Innovative Study of EPQ Model with Time Induced Demand under Decline Release

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Abstract: In this paper production, inventory (EPQ) model by means of incorporate cost diminution release strategy is considered. Production and demand both are simultaneous processes in the real world production and demand rate are considered time-linked. Two models (i) production inventory and (ii) manufacture inventory model in the midst of amalgamating cost decline delivery procedure are discussed. Mathematical formulations are provided to find optimal solution for both models. The objective of this study is to obtain optimal order measure to examine the outcome of lessening for cost release plan in the EPQ model. Best possible fabrication lot size model is developed that diminishes total cost. The sensitivity analysis is discussed for variation of different parameters.

Keywords: Production; demand; Inventory; lot-size; reduction; total cost

1. Introduction.

Inventory refers to commodities produced by an organization for forthcoming usage. An inventory processes is set of strategies and controls that monitors echelons of product, so that total cost per cycle is minimized for fair operations of industry. The predictability of demand insures the inventory model is deterministic, probabilistic or imprecise. Several factors involved for the demand of an inventory model like availability of material, condition of market etc. Thus, decision maker cannot control the processors earlier decided by manager. In case of supply is more than demand shortages certainly occurred. Demand plays a deceive role is making inventory strategy. Large number of researchers have involved for developing several inventory models, considering the demand of items to be steady or time-induced. Time-induced demand inventory model is established by Dave (1986) and Maiti et al. (2009). Tripathi and Tomar (2018) presented an economic order quantity (EOQ) model in favor of quadratic time-linked demand and holding cost in the company of salvage value. Khanra and Chaudhuri (2003) explored a model in favor of weakening products by time-associated demand pattern. Begum et al. (2010) designed an inventory model by means of quadratic time unstable demand. Several research papers are published by Ghosh and Chandhuri (2004), Khanra et al. (2011), Amutha and Chandsekharan (2013), Tripathi et al. (2010), Kalam et al. (2010), Gour (2011), Shukla et al. (2013), Tripathi et al. (2014).

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inventory model in favor of worsening substances by means of time-changing demand and restricted refill rate permitting conservation expertise cost as a pronouncement changeable in combination through production strategy. Several inventory models connecting with EPQ are studied by Poles (2013), Guchhail (2013), Das et al (2015), Ghiami and Williams (2015), Bouslah et al (2013) Noblesse (2014), Wee and Wang (1999), Zou et al (2003), Teng et al (2005), Nobil, et al. (2018), Chung et al. (2017), Bhunia et al. (2017), Pasandish et al. (2016), Saha and Chakrabarti (2018), Nobil, et al. (2018), Teng et al. (2014) proposed an EPQ model from the seller’s probable to resolve his/her most advantageous trade credit epoch and fabrication lot size concurrently where (i) permitted delay period raises for sales and opening cost and defaulting hazard and (ii) production cost turns down and follow a erudition curve occurrence. Lee and Hsu (2009) described a EPQ model over a predetermined setting up prospect for worsening objects by way of time-linked demand through ability restriction. Teng et al.(2014) considered a creation structure that can create various foodstuffs alternately, manufactured goods go during the scheme in a succession and a whole sprint of all products shapes a manufacture cycle and incorporated fabrication forms a defensive unveiling model is built, which is distinguished by delay-time impression.

The remaining part of the article is framed as follows: In section 2 assumptions and notations are given. Section 3 offers EPQ model in two stages. In section 4, we establish mathematical formulation for model I. Section 5, 6, and 7 optimal solution, numerical example and sensitivity analysis are discussed respectively. Mathematical model for model 2 is discussed in section 7. Sections 8, 9 and 10 optimal solution, numerical example and sensitivity for model are given respectively. Conclusion is given in the last section.

