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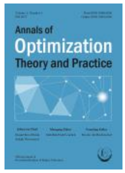

Neutrosophic inventory model under immediate return for deficient items

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AbstractThis paper demonstrates a neutrosophic inventory control problem with an immediate return for deficient items by employing two types of neutrosophic numbers, namely triangular neutrosophic numbers and trapezoidal neutrosophic numbers. The neutrosophic perfective rate, neutrosophic demand rate, and neutrosophic purchasing cost are fuzzified as triangular neutrosophic numbers and trapezoidal neutrosophic numbers are also furnished. The optimum order quantity is acquired in neutrosophic sense with the assist of median rule. The proposed model is illustrated with appropriate instance.

Keywords Deficient items; Neutrosophic demand rate; Neutrosophic perfective rate; Neutrosophic purchasing cost

1. Introduction

Chang(2004)gave an application of fuzzy sets theory to the EOQ model with imperfect quality items. The inventory problem for items received with imperfect quality was investigated. Eroglu and Ozdemir (2007)developed an EOQ model for each ordered lot contains some defective items and shortage backordered. Wee *et al.* (2007)published an article in an optimal inventory model for items with imperfect quality and shortage backordering. This paper assumed that all customers are willing to wait for a new supply where there is a shortage. Ranganathan and Thirunavukarasu (2015)developed a fuzzy inventory model under immediate return for deficient items. Mullai and Broumi (2018)proposed neutrosophic inventory model without shortages. Smarandache (2006)introduced neutrosophic set and neutrosophic logic by considering the non-standard analysis. In this paper is to explore the inventory control problem with immediate return for deficient items in neutrosophic senses, including neutrosophic perfective rate, neutrosophic demand rate and neutrosophic purchasing cost and then

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determine the neutrosophic optimal order quantity. Finally, a numerical example is provided to illustrate the proposed model.

2. NOTATIONS AND ASSUMPTIONS

A. Notations

D^N- Neutrosophic demand rate (unit/per year)
s^N- Neutrosophic selling price per unit ($s^N > c^N$)

c^N- Neutrosophic purchasing cost per unit

b^N- Neutrosophic holding cost rate per unit/per unit time

h^N- Neutrosophic holding cost per unit/per unit time, $h^N = b^N c^N$

a^N- Neutrosophic ordering cost per order

q^N- Neutrosophic perfective rate for each order

p^N- Neutrosophic deficient rate for each order ($p^N = 1 - q^N$)

e^N- Neutrosophic screening rate (unit/per year)

w^N- Neutrosophic screening cost per unit

Q^N- Neutrosophic order size

T^N- Neutrosophic cycle length

B. Assumptions

• In the starting of every neutrosophic inventory cycle, a neutrosophic lot size of Q is renewed instantaneously.

• The screening of the neutrosophic lot will begin at time $t^N{}_1$ and will be finished at time $t^N{}_e$. The neutrosophic screening and neutrosophic demand proceed simultaneously, and the neutrosophic screening rate is greater than the neutrosophic demand rate (i.e.,$e^N > D^N$).

• At the time of screening, if any item is found to be deficient, then it will be returned to the supplier immediately.

• To avoid shortages, assume that the wide variety of good items is at least equal to the neutrosophic demand at some stage in the screening process. This leads to

$e^N \geq D^N/q^N$.

• All other assumptions are available within the neutrosophic EOQ model.

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3. MODEL DESCRIPTION

This section contains the neutrosophic triangular method and neutrosophic trapezoidal method for finding optimal order quantity.

C. Triangular method

In this model, we assume that neutrosophic perfective rate, neutrosophic demand rate and neutrosophic purchasing cost are in triangular neutrosophic numbers with parameters: q^N, D^N, C^N.

