_2}=0$$

Let t_1^* denoted the optimal value of t_2, and then t_2^* must satisfy "(16)," Furthermore, we can see that the stationary point t_2 also satisfies the

$$\frac{d^2TVC_1}{dt_2{}^2}\Big|(t=t_2{}^*)>0$$

Due to the fact that t_1 is a function of t_2, thus $TVC_1(t_1;t_2)$ in "(13)," can be reduced as a function of t_2, we denoted it by $TVC_1(t_1)$, i.e., $TVC_1(t_2)=TVC_1(t_1;t_2)$. Hence, the problem faced by the vendor in Model 1 is

Minimize $TVC_1(t_2)$, Subject to: $0\le t_1\le t_2$.

Consequently, we can obtain the value of t_2 from "(15)," Although we are unable to prove that the solution to "(15)," uniquely exits, the numerical examples in section 4 below indicate so. Once the optimal solution t_2

is obtained, the corresponding optimal value t_1 can be determined from "(9),"

B. Model 2. Model with Shortage

In this model 2, the behaviors of inventory system is depicted in "Fig. 3,"

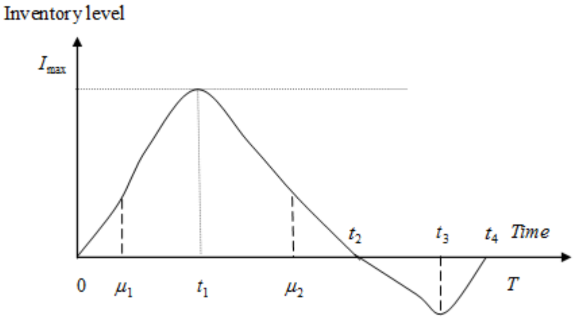

Figure 3. The inventory model with shortage

The Phases 1, 2 ,3 and 4 are same as those in Model 1.

Phase5. During the shortage interval $[t_2, t_3]$, the demand at time t is backlogged. Thus, the inventory level at time t is governed by the following differential equation:

$$\frac{dI_5(t)}{dt} = -(a_1 - b_1 t),\ t_2 \le t \le t_3 \tag{17}$$

With the boundary condition, $I_4(t_2) = 0$.

The solution of "(17)," is

$$I_5(t) = \frac{1}{2}(t - t_2)(-2a_1 + (t + t_2)b_1,\ t_2 \le t \le t_3 \tag{18}$$

Phase6. During the shortage interval $[t_3, t_4]$ the backorders level at time t, is governed by the following differential equation:

$$\frac{dI_6(t)}{dt} = (\beta - 1)(a_1 - b_1 t)\ ,t_3 \le t \le t_4 \tag{19}$$

The solution to "(19)," is

$$I_6(t) = -\frac{1}{2}(t - t_4)(\beta - 1)(-2a_1 + (t + t_4)b_1) \tag{20}$$

with the boundary condition $I_6(t_4) = 0$.

Given the condition $I_5(t_3) = I_6(t_3)$, we get

$$(\beta - 1)(a_1 - b_1 t_3) = -\frac{1}{2}(t_3 - t_4)(\beta - 1)(-2a_1 + (t_3 + t_4)b_1), \tag{21}$$

From "(21)," it is obvious that t_2 is a function of t_3. As a result, the problem here has only one decision variable t_3.

$$t_3 = \frac{-2\beta a_1 - \sqrt{\begin{aligned}&4\beta^2 a_1^2 + 4\beta b_1(-2t_2 a_1 + 2t_4 a_1 - 2t_4 \beta a_1 \\ &+ t_2^2 b_1 - t_4^2 b_1 + t_4^2 \beta b_1)\end{aligned}}}{2\beta b_1}$$

The total cost per cycle of the system consists of the following five elements:

(a) The setup cost is OC= A_0. (22)

(b) The inventory holding cost is $HC_2 = HC_1$ (23)

(c) The inventory deteriorating cost is $DC_2 = DC_1$ (24)

(d) The cost of lost sales is

$$\begin{aligned} SC_2 &= C_3[\int_{t_2}^{t_3} -I_4(t)dt + \int_{t_3}^{t_4} -I_5(t)dt] \\ &= -\frac{1}{6}(-3((t_2 - t_4)(t_2 - 2t_3 + t_4) + (t_3 - t_4)^2 \beta)a_1 \\ &+ (2t_2^3 - 3t_2^2 t_3 - 3t_3 t_4^2(-1 + \beta) \\ &+ 2t_4^3(-1 + \beta) + t_3^3 \beta)b_1)C_3) \end{aligned} \tag{25}$$

