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Two-warehouse system for trapezoidal bipolar neutrosophic disparate expeditious worsen items with power demand pattern

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Abstract: This paper is to introduce a two-warehouse system for trapezoidal bipolar neutrosophic disparate expeditious worsen items with power demand pattern is dealt. Inventory worsens in the both storehouses disparate fixed amount. Demand is considered three different models (a) increasing demand (b) decreasing demand (c) linear demand. The model effectiveness in identifying the optimal order time that minimized overall costs is improved by the trapezoidal bipolar Neutrosophic number representation of the parameters. The Worsen in self-warehouse at earliest but in other scenario rented warehouse mostly we have more provision and potentiality provides for better growth in inventory. Finally, the model is executed using the trapezoidal bipolar neutrosophic number with numerical examples. Affectability analysis of the minimize solution of a total cost is effective to various types of the model is provide the output are furnished in detail.

Keywords: Inventory, Tropezoidal Bipolar Neutrosophic number, Two Ware-House, Power demand, Shortages, worsen, shortage, logarithmic demand.

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1. INTRODUCTION

In inventory models of EOQ is consequence considered request of product is linear regrettably. This may not be attainable in a few circumstances. It'll be best to considered that the demand changes with time. Knowledge on stock demonstrate with power demand pattern is vital since it permit to germane uncover with the behaviours and evolution of the stock.

Consumers want just-finished food items, so demand for baked or ready-made goods such as cakes, cookies, candy and streamed food is increased level at the start of the scheduling period ($m > 1$). Fresh meat, fish, fruits, vegetables, yoghurts, and other foods may all experience this form of demand. Since deals are decreased when the arrange of rot approaches. Request for unused things with a solid specialized parameter is expanded at the begin of the cycle than at the end. Mobile phones, smart phones, and computers, for example, are in higher demand as they first come out on the market because of the creativity and new implementation they provide.

Other items, on other hand, have higher demand during end of the inventory period ($m< 1$). Condition arises when a commodity becomes unavailable, such as gasoline or diesel oil. Flour, coffee, gasoline, milk, water, and sugar are examples of essential household products that fall into this category. Increases in demand happen when the amount of inventory on sale starts to deplete due to daily needs. Other sources request for theatres tickets, cinemas, musical events, sporting events, and other events, it's often positive by closing accounting year, or when it's time to revel it.

Adaraniwon et al. [1] discussed the EOQ model was researched for deferred corruption and missed deals. Request rate, reliable pace of rot, and fractional overabundance pace of request amount, just as absolute stock expense per unit time, are completely expressed. A. K. Bhunia et al.[2] manages a solitary declining thing stock model with two separate stockrooms with various conservation offices. D. Nagarajan et al.[13] developed Dombi Interval Valued Neutrosophic Graph and its Role in Traffic Control Management. J. Kavikumar & D. Nagarajan [16] deal with Neutrosophic General Finite Automata. S. Broumi et al. [21] Analyzing Age Group and Time of the Day Using Interval Valued Neutrosophic Sets. Abdel-Basset et al. [18] manages a Bipolar Neutrosophic Multi Criteria Decision Making Framework for Professional Selection.

S. Agrawal et al. talked about slope type interest, with the capacity to go about as a solitary stockroom stock framework or two distribution center stock frameworks relying upon the model boundaries. Chakraborty & Sankar [7] by allowing The Pentagonal Fuzzy Number: Its Different Representations, Properties, Ranking, Defuzzification and Application in Game Problems. Chakraborty & Broumi [8] introduced Some properties of Pentagonal Neutrosophic Numbers and its Applications in Transportation Problem Environment. Ganesan et al.[15] developed by An integrated new threshold FCMs Markov chain based forecasting model for analyzing the power of stock trading trend. J. Sicilia, et al. [17] examined Stock is deterministic, differs as per time in each solicitation period, and follows a force request design. Chakraborty & Mondal by including Different linear and non-linear form of Trapezoidal Neutrosophic Numbers, De-Neutrosophication Techniques and its Application in time cost optimization technique, sequencing problem. Chakraborty Mondal, S. Broumi deal with De-Neutrosophication technique of pentagonal neutrosophic number and application in minimal spanning tree. S. Broumi & D. Nagarajan introduced by Implementation of Neutrosophic Function Memberships Using MATLAB Program.D.Nagarajan et al[31] explained the nutrosophic multiple regression. S.Broumi et al [32] presented A new distance measure for trapezoidal fuzzy neutrosophic numbers based on the centroid.

R. B. Krishnaraj et al. [20] introduced the two-boundary Weibull circulation decay deterministic stock model for power request designs without deficiencies. S. Te Jung, et al. [26] determined an EOQ model for things Weibull dispersed corruption, deficiencies and force request design.

S. Pradhan, , et al.[25] presented the impact of swelling on the force request design was explored, with two boundaries of the Weibull appropriation for crumbling being thought of, just as a confined pay approach with dynamic trade credit. S.Gomathy et al.[27] by introducing Plithogenic sets and their application in decision making. Muhammad Saqlain & Smarandache [28] show that with Octagonal Neutrosophic Number: Its Different Representations, Properties, Graphs and De-Neutrosophication. Saqlain et al. consider Linear and Non-Linear Octagonal Neutrosophic Numbers: Its Representation, α-Cut and Applications. N. Rajeswari, et al. solved the overabundance pace of neglected interest is thought to be a diminishing outstanding capacity of holding up time in the investigation. Evaluated mean portrayal, marked distance, and centroid strategies are utilized to defuzzify the all-out cost.

2. ASSUMPTIONS AND NOTATIONS

(i) $D(t) = \frac{\varepsilon t^{\frac{1}{m}-1}}{mT^{\frac{1}{m}}}$ where ε is positive constant, 0 <m< 1 , T is the planning horizon.

(ii) Shortages are permitted.

(iii) The lead time is negligible.

(iv) Worsen rate of RW (θ) disparate than the decay rate of OW ($\emptyset$)

(v) The inventory system deals with single item only.

(vi) The cost of holding at RW is less than the holding cost at OW ($IC_{H_0} > IC_{H_r}$).

(vii) The OW is restricted number W units, while the RW is infinite number. For business purposes, RW products are consumed first, followed by OW items.