2. Assumptions and Notations

2.1 Assumption
- Production and demand rates are time-sensitive
- Production rate is considered to be superior to demand rate
- Commodities are shaped & supplementary to the inventory
- Lead time is nil
- Shortages are not allowed
- Model is considered for single item

2.2. Notations

\( D(t) = a + bt \) : demand rate / unit time , \( a > 0 \), \( 0 < b < 1 \)

\( P = P(t) \) : Production rate/ unit time & \( P(t) = \lambda D(t), \lambda > 1 \) (constant)

\( Q_1 \) : Inventory level during \([0, t_1]\]

\( Q \) : Order quantity

\( Q^* \) : Optimal \( Q \)

\( C_p \) : Production cost/ unit

\( C_h \) : Holding cost/ unit/ year

\( K \) : Set up cost / set up

\( C_{RD} \) : Fixed delivery cost

\( C_{H} \) : Holding cost for dealer/ unit time

\( n \) : Number of release to clientele

\( P_c \) : Production cost

\( H_c \) : Holding cost

\( S_c \) : Set up cost

\( D_{ch} \) : Fixed delivery cost/unit time

\( TC \& TC^* \) : Total & optimal cost
3. Mathematical Formulation: Model 1. Production Inventory model

Production and demand rates occur simultaneously during the time \([0, t_f]\). Cycle begins at \(t = 0\), inventory builds up by rate \(P(t) - D(t)\). As a result, from region \(OBQ_1\), we have

\[
Q_i = \int_0^{t_f} (\lambda - 1)(a + bt)\,dt = (\lambda - 1)\left(a + \frac{bt_f}{2}\right) t_f
\]

From Eq.(1), we get

\[
b(\lambda - 1)t_f^2 + 2a(\lambda - 1)t_f - 2Q_i = 0
\]

Or,

\[
t_f = \frac{-2a(\lambda - 1) + \sqrt{4a^2(\lambda - 1)^2 + 8bQ_1(\lambda - 1)}}{2b(\lambda - 1)} = \frac{2a^2(\lambda - 1) - bQ_1}{2a^3(\lambda - 1)}Q_1, \quad \text{approximately}
\]

Production stopped at \(Q_1\). The only demand occurred from \(t_f\) to \(t_f + t_2 = T\). Inventory level begins to diminish due to demand \(D(t)\). In the triangle \(BQ_1C\)

\[
Q_i = \int_{t_f}^{t_2} D(t)\,dt = \left(a + \frac{b}{2}t_2 + bt_1\right)t_2
\]

\[
Q = \int_0^{t_f} P(t)\,dt = \int_0^{t_f} (a + bt)\,dt
\]

\[
t_1 = \frac{\sqrt{a^2 + 2bQ - a}}{b}
\]

\[
t_1 = \frac{Q - bQ_1^2}{a - 2a^3} \quad \text{(Approximately)}
\]

From Eq.(3) and (5), we get

\[
t_2 = \frac{Q_1\left(a^2 - bQ\right)}{a^3} \quad \text{(Approximately)}
\]
From Eqs. (2) and (4), we get \[ \frac{2a^2(\lambda - 1) - bQ_i}{2a^2(\lambda - 1)^2} = \frac{Q}{a \cdot bQ^2} \]

Or, \[ Q_i = \frac{(2a^2 - bQ)(\lambda - 1)Q}{2a^2} \]

\[ T = t_1 + t_2 \]

\[ T = \frac{Q}{2a^2} \left[ \frac{2a^2(\lambda - 1) - bQ_i}{(\lambda - 1)^2} + 2(a^2 - bQ) \right] \]

From Eq. (7) and (8), we get

\[ T = \frac{(2a^2 - bQ)Q}{8a^2} \left\{ 4a^2 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right\} \]

Average inventory is given by

\[ \bar{I} = \frac{Q_i(t_1 + t_2)}{2T} = \frac{(2a^2 - bQ)(\lambda - 1)Q}{4a^2} \]

Total cost: In case of production process, total cost includes three main costs: such as \( S_c, P_c \) and \( H_c \).