Consequently, the total cost per unit time during time-span $[0, t_4]$ is

$$TVC_2(t_1, t_2, t_3, t_4) = \frac{TC_2(t_1, t_2, t_3, t_4)}{t_4} \tag{26}$$

where

$$TC_2(t_1, t_2, t_3, t_4) = A_0 + HC_2 + DC_2 + SC_2 \tag{27}$$

From "(9)," and "(21)," we know that t_2 is a function of t_1, and t_4 is a function of t_2 and t_3 Consequently, the decision variables in Model 2 can be reduced from four dimensions (t_1, t_2, t_3, t_4) to two dimensions (t_1, t_3), i.e., the problem faced by the vendor in this model is

$$\text{(P2) Minimize } TVC_2(t_1; t_3) \tag{28}$$

Subject to: $0 \le t_1 \le t_2$, $t_2 \le t_3 \le t_4$.

Our objective is to find the optimal values of t_1 and t_3 such that $TVC_2(t_1; t_3)$ has minimum. That is, in order to find the optimal values of t_1 and t_3, we have to solve the complex nonlinear equations $\frac{\partial TVC_1(t_1, t_3)}{\partial t_1} = 0$ and $\frac{\partial TVC_1(t_1, t_3)}{\partial t_3} = 0$.

We can obtain the optimal values t_1^* and t_3^*. Once we obtain the optimal value $(t_1^*; t_3^*)$, the optimal solution $(t_2^*; t_4^*)$ is obtained from "(9)," and "(21),".

IV. Numerical Examples and Sensitivity Analysis

By applying the subroutine, we obtain the optimum solution for TVC_1^* of "(13),". Then by applying the subroutine the same package as above, the optimum solutions for TVC_2^* of "(26),". In order to illustrate the above solution procedure, let us consider an inventory system with the following data.

Example 1: For the model without shortage, we let A_0 =\$200 per setup, C_1 =\$3/unit, C_2 =\$5/unit, μ_1 =2,

μ_2 =8, b_0 =4000, β =1.3, $\theta = 0.03$, $a_1 = 400$, b_1 =10 .In appropriate units. By using the subroutine FindRoot in commercial software Mathematica 5.2, we obtain the optimal solutions for t_1^* , t_2^* and TVC_1^* are given as t_1^* = 6.93075, t_2^* = 21.7639 and TVC_1^* = 10732.

Example 2: For the model with shortage, we let A_0 =\$200 per setup, C_1 =\$3/unit, C_2 =\$5/unit, C_3 =\$6/unit, μ_1 =2, μ_2 =8, b_0 =4000, β =1.3, $\theta = 0.03$, a_1 =400, $b_1 = 10$. In appropriate units. By using the subroutine FindRoot in commercial software Mathematica 5.2, we obtain the optimal solutions for $t_1^*; t_2^*; t_3^*; t_4^*$ and TVC_2^* are given as t_1^* = 6.75599, t_2^* = 15.7612, t_3^* =71.5392, t_4^* = 88.498 and TVC_2^* = 6696.95.

A. Sensitivity Analysis

For studying the sensitivity analysis of the parameters on the proposed models, we changed (increasing or decreasing) the parameters by 25% and took one parameter at a time, kept the remaining parameters at their original values.

The results are shown in Tables 1 and Tables 2 reveals the following points.

TABLE I. WITHOUT SHORTAGE MODEL (I.E., EXAMPLE 1)

Changing parameter	(%) change	(%)change		
		t_1^*	t_2^*	TVC_1^*
C_1	25	-0.0025	-0.0285	23.7896
	-25	0.0040	0.0464	-23.7888
C_2	25	-0.00014	-0.0018	1.1899
	-25	0.00014	0.0018	-1.1890
μ_1	25	0.7866	19.8958	9.0095
	-25	-0.5424	-15.5395	-12.9620
μ_2	25	24.0147	24.1703	20.6783
	-25	-25.4750	-37.6123	-25.7842
b_0	25	-0.0434	17.8465	13.3861
	-25	-0.2483	-18.8340	-16.8235
a_1	25	-0.6424	-22.9729	12.1599
	-25	-2.0311	12.2726	-21.8193
b_1	25	-1.1775	-3.8573	-6.5011
	-25	-0.8223	-15.7481	5.3951

Example 1:

(1) It can be found that the value t_1^* is highly sensitive to change in the value of μ_2 . Moreover, t_1^* is low sensitive to change in the value of C_1, C_2, μ_1, b_0, a_1 and b_1.