The accompanying documentations are utilized all through the paper:

$\mathfrak{I}_r(t)$: Stock volume in RW at time t , t≥0.
$\mathfrak{I}_0(t)$: Stock volume in OW at time t, t≥0.
S(t) : Scarcity Stock volume at time t, t≥0
A : Ordering cost per order per year.
T : Cycle of length.
t_1 : Time of the Stock level it vanish in RW
t_2 : Time of the Stock level it vanish in OW
IC_{H_0} : Holding cost per unit for OW $IC_{H_0} > IC_{H_r}$
IC_{H_r} : Holding cost per unit for RW
$\mathcal{H}_r$: Inventory holding cost per unit of RW
$\mathcal{H}_0$: Inventory holding cost per unit of OW
S : Inventory Shortage cost per cycle.
IC_S :Shortagecost per unit .
IC_d : Worsen cost per unit.
ε : Demand index during the constant cycle time T
m : Demand index
Z : Stock level Higher at the beginning of the cycle.
W : Warehouse capacity of OW.
Q : Total order Quantity per cycle.
TC (t_1, T) : Optimum total cost per unit.

3. MATHEMATICAL FORMULATION

Definition :3.1

Fuzzy set: A set s $\hat{S}$, defined as $\hat{S} = \{(A, \emptyset_{\hat{S}}) :\ A \in S \ \ \emptyset_{\hat{S}}(A) \in [0,1]\}$ and usually denoted by the pair as $(A, \emptyset_{\hat{S}}(A))$, $A \in S$ and $\emptyset_{\hat{S}}(A) \in [0,1]$ then $\hat{S}$ is said to be a fuzzy set.

Definition 3.2 Neutrosophic set: [5] A set $\hat{T}$ is identified as a neutrosophic set if $\hat{T} = \{\langle p; \alpha_{\hat{T}}(p), \beta_{\hat{T}}(p), \gamma_{\hat{T}}(p)\ ]\rangle$ ∶ x ∈ P, P = universal set} , where $\alpha_{\hat{T}}(p)$ ∶ P → [0, 1] signifes the scale of confidence $\beta_{\widehat{neuBiT}}(p)$ (p) ∶ P → [0, 1] signifies the scale of hesitation and $\gamma_{\hat{T}}(p)$ ∶ P → [0, 1] signifes the scale of falseness. Where, $\alpha_{\hat{T}}(p), \beta_{\hat{T}}(p), and\ \gamma_{\hat{T}}(p)$ satisfies the relation:

$$0 \le \alpha_{\hat{T}}(p) + \beta_{\hat{T}}(p), + \gamma_{\hat{T}}(p) \le 3$$

Definition :3.3 Single-Valued Neutrosophic..Set: $Chakraborty$ [4]

A set of Neutrosphic is $\widetilde{Ns}$ in the?definition 3.1. is claimed to be a single-Valued neutrosophic set ($\widetilde{SVTrNs}$) if x may be single-valued independent variable. $\widetilde{SVTrNs}$ = {⟨x; [$\rho_{\widetilde{SVTrNs}}(x)$, $\sigma_{\widetilde{SVTrNs}}(x)$, $\tau_{\widetilde{SVTrNs}}(x)$]⟩∶ x∈X}, where $\rho_{\widetilde{SVTrNs}}(x)$, $\sigma_{\widetilde{SVTrNs}}(x)$, $\tau_{\widetilde{SVTrNs}}(x)$ provided the method of accuracy, dubiety and falsehood-memberships function0respectively.

Definition :3.4 (.Tropezoidal&Single Valued Neutrosophic Number&)

Neutrosophic number with tropezoidal Single Valued ($\tilde{\Omega}$) is defined a $\tilde{\Omega}$=< $(r_1, r_2, r_3, r_4: \Upsilon), (u_1, u_2, u_3, u_4: \lambda), (q_1, q_2, q_3, q_4: \eta)$ > , $where \mu,\ \vartheta,\ \zeta \in$ [0,1]. The real/membership function $\rho_{\tilde{\Omega}}$: R → [0, ϒ], the dubiety/membership function $\sigma_{\tilde{\Omega}}$: R → [λ, 1] and the falsehood/membership function $\tau_{\tilde{\Omega}}$: : R+→//[η, 1] are characterized as follows:

$$\pi_{\tilde{\Omega}} = \begin{cases} \vartheta_{\tilde{\Omega}l}(x), & r_1 \le x < r_2 \\ \Upsilon, & r_2 \le x < r_3 \\ \vartheta_{\tilde{\Omega}r}(x), & r_3 < x \le r_4 \\ 0, & otherwise >. \end{cases}$$

$$\theta_{\tilde{\Omega}} = \begin{cases} \varepsilon_{\tilde{\Omega}l}(x), & u_1 \le x < u_2 \\ \lambda, & u_2 \le x < u_3 \\ \varepsilon_{\tilde{\Omega}r}(x), & u_3 < x \le u_4 \\ 1, & otherwise >. \end{cases}$$

$$\eta_{\tilde{\Omega}} = \begin{cases} \ell_{\tilde{\Omega}l}(x), & q_1 \le x < q_2 \\ \eta, & q_2 \le x < q_3 \\ \ell_{\tilde{\Omega}r}(x), & q_3 < x \le q_4 \\ 1, & otherwise >. \end{cases}$$

Definition :3.5 Bipolar neutrosophic set: A set $\hat{T}$ is identified as a neutrosophic set if $\widehat{T_{neuB\iota}} = \{\langle p; \alpha_{\widehat{T_{neuB\iota}}}(p), \beta_{\widehat{T_{neuB\iota}}}(p), \gamma_{\widehat{T_{neuB\iota}}}(p)\ ]\rangle$ ∶ x ∈ P, P = universal set} , where $\alpha_{\widehat{T_{neuB\iota}}}{}^{+}(p)$: P → [0, 1], $\alpha_{\widehat{T_{neuB\iota}}}{}^{-}(p)$: P → [-1, 0], signifies the scale of confidence $\beta_{\widehat{T_{neuB\iota}}}{}^{+}(p)$: P → [0, 1], $\beta_{\widehat{T_{neuB\iota}}}{}^{-}(p)$: P → [-1, 0] signifies the scale of hesitation $\gamma_{\widehat{T_{neuB\iota}}}{}^{+}(p)$: P → [0, 1], $\gamma_{\widehat{T_{neuB\iota}}}{}^{-}(p)$: P → [-1, 0],signifies the scale of falseness. Where, $\alpha_{\widehat{T_{neuB\iota}}}(p), \beta_{\widehat{T_{neuB\iota}}}(p), and\ \gamma_{\widehat{T_{neuB\iota}}}(p)$ satisfies the relation:
$-0 \le \alpha_{\widehat{T_{neuB\iota}}}(p), \beta_{\widehat{T_{neuB\iota}}}(p), and\ \gamma_{\widehat{T_{neuB\iota}}}(p) \le 3+$