Set up Cost \( (S_c) \)

\[ T = \frac{8a^2K}{(2a^2 - bQ)Q\left\{ 4a^2 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right\}} \]

Production Cost \( (P_c) \)

\[ \frac{Q_P}{T} = \frac{8a^2P_c}{(2a^2 - bQ)\left\{ 4a^2 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right\}} \]

Holding Cost \( (H_c) \)

\[ C_h \left( \frac{(2a^2 - bQ)(\lambda - 1)Q}{4a^2} \right) \]

Total Cost = Set up Cost + Production Cost + Holding Cost

\[ TC = \frac{8a^2K}{(2a^2 - bQ)Q\left\{ 4a^2 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right\}} + \frac{8a^2P_c}{(2a^2 - bQ)\left\{ 4a^2 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right\}} + C_h \left( \frac{(2a^2 - bQ)(\lambda - 1)Q}{4a^2} \right) \]

\[ TC(Q) = \frac{8a^2(K + Q_P)}{(2a^2 - bQ)Q\left\{ 4a^2 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right\}} + \frac{(2a^2 - bQ)(\lambda - 1)QC_h}{4a^2} \]

4. Optimal Solution

Differentiating (14) partially w.r.t. \( Q \) and putting \( \frac{dTC(Q)}{dQ} = 0 \), we get
32a^9PQ(2a^2 - bQ) + 2(\lambda - 1)Q\{4a^2 - bQ\}(2a^2 - bQ)\{4a^2 - bQ(2a^2 - bQ) + 4a^2 - bQ(\lambda - 1)\}\{4a^2 - bQ(\lambda - 1)\} - 32a^9(K + Qp) + 8a^4\{a^2 - bQ\} - 4bQ(2a^4 + b^2Q^2 - 3a^2bQ) + 4a^4(\lambda - 1)\{2a^2 - 6a^2bQ + 3b^2Q^2\} = 0 \tag{15}

Thus optimal $Q^*$ can obtained from (15), TC will be minimum at $Q^*$ if $\frac{d^2TC(Q)}{dQ^2} > 0$. However it is difficult to find $\frac{d^2TC(Q)}{dQ^2} > 0$, we will show it by graph.

5. Numerical Example

Let us consider the following parameter values, $a = 1000$, $b = 50$, $\lambda = 1.5$, $C_p = 100$, $K = 100$ units/year, $C_h = 10$ units/year. Putting these values in Eqn(11), we obtain $Q^* = 12823.2$, and corresponding $TC = TC^* = $ 209965.0.

6. Sensitivity Analysis I

Variation of commodities is a natural phenomenon in the universe. Varying single constraint at a time and maintaining residual parameters identical as above example.

<table>
<thead>
<tr>
<th>$a$</th>
<th>$Q$</th>
<th>$S_c$</th>
<th>$P_c$</th>
<th>$H_c$</th>
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<table>
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<table>
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**Managerial Insights:** From managerial point of view, following deduction can be prepared from the above tables. From Table 1: we see that increase of initial demand results increase in order quantity, production cost, holding cost and total cost while slightly decrease in setup cost. From Table 2, it is clear that increase of demand coefficient $b$ leads increase in setup cost and cost while decrease order quantity, holding cost and total cost. From Table 3, we see that increase of $\lambda$ results decrease in $Q$, $P_c$ and $TC$ and increase in $S_c$ and $H_c$.

7. Model 2: Production inventory model with integrating cost and decline Release policy

This model integrates a cost delivery strategy. It is unspecified that completed objects can only be distributed to purchaser, if entire lot is assumed at the closing stages of manufacture time $t_f$. Permanent quantity of $n$ completed article is delivered to
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customer $t_2$ for purchase of subordinating manufacturer’s stock holding cost by means of rationale of dropping holding cost. Average inventory is given by

$$T = \frac{Q}{2T} \left[ t_1 + \left( \frac{n-1}{n} \right) t_2 \right] = \frac{(2a^2 - bQ)(\lambda - 1)Q \left[ 4a^4n - bQn(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right]}{4a^2n \left[ 4a^4 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right]}$$

(16)

In this model $TC$ consists of

Set up Cost $= \frac{K}{T} = \frac{8a^2K}{(2a^2 - bQ)Q \left[ 4a^4 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right]}$

(17)

Production Cost $= \frac{Q\rho}{T} = \frac{8a^2Q\rho}{(2a^2 - bQ)Q \left[ 4a^4 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right]}$

(18)

Holding Cost $= \frac{C_H}{T} \left( \text{Average inventory} \right)$

$$= \frac{C_H(2a^2 - bQ)(\lambda - 1)Q \left[ 4a^4n - bQn(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right]}{4a^2n \left[ 4a^4 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right]}$$

(19)