Suppose, $q^N = (q^N_1, q^N_2, q^N_3)\ (q'^N_1, q^N_2, q'^N_3)\ (q''^N_1, q^N_2, q''^N_3)$

$D^N = (d^N_1, d^N_2, d^N_3)\ (d'^N_1, d^N_2, d'^N_3)\ (d''^N_1, d^N_2, d''^N_3)$

$c^N = (c^N_1, c^N_2, c^N_3)\ (c'^N_1, c^N_2, c'^N_3)\ (c''^N_1, c^N_2, c''^N_3)$

Then, the corresponding neutrosophic total profit ($P^N(Q)$) is as follows: Ranganathan and Thirunavukarasu (2015)

$$P^N(Q) = s^N D^N - (C^N \otimes D^N) + \frac{b^N Q^N}{2e^N}(C^N \otimes D^N) - \frac{b^N Q^N}{2}(C^N \otimes q^N) - \left(\frac{a^N}{Q^N} + w^N\right)(D^N \div q^N) - \frac{b^N Q^N}{2e^N}(C^N \otimes (D^N \div q^N))$$

The neutrosophic total relevance cost can be formulated as,

$$P^N(Q) = s^N((d^N_1+d^N_2+d^N_3)+(d''^N_1+d^N_2+d''^N_3)) - [((c^N_1+c^N_2+c^N_3)+(c''^N_1+c^N_2+c''^N_3))+((d^N_1+d^N_2+d^N_3)+(d''^N_1+d^N_2+d''^N_3))] + \frac{b^N Q^N}{2e^N}[((c^N_1+c^N_2+c^N_3)+(c''^N_1+c^N_2+c''^N_3))+((d^N_1+d^N_2+d^N_3)+(d''^N_1+d^N_2+d''^N_3))] - \frac{b^N Q^N}{2}[((c^N_1+c^N_2+c^N_3)+(c''^N_1+c^N_2+c''^N_3))+((q^N_1+q^N_2+q^N_3)+(q''^N_1+q^N_2+q''^N_3))] - \left(\frac{a^N}{Q^N} + w^N\right)\left[\left(\frac{d^N_1}{q^N_1}+\frac{d^N_2}{q^N_2}+\frac{d^N_3}{q^N_3}\right)+\left(\frac{d''^N_1}{q''^N_1}+\frac{d^N_2}{q^N_2}+\frac{d''^N_3}{q''^N_3}\right)\right] - \frac{b^N Q^N}{2e^N}\left[\left(\frac{c^N_1 d^N_1}{q^N_1}+\frac{c^N_2 d^N_2}{q^N_2}+\frac{c^N_3 d^N_3}{q^N_3}\right)+\left(\frac{c''^N_1 d''^N_1}{q''^N_1}+\frac{c^N_2 d^N_2}{q^N_2}+\frac{c''^N_3 d''^N_3}{q''^N_3}\right)\right]$$

The defuzzified neutrosophic total relevance cost is given by

$$P^N(Q) = \frac{1}{8}\{s^N((d^N_1+2d^N_2+d^N_3)+(d''^N_1+2d^N_2+d''^N_3)) - [((c^N_1+2c^N_2+c^N_3)+(c''^N_1+2c^N_2+c''^N_3))+((d^N_1+2d^N_2+d^N_3)+(d''^N_1+2d^N_2+d''^N_3))] + \frac{b^N Q^N}{2e^N}[((c^N_1+2c^N_2+c^N_3)+(c''^N_1+2c^N_2+c''^N_3))+((d^N_1+2d^N_2+d^N_3)+(d''^N_1+2d^N_2+d''^N_3))] - \frac{b^N Q^N}{2}[((c^N_1+2c^N_2+c^N_3)+(c''^N_1+2c^N_2+c''^N_3))+((q^N_1+2q^N_2+q^N_3)+(q''^N_1+2q^N_2+q''^N_3))] - \left(\frac{a^N}{Q^N} + w^N\right)\left[\left(\frac{d^N_1}{q^N_1}+2\frac{d^N_2}{q^N_2}+\frac{d^N_3}{q^N_3}\right)+\left(\frac{d''^N_1}{q''^N_1}+2\frac{d^N_2}{q^N_2}+\frac{d''^N_3}{q''^N_3}\right)\right] - \frac{b^N Q^N}{2e^N}\left[\left(\frac{c^N_1 d^N_1}{q^N_1}+2\frac{c^N_2 d^N_2}{q^N_2}+\frac{c^N_3 d^N_3}{q^N_3}\right)+\left(\frac{c''^N_1 d''^N_1}{q''^N_1}+2\frac{c^N_2 d^N_2}{q^N_2}+\frac{c''^N_3 d''^N_3}{q''^N_3}\right)\right]\}$$