Definition :3.6 De- Bipolar neutrosophication of Tropezoidal. Neutrosophic0 number:

This..system, the expulsion region procedure executed to assess the de-neutrosophication worth of tropezoidal single esteemed neutrosophic number is
$\widehat{T_{neuB\iota}}$ =< $(r_1, r_2, r_3, r_4: \Upsilon), (u_1, u_2, u_3, u_4: \lambda), (q_1, q_2, q_3, q_4: \eta)$ > , de-neutrosophic form $\tilde{S}$ is provided as
$\widehat{T_{DneuB\iota}} = \left(\frac{r_1 + r_2 + r_3 + r_4 + u_1 + u_2 + u_3 + u_4 + q_1 + q_2 + q_3 + q_4}{6}\right)$

The inventory model is created in the following manner: At the start of each period, Z units of goods arrived in the stock system. The W units are kept in OW, while the rest are kept in RW. The items in OW are devoured solely after the products in RW have been burned-through. The stock level is diminishing in the RW during the time span $[o, t_1]$, because of the request rate and disintegration.

The stock model is advanced as follows: Z units of object arrived inventory model at the start of each period. W units are kept in OW and the rest is put absent in RW. The things of OW are eaten up exclusively after burning-through the items kept in RW. In the RW, during the time span $[o, t_1]$, stock level is diminishing because of the interest rate and disintegration and the stock level is lessening to zero at t_1. The stock W diminishes during $[o, t_1]$, because of decay just, while during $[\ t_1, t_2]$, the stock is exhausted because of both interest and crumbling. The Stock level is dropping to zero at t_2. Worsen rate of RW (θ) is disparate than the worsen rate of OW $(\emptyset)$.The holding cost at RW is less than the holding cost at OW $(IC_{H_0} > IC_{H_r})$. Finally, a shortfall happens due to demand during the time span $[\ t_1, T]$.

Case (i) System with increasing demand $0 < m < 1$
The total request during the span is ε units. When $0 < m < 1$, a larger portion of request at end of inventory cycle.

Here the Stock level at RW reduce due to increasing demand rate and constant worsen rate in the interval $(\ 0, t_1)$ and reaches zero at t_1.

Hence, the Stock level in RW for $t \epsilon (0, t_1)$ fulfil the differential equations

$$\frac{d\Im_r(t)}{dt} = -\frac{\varepsilon t^{\frac{1}{m}-1}}{mT^{\frac{1}{m}}} - \theta\, \Im_r(t) \qquad 0 \le t \le t_1 \qquad (1)$$

Stock level at OW diminishes, because of weakening over the span $(0, t_1)$, and because of expanding request rate and consistent decay rate over the stretch (t_1, t_2) and arrives at zero at t_2. In this manner it fulfils the differential conditions

$$\frac{d\Im_0(t)}{dt} = -\emptyset \Im_0(t) \qquad 0 \le t \le t_1 \qquad (2)$$

$$\frac{d\Im_0(t)}{dt} = -\frac{\varepsilon t^{\frac{1}{m}-1}}{mT^{\frac{1}{m}}} - \emptyset \Im_0(t) \qquad t_1 \le t \le t_2 \qquad (3)$$

The range of pending shortages over (t_2, T) satisfies the derivative

$$\frac{dS(t)}{dt} = -\frac{\varepsilon\, t^{\frac{1}{m}-1}}{mT^{\frac{1}{m}}} \qquad t_2 \le t \le T \qquad (4)$$

The actions of the stock system during the entire span [0, T] is shown in Figures 1

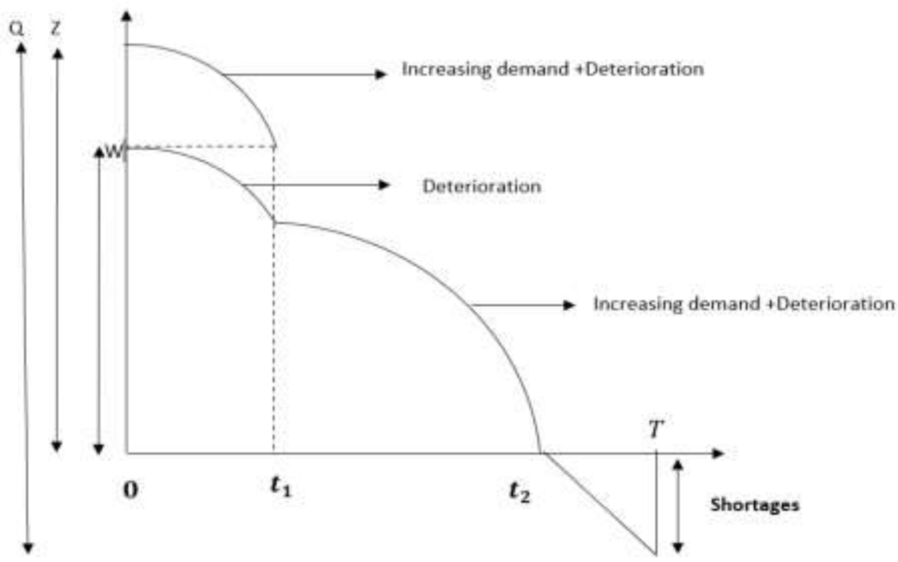

Figure 1. Graphical representation of a two-warehouse inventory system with Increasing Demand