Fixed Delivery Cost ($C_{FD}$) $= \frac{1}{T} nD = \frac{8a^2nD}{(2a^2 - bQ)Q \left[ 4a^4 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right]}$

(20)

Stock holding cost for buyer $= \frac{C_Ht_2}{2nT} = \frac{C_H(\lambda - 1)^2 Q(2a^2 - bQ)}{n \left[ 4a^4 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right]}$

(21)

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Figure 2. Inventory with integrates cost decline release policy
\[ TC = \frac{8a^2 \left( K + QP + nD_n \right)}{\left( 2a^2 - bQ \right) Q \left( 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right)} + \]
\[ C_H \left( 2a^2 - bQ \right) \left( \lambda - 1 \right) Q \left( 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right) \]
\[ + \frac{4a^2 C_H \left( \lambda - 1 \right)^2 \left( a^2 - bQ \right) \left( 2a^2 - bQ \right)}{4a^2 n^4 \left[ 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right]} \]

8. **Optimal Solution**: Differentiating partially Eq\( a \) (22) w.r.t. \( Q \), we get

\[ \frac{\partial TC(Q,n)}{\partial Q} = 4a^2 n \left( 2a^2 - bQ \right) \left( 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right) \]
\[ + \frac{32a^3 n P + 16a^2 n \left( \lambda - 1 \right) Q C_H \left( 2a^4 + b^2 Q^2 - 3a^2 bQ \right) - 6bn \left( \lambda - 1 \right) C_H \left( 4a^4 - bQ^3 - 8a^4 bQ + 5a^2 b^2 Q^2 \right) + 4a^2 \left( \lambda - 1 \right) \left( n-1 \right) C_H \left( 4a^4 - 6a^2 b^2 + 3b^2 Q^2 \right) + 4a^2 C_H \left( \lambda - 1 \right)^2 Q \left( a^2 - bQ \right) \left( 2a^2 - bQ \right) \right] \]
\[ = 4a^2 \left( a^2 - bQ \right) - 4bQ \left( 2a^4 + 3b^2 Q^2 - 3a^2 bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( 2a^4 - 6a^2 b^2 + 3b^2 Q^2 \right) \]
\[ + 4a^4 \left( a^2 - bQ \right) + 4a^4 \left( \lambda - 1 \right) \left( n-1 \right) \left( a^2 - bQ \right) + 4a^2 C_H \left( \lambda - 1 \right)^2 Q \left( a^2 - bQ \right) \left( 2a^2 - bQ \right) \]
\[ + \left( 4a^4 \left( a^2 - bQ \right) - 4bQ \left( 2a^4 + 3b^2 Q^2 - 3a^2 bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( 2a^4 - 6a^2 b^2 + 3b^2 Q^2 \right) \right) \]

Differentiating Eq\( a \) (20) partially w.r.t. \( n \) two times, we get

\[ \frac{\partial^2 TC}{\partial n^2} = \frac{8a^2 D_n}{\left( 2a^2 - bQ \right) Q \left[ 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right]} + \frac{C_H Q \left( \lambda - 1 \right)^2 \left( a^2 - bQ \right)}{4a^2 n^4 \left[ 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right]} \]
\[ + \frac{4a^2 C_H \left( \lambda - 1 \right)^2 Q \left( a^2 - bQ \right) \left( 2a^2 - bQ \right)}{4a^2 n^4 \left[ 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right]} \]
\[ + \frac{32a^3 D_n n + C_H Q \left( a^2 - bQ \right) ^2 \left( \lambda - 1 \right) \left[ 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right]}{\left( 2a^2 - bQ \right) Q \left[ C_H \left( a^2 - bQ \right) \left( \lambda - 1 \right) Q \left[ 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right] \right]} \]
\[ + \frac{4a^2 C_H \left( \lambda - 1 \right)^2 Q \left( a^2 - bQ \right) \left( 2a^2 - bQ \right)}{\left( 2a^2 - bQ \right) Q \left[ C_H \left( a^2 - bQ \right) \left( \lambda - 1 \right) Q \left[ 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right] \right]} \]

\[ \frac{\partial^2 \left( TC \right)}{\partial n^2} = \frac{C_H \left( 2a^2 - bQ \right) \left( \lambda - 1 \right) Q \left[ 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right]}{\left( 2a^2 - bQ \right) Q \left[ 4a^4 - bQ \left( 2a^2 - bQ \right) + 4a^2 \left( \lambda - 1 \right) \left( a^2 - bQ \right) \right]} \]
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\[
\frac{2C_H(\lambda - 1)\lambda Q(a^2 - bQ)}{n^4} \cdot \left\{ 4a^4 - bQ(2a^2 - bQ) + 4a^2(\lambda - 1)(a^2 - bQ) \right\}
\]