(2) It can be found that the value t_2^* is highly sensitive to change in the value of μ_1, μ_2, b_0 and a_1. Moreover, t_2^* is moderately sensitive to change in the value of b_1. In addition, t_2^* is low sensitive to change in value of C_1 and C_2.

(3) It can be found that the value TVC_1^* is highly sensitive to change in the value of C_1, μ_2, b_0 and a_1. Moreover, TVC_1^* is moderately sensitive to change in the value of C_2, μ_1 and b_1.

TABLE II. THE INVENTORY MODEL WITH SHORTAGE.(I.E., EXAMPLE 2)

Changing parameter	(%) change	(%)change				
		t_1^*	t_2^*	t_3^*	t_4^*	TVC_2^*
C_1	25	-0.021	-0.287	0.065	0.063	7.426
	-25	0.021	0.296	-0.066	-0.063	-7.477
C_2	25	-0.001	-0.015	0.003	0.003	0.373
	-25	0.001	0.015	-0.003	-0.003	-0.373
C_3	25	0.018	0.248	-0.056	-0.054	17.146
	-25	-0.029	-0.402	0.092	0.089	-17.206
μ_1	25	-0.008	-0.274	0.202	0.378	3.234
	-25	0.511	0.317	-0.237	-0.447	-3.85
μ_2	25	22.840	-0.576	0.691	1.397	8.753
	-25	-22.485	0.222	-0.511	-1.102	-5.343
b_0	25	-0.747	-0.430	0.301	0.557	4.869
	-25	1.242	0.419	-0.303	-0.566	-4.923
a_1	25	-0.543	-18.26	21.942	-0.979	276.267
	-25	-1.605	-7.272	-27.932	-26.556	-46.325
b_1	25	-1.103	-11.643	-24.5	-27.916	-3.106
	-25	0.727	4.097	38.581	36.461	77.654

Example 2:

(1) It can be found that the value t_1^* is highly sensitive to change in the value of μ_2 . Moreover, t_1^* is low sensitive to change in the value of C_1, C_2, C_3, μ_1, b_0, a_1 and b_1.

(2) It can be found that the value t_2^* is highly sensitive to change in the value of a_1. Moreover, t_2^* is moderately sensitive to change in the value of b_1. In addition, t_2^* is low sensitive to change in the value of C_1, C_2, C_3, μ_1, μ_2 and b_0.

(3) It can be found that the value t_3^* is highly sensitive to change in the value of a_1 and b_1. Moreover, t_3^* is low sensitive to change in value of C_1, C_2, C_3, μ_1, μ_2 and b_0.

(4) It can be found that the value t_4^* is highly sensitive to change in the value of a_1 and b_1 . Moreover, t_4^* is moderately sensitive to change in the value of μ_2 . In addition, t_4^* is low sensitive to change in value of C_1, C_2, C_3, μ_1 and b_0.

(5) It can be found that the value TVC_2^* is highly sensitive to change in the value of C_3 , a_1 and b_1 . Moreover, TVC_2^* is moderately sensitive to change in the value of C_1 , μ_1 , μ_2 and b_0 . In addition, t_4^* is low sensitive to change in value of C_2 and μ_1.

V. CONCLUDING REMARKS

In this article, we considering the inventory and pricing strategies. The objective is to find the optimal inventory and pricing strategies maximizing the net present value of total profit over the infinite horizon, it is important to control and maintain the inventories of deteriorating items for the modern corporation.

This paper presented a methodology and provided numerical results related to trapezoidal type demand rate to find the optimal inventory policy. Two numerical examples are given to illustrate the solution procedure and sensitivity analyses have been shown. Example 1 is seen that the percentage change in the optimal total average cost per unit time is highly sensitive in parameters C_2, μ_1, μ_2, a_1 and b_0. Example 2 is seen that the percentage change in the optimal total average cost per unit time is highly sensitive in parameters C_3, μ_2, a_1 and b_1.

We think that such type of trapezoidal type demand rate is quite realistic and can provide for the further study of this kind of important inventory models from the market information.

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