Solving the above differential equations with the boundary conditions

$\Im_r(t_1) = 0, \qquad 0 \le t \le t_1$
$\Im_o(0) = W, \qquad 0 \le t \le t_1$
$\Im_0(t_2) = 0\,, \qquad t_1 \le t \le t_2$
$S(t_2) = 0, \qquad t_2 \le t \le T$

The solutions to Equations (1)-(4) are

$$\Im_r(t) = \frac{\varepsilon}{T^{\frac{1}{m}}} \left\{ \left\{ t_1^{\frac{1}{m}} - t^{\frac{1}{m}} \right\} - \frac{m\,\theta}{m+1} \left\{ t_1^{\frac{1}{m}+1} - t^{\frac{1}{m}+1} \right\} \right\} \qquad 0 \le t \le t_1 \qquad (5)$$

$$\Im_0(t) = W - \emptyset t \qquad 0 \le t \le t_1 \qquad (6)$$

$$\Im_0(t) = \frac{\varepsilon}{T^{\frac{1}{m}}} \left\{ \left\{ t_2^{\frac{1}{m}} - t^{\frac{1}{m}} \right\} - \frac{m\emptyset}{m+1} \left\{ t_2^{\frac{1}{m}+1} - t^{\frac{1}{m}+1} \right\} \right\} \qquad t_1 \le t \le t_2 \qquad (7)$$

$$S(t) = \frac{\varepsilon}{T^{\frac{1}{m}}} \left\{ t_2^{\frac{1}{m}} - t^{\frac{1}{m}} \right\} \qquad t_2 \le t \le T \qquad (8)$$

Applying the boundary condition $\Im_r(0) = Z - W$ the value of Z is

$$Z = W + \frac{\varepsilon}{T^{\frac{1}{m}}} \left\{ 1 - \frac{m\,\theta\, t_1}{m+1} \right\} \left\{ t_1^{\frac{1}{m}} \right\} \qquad (9)$$

The maximum shortage inventory, S(T) is obtained from equation (8)

Q= Z - S(T)

Finally, from equation (9) we have

$$Q = W + \frac{\varepsilon}{T^{\frac{1}{m}}}\left\{1 - \frac{m\,\emptyset\, t_1}{m+1}\right\}\left\{t_1^{\frac{1}{m}}\right\} - \frac{\varepsilon}{T^{\frac{1}{m}}}\left\{t_2^{\frac{1}{m}} - T^{\frac{1}{m}}\right\} \quad (10)$$

Total similar inventory cost per span consists of the following cost parameters:

1. **The invoice cost is A**
2. **The holding cost of inventory in RW is resulting**

$$\mathcal{H}_r = IC_{H_r}\{\int_0^{t_1} \Im_r(t)\, dt\}$$

$$\mathcal{H}_r = \frac{IC_{H_r}\,\varepsilon}{T^{\frac{1}{m}}}\left\{\left\{\left(\frac{1}{m+1}\right) t_1^{\frac{1}{m}+1}\right\} - \left\{\left(\frac{\theta m}{(2m+1)}\right) t_1^{\frac{1}{m}+2}\right\}\right\} \quad (11)$$

3. **The holding cost of inventory in OW is resulting**

$$\mathcal{H}_0 = IC_{H_0}\{\int_0^{t_2} \Im_0(t)\, dt\}$$

$$\mathcal{H}_0 = IC_{H_0}\left\{W\, t_1 - \emptyset\frac{t_1^2}{2}\right\} + \frac{IC_{H_0}\varepsilon}{T^{\frac{1}{m}}}\left\{\left\{\left(\frac{1}{m+1}\right) t_2^{\frac{1}{m}+1}\right\} - \left\{\left(\frac{\emptyset m}{(2m+1)}\right) t_2^{\frac{1}{m}+2}\right\}\right\} - \frac{IC_{H_0}\,\varepsilon}{T^{\frac{1}{m}}}\left\{\left\{t_1\, t_2^{\frac{1}{m}} - \left\{\left(\frac{m}{m+1}\right) t_1^{\frac{1}{m}+1}\right\}\right\} - \left(\frac{\emptyset m}{(m+1)}\right)\left\{t_1\, t_2^{\frac{1}{m}+1} - \left\{\left(\frac{m}{(2m+1)}\right) t_1^{\frac{1}{m}+2}\right\}\right\}\right\} \quad (12)$$

4. **The shortage cost per cycle is**

$$S = IC_s\left\{\int_{t_2}^{T} \frac{\varepsilon}{T^{\frac{1}{m}}}\left\{t_2^{\frac{1}{m}} - t^{\frac{1}{m}}\right\} dt\right\}$$

$$S = IC_s\frac{\mathrm{IC}}{T^{\frac{1}{m}}}\left\{t_2^{\frac{1}{m}}T - \left(\frac{m}{m+1}\right)T^{\frac{1}{m}+1} - \left(\frac{1}{m+1}\right) t_2^{\frac{1}{m}+1}\right\} \quad (13)$$

5. **The cost of worsen products in RW and OW during $(\mathbf{0}, \boldsymbol{t_2})$ are**

$$D = IC_d\{\theta\int_0^{t_1} \Im_r(t)\, dt + \emptyset\int_0^{t_2} \Im_0(t)\, dt\}$$

$$D = \frac{IC_d\,\varepsilon\,\theta}{T^{\frac{1}{m}}}\left\{\left\{\left(\frac{1}{m+1}\right) t_1^{\frac{1}{m}+1}\right\} - \left\{\left(\frac{\theta m}{(2m+1)}\right) t_1^{\frac{1}{m}+2}\right\}\right\} + IC_d\,\emptyset\left\{W\, t_1 - \emptyset\frac{t_1^2}{2}\right\} + \frac{IC_d\,\varepsilon\,\emptyset}{T^{\frac{1}{m}}}\left\{\left\{\left(\frac{1}{m+1}\right) t_2^{\frac{1}{m}+1}\right\} - \left\{\left(\frac{\emptyset m}{(2m+1)}\right) t_2^{\frac{1}{m}+2}\right\}\right\} - \frac{IC_d\,\varepsilon}{T^{\frac{1}{m}}}\left\{\left\{t_1\, t_2^{\frac{1}{m}} - \left\{\left(\frac{m}{m+1}\right) t_1^{\frac{1}{m}+1}\right\}\right\} - \left(\frac{\emptyset m}{(m+1)}\right)\left\{t_1\, t_2^{\frac{1}{m}+1} - \left\{\left(\frac{m}{(2m+1)}\right) t_1^{\frac{1}{m}+2}\right\}\right\}\right\} \quad (14)$$