Optimal \( Q \) & \( n \) is obtained by solving

\[
\frac{\partial TC(Q,n)}{\partial Q} = 0 \quad \text{and} \quad \frac{\partial TC(Q,n)}{\partial n} = 0, \quad \text{simultaneously}
\]

Putting (21) and (23) equal to zero, we get (25).

\( Q^* \) and \( n^* \) will be minimum if \( \frac{\partial^2 TC(Q,n)}{\partial Q^2} > 0 \) and \( \frac{\partial^2 TC(Q,n)}{\partial n^2} > 0 \), but it is difficult to find the second order derivative with respect to \( Q \) and \( n \) positive. We can show it by graph (Fig. 3 and 4 respectively). Putting (21) and (23) equal to zero, we get (27). Solving equations (27) simultaneously for \( Q \) and \( n \), we get optimal values of \( Q \) and \( n \).

9. Numerical Example

Let us consider the parameter values.

\( a = 45 \ \text{unit/year} \), \( b = 10 \ \text{unit/year} \), \( \lambda = 1.5 \), \( P_c = 10 \ \text{$/year} \), \( K = 10 \ \text{units/year} \), \( C_b = 10 \ \text{units/year} \),
\( C_H = 5 \ \text{$/year} \), \( D_c = 2 \ \text{$/year} \).
Solution: Solving the simultaneous equations (21) and (23) by Mathematica

Software $Q = 404.997$, $n = 0.0055417$, Set up Cost ($Sc$) = 300002.0 $/year$, Production Cost ($P_r$) = $1.215 \times 10^8$ $/year$, Holding Cost ($H_r$) = 0.272169 $/year$, Fixed Delivery Cost ($C_{FD}$) = 332.504 $/year$, Stock Holding Cost for Suppliers = $-0.676673$ $/year$, Total Cost ($TC$) = $1.218 \times 10^8$ $/year$.

10. Sensitivity analysis II

Variation is the natural phenomena of all most all commodities in the university

Table 4. Variation of $Q$, $n$, $S_r$, $P_r$, $H_r$, $D_r$, $C_{FD}$ and $TC$ with $a$

<table>
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<th>$a$</th>
<th>$Q$</th>
<th>$n$</th>
<th>$S_r$</th>
<th>$P_r$</th>
<th>$H_r$</th>
<th>$C_{FD}$</th>
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<td>0.00049801</td>
<td>5.3334</td>
<td>1333.34</td>
<td>0.00024867</td>
<td>0.000531</td>
<td>1752.84</td>
</tr>
<tr>
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<td>0.00045305</td>
<td>4.8485</td>
<td>1466.67</td>
<td>0.00022627</td>
<td>0.000439</td>
<td>2023.36</td>
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<td>0.00041551</td>
<td>4.4846</td>
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<td>0.00020756</td>
<td>0.000370</td>
<td>1824.97</td>
</tr>
<tr>
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<td>0.00038371</td>
<td>4.1026</td>
<td>1733.33</td>
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<td>0.000315</td>
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<tr>
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<td>0.00035642</td>
<td>3.8122</td>
<td>1869.84</td>
<td>0.00017809</td>
<td>0.000272</td>
<td>2430.52</td>
</tr>
</tbody>
</table>

Table 5. Variation of $Q$, $n$, $S_r$, $P_r$, $H_r$, $D_r$, $C_{FD}$ and $TC$ with $b$