By taking the derivative $D(P^N(Q))$ and equating it to zero, we have

$\frac{1}{8}\{\frac{b^N}{2e^N}[((c^N_1d^N_1+2c^N_2d^N_2+c^N_3d^N_3)+(c''^N_1d''^N_1+2c^N_2d^N_2+c''^N_3d''^N_3))-e^N((c^N_1q^N_1+2c^N_2q^N_2+c^N_3q^N_3)+(c''^N_1q''^N_1+2c^N_2q^N_2+c''^N_3q''^N_3))-(\frac{c_1^Nd_1^N}{q_1^N}+2\frac{c_2^Nd_2^N}{q_2^N}+\frac{c_3^Nd_3^N}{q_3^N})+(\frac{c''^N_1d''^N_1}{q''^N_1}+2\frac{c_2^Nd_2^N}{q_2^N}+\frac{c''^N_3d''^N_3}{q''^N_3})]+\frac{a^N}{Q^{2N}}(\frac{d_1^N}{q_1^N}+2\frac{d_2^N}{q_2^N}+\frac{d_3^N}{q_3^N})+(\frac{d''^N_1}{q''^N_1}+2\frac{d_2^N}{q_2^N}+\frac{d''^N_3}{q''^N_3})\} = 0$

$\Rightarrow$

$\frac{1}{8}\{\frac{b^N}{2e^N}(\frac{1}{((q_1^N+2q_2^N+q_3^N)+(q''^N_1+2q_2^N+q''^N_3))})[((c^N_1d^N_1+2c^N_2d^N_2+c^N_3d^N_3)+(c''^N_1d''^N_1+2c^N_2d^N_2+c''^N_3d''^N_3))-e^N((c^N_1{q_1}^{2N}+2c^N_2{q_2}^{2N}+c^N_3{q_3}^{2N})+(c''^N_1q''^{2N}_1+2c^N_2{q_2}^{2N}+c''^N_3q''^{2N}_3))-((c^N_1d^N_1+2c^N_2d^N_2+c^N_3d^N_3)+(c''^N_1d''^N_1+2c^N_2d^N_2+c''^N_3d''^N_3))]+\frac{a^N}{Q^{2N}}(\frac{d_1^N}{q_1^N}+2\frac{d_2^N}{q_2^N}+\frac{d_3^N}{q_3^N})+(\frac{d''^N_1}{q''^N_1}+2\frac{d_2^N}{q_2^N}+\frac{d''^N_3}{q''^N_3})\} = 0$

$\Rightarrow$

$\frac{1}{8}\frac{a^N}{Q^{2N}}(\frac{d_1^N}{q_1^N}+2\frac{d_2^N}{q_2^N}+\frac{d_3^N}{q_3^N})+(\frac{d''^N_1}{q''^N_1}+2\frac{d_2^N}{q_2^N}+\frac{d''^N_3}{q''^N_3})=\frac{1}{8}\frac{b^N}{2e^N}(\frac{1}{((q_1^N+2q_2^N+q_3^N)+(q''^N_1+2q_2^N+q''^N_3))})[((c^N_1d^N_1+2c^N_2d^N_2+c^N_3d^N_3)+(c''^N_1d''^N_1+2c^N_2d^N_2+c''^N_3d''^N_3))-e^N((c^N_1{q_1}^{2N}+2c^N_2{q_2}^{2N}+c^N_3{q_3}^{2N})+(c''^N_1q''^{2N}_1+2c^N_2{q_2}^{2N}+c''^N_3q''^{2N}_3))-((c^N_1d^N_1+2c^N_2d^N_2+c^N_3d^N_3)+(c''^N_1d''^N_1+2c^N_2d^N_2+c''^N_3d''^N_3))]$

$\Rightarrow$

$\frac{1}{Q^{2N}}(\frac{d_1^N}{q_1^N}+2\frac{d_2^N}{q_2^N}+\frac{d_3^N}{q_3^N})+(\frac{d''^N_1}{q''^N_1}+2\frac{d_2^N}{q_2^N}+\frac{d''^N_3}{q''^N_3})=\frac{b^N}{2a^Ne^N}\{(\frac{c_1^N}{q_1^N}+2\frac{c_2^N}{q_2^N}+\frac{c_3^N}{q_3^N})+(\frac{c''^N_1}{q''^N_1}+2\frac{c_2^N}{q_2^N}+\frac{c''^N_3}{q''^N_3})[(1-((q^N_1+2q^N_2+q^N_3)+(q''^N_1+2q^N_2+q''^N_3)))((d^N_1+2d^N_2+d^N_3)+(d''^N_1+2d^N_2+d''^N_3))+e^N(({q_1}^{2N}+2{q_2}^{2N}+{q_3}^{2N})+(q''^{2N}_1+2{q_2}^{2N}+q''^{2N}_3))]\}$,