Finally, the Total inventory cost per unit time is resulting

TC (t_2)= $\frac{1}{T}$ (Invoice cost + Holding cost +Shortage cost +Worsen cost)

$$\begin{aligned} \mathrm{TC}\,(t_2) = \frac{1}{T}\Bigg\{ &(A) + \frac{(IC_{H_r} + IC_d\,\theta)\,\varepsilon}{T^{\frac{1}{m}}}\left\{\left\{\left(\frac{1}{m+1}\right) t_1^{\frac{1}{m}+1}\right\} - \left\{\left(\frac{\theta m}{(2m+1)}\right) t_1^{\frac{1}{m}+2}\right\}\right\} \\ &+ \left(IC_{H_0} + IC_d\,\emptyset\right)\left\{W\, t_1 - \emptyset\frac{t_1^2}{2}\right\} \\ &+ \frac{(IC_{H_0} + IC_d\,\emptyset)\varepsilon}{T^{\frac{1}{m}}}\left\{\left\{\left(\frac{1}{m+1}\right) t_2^{\frac{1}{m}+1}\right\} - \left\{\left(\frac{\emptyset m}{(2m+1)}\right) t_2^{\frac{1}{m}+2}\right\}\right\} \\ &- \frac{(IC_{H_0} + IC_d\,\emptyset)\varepsilon}{T^{\frac{1}{m}}}\left\{\left\{t_1\, t_2^{\frac{1}{m}} - \left\{\left(\frac{m}{m+1}\right) t_1^{\frac{1}{m}+1}\right\}\right\}\right. \\ &\left. - \left(\frac{\emptyset m}{(m+1)}\right)\left\{t_1\, t_2^{\frac{1}{m}+1} - \left\{\left(\frac{m}{(2m+1)}\right) t_1^{\frac{1}{m}+2}\right\}\right\}\right\} \\ &+ \frac{IC_s}{T^{\frac{1}{m}}}\left\{t_2^{\frac{1}{m}}T - \left(\frac{m}{m+1}\right)T^{\frac{1}{m}+1} - \left(\frac{1}{m+1}\right) t_2^{\frac{1}{m}+1}\right\}\Bigg\} \end{aligned} \quad (15)$$

Numerical examples

We represent the proposed model for certain mathematical models as given below.

Example 1 [Case(i) increasing demand 0<m<1]

W=100, A=50, ε=100, $\theta = 0.02$,$\emptyset = 0.03$, $IC_{H_r} = \$\,3/unit/\,year, IC_{H_0} = 5, IC_s = 12, IC_d =$ 10, m=0.5 , t_1= 0.8, T=1 in appropriate units. The result is obtained as follows $t_2 = 1.15337$, $\mathrm{TC}(t_2{}^*) = 618.872$ $Q = 130.462\ units.$

Example 2 [Case(ii) decreasing demand m>1]

As like the same Example 1 with m= 1,

$t_2 = 1.1487$, $\mathrm{TC}(t_2{}^*) = 593.214$ $Q = 164.147\ units$

Example 3 [Case(iii) Linear demand m=1]

As like the same Example 1 with m= 2,

The result obtained is as follows like $t_1 = 0.8\ months,\ T = 1\ years,$

$t_2 = 1.14419$, $\mathrm{TC}(t_2{}^*) = 572.59$ $Q = 175.254\ unit$

Solution procedure

We came to know that the nonlinear equations. Here, we use MATHEMATICA 9.0 tool find the optimum solution of $t_1{}^*$ and T^* using equation (15)

$D(t_1{}^*, T^*) = \frac{\partial^2 TC\,(t_1,T)}{\partial t_1{}^2}\frac{\partial^2 TC\,(t_1,T)}{\partial T^2} - \left[\frac{\partial^2 TC\,(t_1,T)}{\partial t_1\,\partial T}\right]^2 > 0$ we recommended "D-test" for optimizing functions of two variables t_1 and T such that

$$\frac{\partial TC\,(t_1,T)}{\partial T} = \Big\{\Big(-\frac{A}{T^2}\Big) - \Big\{1 + \frac{1}{m}\Big\}\ \frac{(IC_{H_r} + \theta IC_d)\,IC}{T^{\frac{1}{m}+2}}\Big\{\ \Big\{\Big(\frac{1}{m+1}\Big)\ t_1{}^{\frac{1}{m}+1}\Big\} + \ \Big\{\Big(\frac{2\theta m}{(m+1)(m+2)}\Big)\ t_1{}^{\frac{1}{m}+2}\Big\}\Big\} + (IC_{H_0} + \emptyset\ IC_d)W\Big\{t_1 - \emptyset\frac{t_1{}^2}{2}\Big\}\Big(-\frac{1}{T^2}\Big) - \Big\{1 + \frac{1}{m}\Big\}\ \frac{(IC_{H_0} + \emptyset\ IC_d)\,IC}{T^{\frac{1}{m}+2}}\Big\{\ \Big\{\Big(\frac{1}{m+1}\Big)\ t_2{}^{\frac{1}{m}+1}\Big\} + \Big\{\Big(\frac{2\theta m}{(m+1)(m+2)}\Big)\ t_2{}^{\frac{1}{m}+2}\Big\}\Big\} + IC_s\frac{IC}{T^{\frac{1}{m}+1}}\ \Big\{-\frac{1}{m}\,t_2{}^{\frac{1}{m}}\Big\} - \Big\{\frac{1}{m}\ \frac{IC_s\ IC}{T^{\frac{1}{m}+2}}\ t_2{}^{\frac{1}{m}+1}\Big\}\ \Big\} \qquad (16)$$

$$\frac{\partial TC\,(t_1,T)}{\partial t_1} == \frac{(IC_{H_r} + \theta IC_d)\,IC}{T^{\frac{1}{m}+1}}\Big\{\ \Big\{\Big(\frac{1}{m}\Big)\ t_1{}^{\frac{1}{m}}\Big\} + \ \Big\{\Big(\frac{2\theta(2m+1)}{(m+1)(m+2)}\Big)\ t_1{}^{\frac{1}{m}+1}\Big\}\Big\} + \Big(\frac{1}{T}\Big)\,(IC_{H_0} + \emptyset\ IC_d)W\{1 - \emptyset\ t_1\} \qquad (17)$$

$$\frac{\partial TC\,(t_1,T)}{\partial t_1} = 0 \quad \text{and} \quad \frac{\partial TC\,(t_1,T)}{\partial T} = 0$$