<table>
<thead>
<tr>
<th>$b$</th>
<th>$Q$</th>
<th>$n$</th>
<th>$S_r$</th>
<th>$P_r$</th>
<th>$H_r$</th>
<th>$C_{FD}$</th>
<th>$TC$</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>135.0</td>
<td>0.0005514</td>
<td>8.8893</td>
<td>1200.0</td>
<td>0.00027504</td>
<td>0.0009804</td>
<td>1359.36</td>
</tr>
<tr>
<td>20</td>
<td>101.3</td>
<td>0.0005501</td>
<td>11.8519</td>
<td>1200.0</td>
<td>0.00027413</td>
<td>0.0013039</td>
<td>1361.49</td>
</tr>
<tr>
<td>25</td>
<td>81.00</td>
<td>0.0005487</td>
<td>14.8149</td>
<td>1200.0</td>
<td>0.00027322</td>
<td>0.0016258</td>
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<tr>
<td>30</td>
<td>67.50</td>
<td>0.0005473</td>
<td>17.7779</td>
<td>1200.0</td>
<td>0.00027231</td>
<td>0.0019460</td>
<td>1317.02</td>
</tr>
<tr>
<td>35</td>
<td>57.89</td>
<td>0.0005459</td>
<td>20.7409</td>
<td>1200.0</td>
<td>0.00027140</td>
<td>0.0022647</td>
<td>7599.04</td>
</tr>
</tbody>
</table>

Table 6. Variation of $Q$, $n$, $S_r$, $P_r$, $H_r$, $D_r$, $C_{FD}$ and $TC$ with $\lambda$

<table>
<thead>
<tr>
<th>$\lambda$</th>
<th>$Q$</th>
<th>$n$</th>
<th>$S_r$</th>
<th>$P_r$</th>
<th>$H_r$</th>
<th>$C_{FD}$</th>
<th>$TC$</th>
</tr>
</thead>
<tbody>
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<td>9.6 x10^{-4}</td>
<td>225001.0</td>
<td>9.11244 x10^{7}</td>
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<td>0.0011322</td>
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<tr>
<td>1.7</td>
<td>202.5</td>
<td>1.5 x10^{-3}</td>
<td>249999.0</td>
<td>1.01248 x10^{8}</td>
<td>0.64864</td>
<td>0.0001798</td>
<td>2366.6</td>
</tr>
<tr>
<td>1.8</td>
<td>202.5</td>
<td>2.3 x10^{-3}</td>
<td>281239.0</td>
<td>1.13900 x10^{9}</td>
<td>1.13413</td>
<td>0.0002684</td>
<td>3185.9</td>
</tr>
<tr>
<td>1.9</td>
<td>202.5</td>
<td>3.2 x10^{-3}</td>
<td>409013.0</td>
<td>1.65646 x10^{9}</td>
<td>2.76163</td>
<td>0.0003821</td>
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</tr>
<tr>
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<td>202.5</td>
<td>4.4 x10^{-3}</td>
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<td>4.36739 x10^{11}</td>
<td>9134.93</td>
<td>0.0005242</td>
<td>6041.2</td>
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</tbody>
</table>

Managerial Insights: From managerial point of view following deduction can be prepared from the above tables. From Table 4, we see that enlarge of ‘a’ results increase of $Q$, $S_r$, $P_r$, $C_{FD}$ and decrease in $n$ and $H_r$. From Table 5, we see that, increase of ‘b’ results decrease in $Q$, $n$, $S_r$, $C_{FD}$, and fluctuation in $P_r$ and $TC$. Table 6, indicates that increase of $\lambda$ leads no variation in $Q$, increase in $n$, $H_r$ and $C_{FD}$ and fluctuation in $S_r$, $P_r$ and $TC$.

11. Conclusion and Future Research

Production and demand both are spontaneous and continuous processes for for both the buyer and the vendor. In this paper, we have discussed the manufacture inventory model for time-linked production and demand rates and integrated cost diminution delivery policy into a production inventory model. Mathematical formulations have been established for finding optimal solution. Numerical illustrations are given to demonstrate the practical usages. Sensitivity investigations are discussed with the variation of different parameters.

The research work presented in this study can be extended for time sensitive deterioration as well as Weibull deterioration. We can also generalize the model considering exponential demand, freight charges and advertisement cost and others.

References


Innovative Study of EPQ Model with Time Induced Demand under ...