If $\frac{\partial^2 TC\,(t_1{}^*,T^*)}{\partial t_1{}^2} > 0$ then $TC\,(t_1{}^*, T^*)$ is minimum Value

Case (ii) Model **with decreasing demand ($m > 1$)**

The total requires during the time period is IC units. At the point when m > 1, a larger part of request happens at the start of the time span.

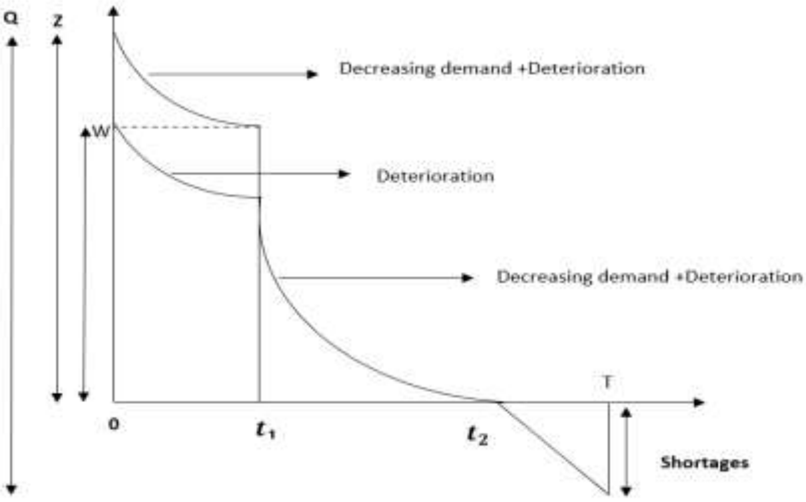

Figure 2 . Graphical representation of a two-warehouse inventory system with Decreasing Demand

Case (iii) Model with Linear demand $m = 1$

The total requires during the time span is IC units. When *m* = 1, the request follows a uniform system.

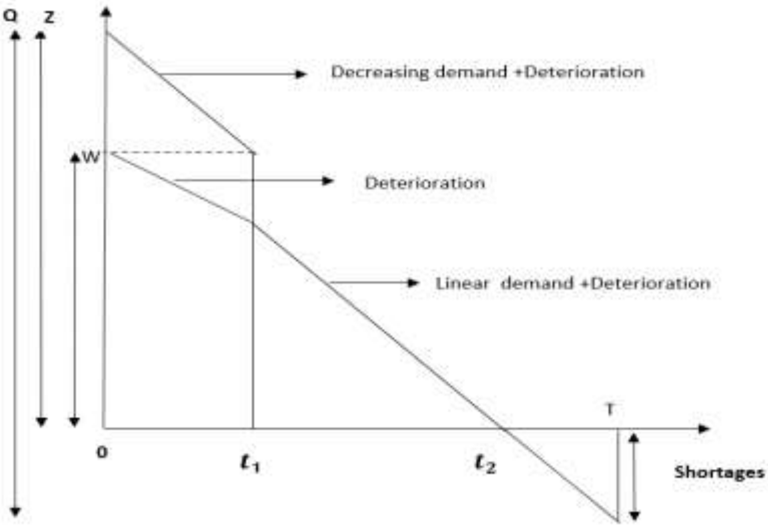

Figure 3 . Graphical representation of a two-warehouse inventory system with Linear Demand

$$\widehat{TC}_{T_{\widehat{neuBi}}}(t_2) = \frac{1}{T}\left\{ (A) + \frac{(\widehat{IC}_{H_r}+\widehat{IC}_d\,\theta)\,\varepsilon}{T^{\frac{1}{m}}}\left\{ \left\{\left(\frac{1}{m+1}\right) t_1^{\frac{1}{m}+1}\right\} - \left\{\left(\frac{\theta m}{(2m+1)}\right) t_1^{\frac{1}{m}+2}\right\}\right\} + (\widehat{IC}_{H_0}+\widehat{IC}_d\ \emptyset)\left\{W\ t_1 - \emptyset \frac{t_1^2}{2}\right\} + \frac{(\widehat{IC}_{H_0}+\widehat{IC}_d\ \emptyset)\varepsilon}{T^{\frac{1}{m}}}\left\{ \left\{\left(\frac{1}{m+1}\right) t_2^{\frac{1}{m}+1}\right\} - \left\{\left(\frac{\emptyset m}{(2m+1)}\right) t_2^{\frac{1}{m}+2}\right\}\right\} - \frac{(\widehat{IC}_{H_0}+\widehat{IC}_d\ \emptyset)\varepsilon}{T^{\frac{1}{m}}}\left\{ \left\{t_1\ t_2^{\frac{1}{m}} - \left\{\left(\frac{m}{m+1}\right) t_1^{\frac{1}{m}+1}\right\}\right\} - \left(\frac{\emptyset m}{(m+1)}\right)\left\{t_1\ t_2^{\frac{1}{m}+1} - \left\{\left(\frac{m}{(2m+1)}\right) t_1^{\frac{1}{m}+2}\right\}\right\}\right\} + \frac{IC_s}{T^{\frac{1}{m}}}\left\{t_2^{\frac{1}{m}}T - \left(\frac{m}{m+1}\right) T^{\frac{1}{m}+1} - \left(\frac{1}{m+1}\right) t_2^{\frac{1}{m}+1}\right\}\right\} \tag{15}$$

The effects of trapezoidal bipolar neutrosophic numbers:

Here, deteriotion cost $\widehat{IC_d}$, holding cost in owned warehouse $\widehat{IC}_{H_o}$, holding cost in rented warehouse $\widehat{IC}_{H_r}$ have been considerede.as trapezoidal bipolar neutrosophic fuzzy set. Thus, the parameters of bipolar neutrosophic numbers are:

$$\widehat{IC_d} < (2.25, 2.72, 3.26, 4.82); (1.76, 2.88, 3.14, 4.37), (1.44, 2.76, 3.38, 4.02) >$$
$$\widehat{IC}_{H_o} = < (2.29, 3.26, 5.02, 6.82); (2.06, 3.39, 4.92, 5.65), (3.85, 4.48, 6.34, 8.10\ ) >$$
$$\widehat{IC}_{H_r} = < (3.11, 4.15, 5.81, 6.80); (1.57, 2.73, 3.42, 4.04), (0.04, 1.26, 2.35, 3.22) >$$

We can generate outcomes into neutrosophic numbers based on the result of trapezoidal bipolar neutrosophic number and its membership functions as the De-neutrosophication technology develops.

$$\widehat{T_{DneuBi}} = \left(\frac{r_1 + r_2 + r_3 + r_4 + u_1 + u_2 + u_3 + u_4 + q_1 + q_2 + q_3 + q_4}{6}\right)$$

Numerical examples

We represent the proposed model for certain mathematical models as given below.

Example 1 [Case(i) increasing demand 0<m<1]

W=100, A=50, ε=100, $\theta = 0.02$,$\emptyset = 0.03$, $\widehat{IC}_{H_r} = \$\,6.75/unit/\,year$, $\widehat{IC}_{H_0} = 9.36$, $\widehat{IC_d} = 6.13$, $IC_s = 12$, m=0.5 , t_1= 0.7, T=1 year in right units. The results extracted as follows $t_2 = 1.078$, $\mathrm{TC}(\mathrm{t_2}^*) = 510.572$ $Q = 163.90\ units$.

Example 2 [Case(ii) decreasing demand m>1]

As like the same Example 1 with m= 2,

The results were obtained as follows $t_1 = 0.8\ months$, $T = 1\ years$, $t_2 = 1.624$,

$\mathrm{TC}(\mathrm{t_2}^*) = 564.854$ $Q = 148.152\ units$

Example 3 [Case(iii) Linear demand m=1]

As like the same Example 1 with m= 1,

The results were obtained as follows $t_1 = 0.8\ years$, $T = 1\ years$, $t_2 = 1.14419$,

$\mathrm{TC}(\mathrm{t_2}^*) = 546.21$ $Q = 150.724\ units$

Table 1
Impacts of changes within the different sort of the show.

α^*	β^*	γ^*	t_1	T	$\widehat{TC}_{\widehat{T_{neuBt}}}(t_2)$	Z	Q
W	120	+20	0.3476	0.5034	474.505	167.569	219.89
	110	+10	0.3758	0.515	454.438	163.114	209.867
	100	0	0.3815	0.5326	417.787	151.178	199.87
	90	-10	0.3951	0.5464	388.933	142.149	189.862
	80	-20	0.3987	0.5558	322.461	126.996	179.872
ε	120	+20	0.3976	0.4798	532.097	183.68	219.776
	110	+10	0.394	0.4743	515.487	175.707	209.801
	100	0	0.3926	0.4696	501.177	169.712	199.817
	90	-10	0.3728	0.4687	408.982	156.797	189.858
	80	-20	0.3416	0.4642	398.818	148.627	189.789
A	60	+20	0.3939	0.6308	271.028	138.891	199.898
	55	+10	0.3726	0.6203	267.199	135.992	199.91
	50	0	0.3349	0.6146	255.416	129.626	199.934
	45	-10	0.3108	0.6041	251.385	126.415	199.945
	40	-20	0.3024	0.5968	247.617	125.623	199.948
M	0.6	+20	0.394	0.652	251.134	143.065	199.872
	0.55	+10	0.3905	0.6442	250.102	140.135	199.888
	0.5	0	0.3666	0.6311	248.016	133.661	199.918
	0.45	-10	0.3448	0.6254	239.399	126.572	199.943
	0.4	-20	0.3321	0.5901	238.567	121.624	199.959
t_2	0.48	+20	0.3684	0.5295	456.028	148.288	199.881
	0.44	+10	0.3726	0.5353	397.648	148.329	199.88
	0.4	0	0.3805	0.5396	341.843	149.568	199.874
	0.36	-10	0.3847	0.5451	283.619	149.679	199.872
	0.32	-20	0.3872	0.5516	228.066	149.686	199.871
$\widehat{IC}_{H_r}$	2.4	+20	0.348	0.5651	310.475	137.835	199.912
	2.2	+10	0.3549	0.5754	299.415	137.953	199.91
	2	0	0.3682	0.5911	285.082	138.706	199.905
	1.8	-10	0.3839	0.6142	264.511	138.968	199.9
	1.6	-20	0.3917	0.622	256.041	139.554	199.896
$\widehat{IC}_{H_0}$	4.8	+20	0.3965	0.5866	340.075	145.567	199.871
	4.4	+10	0.3924	0.5696	335.495	147.335	199.872
	4	0	0.384	0.5442	333.16	149.663	199.873
	3.6	-10	0.3757	0.5313	327.115	149.873	199.875
	3.2	-20	0.3628	0.5126	319.867	149.972	199.879
IC_s	14.4	+20	0.3784	0.5359	338.189	149.732	199.874
	13.2	+10	0.3734	0.52	357.968	151.435	199.872
	12	0	0.3687	0.5053	375.68	153.11	199.869
	10.8	-10	0.3624	0.4913	391.145	154.279	199.868
	9.6	-20	0.3568	0.47	415.109	157.494	199.863
$\widehat{IC}_d$	12	+20	0.2886	0.4986	348.947	133.439	199.936
	11	+10	0.3024	0.5108	346.59	134.977	199.929
	10	0	0.3176	0.5281	331.785	136.092	199.923
	9	-10	0.3262	0.5308	329.747	137.684	199.918
	8	-20	0.3428	0.5381	325.654	140.491	199.907
θ	0.024	+20	0.3985	0.6005	289.962	143.898	199.86
	0.022	+10	0.3956	0.5984	290.647	143.578	199.873
	0.02	0	0.3867	0.5953	299.51	142.494	199.903
	0.018	-10	0.3756	0.58	301.548	141.842	199.905
	0.016	-20	0.3734	0.5684	302.033	141.594	199.917
$\emptyset$	0.036	+20	0.3213	0.5659	291.871	130.792	199.934
	0.033	+10	0.327	0.5765	293.236	132.103	199.93
	0.03	0	0.3327	0.5796	296.559	133.685	199.925
	0.027	-10	0.3789	0.5826	298.656	142.19	199.893
	0.024	-20	0.3998	0.5859	300.648	146.439	199.876

Note: α^*= **Parameters,** β^*=**Values,** γ^*=**%Changes**

To understand the impact of different parameters, on the optimal cost given by the considered strategy. Affectability result is executed by changing (increasing and decreasing) 10 % in every parameter. The effect of the parameters is detailed below.

As the result of the above table ,

(i) Increases in the value of the parameter W then $t_1,\ T\ is\ decreased\ and\ \widehat{TC}_{\widehat{T_{neuBi}}}(t_2),\ Z\ ,\ Q$ is increased.

(ii) Increases in the value of the parameter δ then $t_1,\ T\ ,\widehat{TC}_{\widehat{T_{neuBi}}}(t_2)\ ,\ Z\ ,\ Q$ is increased.

(iii) Increases in the values of either of the parameters A, m then $t_1,\ T\ ,\widehat{TC}_{\widehat{T_{neuBi}}}(t_2)\ ,\ Z\ is\ increased\ and\ \ Q$ is decreased.

(iv) Increases in the values of either of the parametersIC_{H_r}, $\widehat{IC}_d$, t_2 then $t_1,\ T\ ,\ Z$ is decreased and $Q\ ,\widehat{TC}_{\widehat{T_{neuBi}}}(t_2)$ is increased.

(v) Increases in the values of the parameter $\widehat{IC}_{H_0}$ then $t_1,\ T\ ,\ \widehat{TC}_{\widehat{T_{neuBi}}}(t_2)$ is increased and $Q\ ,Z$ is decreased.

(vi) Increases in the values of the parameter IC_s then $t_1,\ T\ ,\ Q$ is decreased and $\widehat{TC}_{\widehat{T_{neuBi}}}(t_2)\ ,Z$ is increased.

(vii) Increases in the values of the parameter θ then $t_1,\ T\ ,Z$ is increased and $\widehat{TC}_{\widehat{T_{neuBi}}}(t_2)\ ,\ Q$ is decreased

(viii) Increases in the values of the parameter $\emptyset$ then $t_1,\ T\ ,\widehat{TC}_{\widehat{T_{neuBi}}}(t_2)\ ,Z$ is decreased *and* Q is increased.

Changing the parameter values and different total cost of power demand pattern

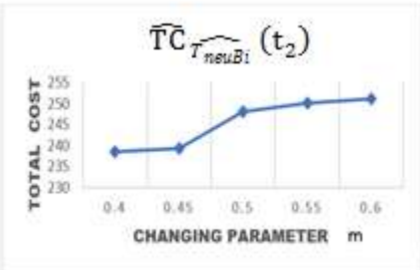

Figure 4

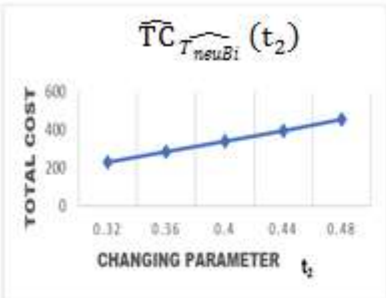

Figure 5

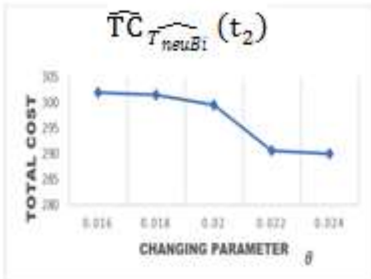

Figure 6

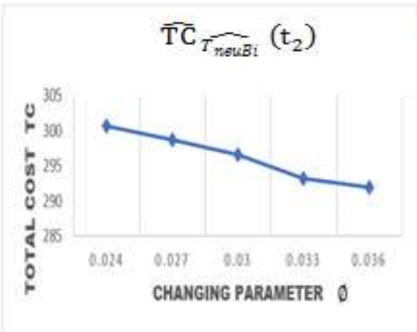

Figure 7

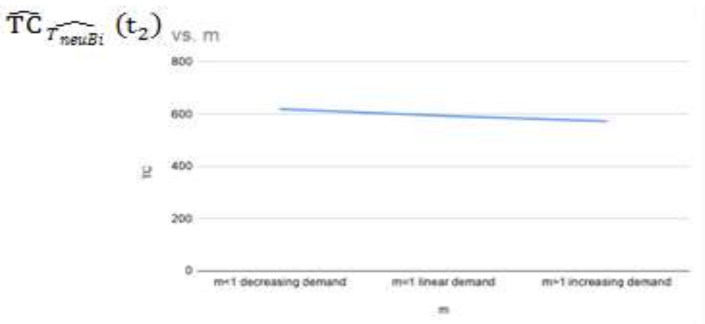

Figure 8

CONCLUSON

In this article, two-warehouse system for trapezoidal bipolar neutrosophic disparate expeditious worsen items with power demand pattern. Because of the various preservation conditions, OW and RW have trapezoidal bipolar neutrosophic parameters holding costs and exacerbate costs. The impact of demand pattern index optimal policy is dependent on whether the request sample index is lower than, equal to, or more than 1.0, according to our findings. Furthermore, when the request sample index is $0<m<1$, a similar structure emerges. However, when $m = 1$, a different structure emerges. However, when $m > 1$, The proposed demonstrate joins some practical highlights that are probably going to be associated for certain sorts of stock. Likewise, this model can be embraced in the stock control of retail business like food ventures, convenient garments household goods, car accessories, electronic items etc. increases quantity and decreases the cost of total amount. In future this paper can be extended in the Nero fuzzy environment and can be elongate the EPQ model is considering variable worsen with index of power demand and shortages not allow.

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