we get

$$Q^{N^*}=\sqrt{\frac{A}{B}}\ldots\ldots\ldots\ldots \quad (1)$$

where, $A=2a^Ne^N((d_1^N+2d_2^N+d_3^N)+(d''^N_1+2d_2^N+d''^N_3))$,

$B= b^N((c_1^N+2c_2^N+c_3^N)+(c''^N_1+2c_2^N+c''^N_3))[(1-((q_1^N+2q_2^N+q_3^N)+(q''^N_1+2q_2^N+q''^N_3)))((d_1^N+2d_2^N+d_3^N)+(d''^N_1+2d_2^N+d''^N_3))+e^N((q_1^{2N}+2q_2^{2N}+q_3^{2N})+(q''^{2N}_1+2q_2^{2N}+q''^{2N}_3))]$

D. Trapezoidal method

Let $q^N = (q^N_1, q^N_2, q^N_3, q^N_4)\ (q'^N_1, q'^N_2, q'^N_3, q'^N_4)\ (q''^N_1, q''^N_2, q''^N_3, q''^N_4)$

$D^N = (d^N_1, d^N_2, d^N_3, d^N_4)\ (d'^N_1, d'^N_2, d'^N_3, d'^N_4)\ (d''^N_1, d''^N_2, d''^N_3, d''^N_4)$

$c^N = (c^N_1, c^N_2, c^N_3, c^N_4)\ (c'^N_1, c'^N_2, c'^N_3, c'^N_4)\ (c''^N_1, c''^N_2, c''^N_3, c''^N_4)$

Then, the corresponding neutrosophic total profit ($P^N(Q)$) is as follows: Ranganathan and Thirunavukarasu (2015)

$P^N(Q) = s^N D^N - (C^N \otimes D^N) + \frac{b^N Q^N}{2e^N}(C^N \otimes D^N) - \frac{b^N Q^N}{2}(C^N \otimes q^N) - (\frac{a^N}{Q^N} + w^N)(D^N \div q^N) - \frac{b^N Q^N}{2e^N}(C^N \otimes (D^N \div q^N)$

The neutrosophic total relevance cost can be formulated as,

$$P^N(Q)= \sum_{i=1}^{4}(sd_i{}^N - c_i{}^N d_i{}^N + \frac{bQ}{2e}c_i{}^N d_i{}^N - \frac{bQ}{2}c_i{}^N q_i{}^N - \left(\frac{a}{Q}+w\right)\frac{d_i{}^N}{q_i{}^N} - \frac{bQ}{2e}\frac{c_i{}^N d_i{}^N}{q_i{}^N}) + \sum_{i=1}^{4}(sd_i{}'^N - c_i{}'^N d_i{}'^N + \frac{bQ}{2e}c_i{}'^N d_i{}'^N - \frac{bQ}{2}c_i{}'^N q_i{}'^N - \left(\frac{a}{Q}+w\right)\frac{d_i{}'^N}{q_i{}'^N} - \frac{bQ}{2e}\frac{c_i{}'^N d_i{}'^N}{q_i{}'^N}) + \sum_{i=1}^{4}(sd_i{}''^N - c_i{}''^N d_i{}''^N + \frac{bQ}{2e}c_i{}''^N d_i{}''^N - \frac{bQ}{2}c_i{}''^N q_i{}''^N - \left(\frac{a}{Q}+w\right)\frac{d_i{}''^N}{q_i{}''^N} - \frac{bQ}{2e}\frac{c_i{}''^N d_i{}''^N}{q_i{}''^N})$$

The defuzzified neutrosophic total relevance cost is given by

$$P^N(Q)=\frac{1}{8}[\sum_{i=1}^{4}(sd_i{}^N - c_i{}^N d_i{}^N + \frac{bQ}{2e}c_i{}^N d_i{}^N - \frac{bQ}{2}c_i{}^N q_i{}^N - \left(\frac{a}{Q}+w\right)\frac{d_i{}^N}{q_i{}^N} - \frac{bQ}{2e}\frac{c_i{}^N d_i{}^N}{q_i{}^N}) + \sum_{i=1}^{4}(sd_i{}''^N - c_i{}''^N d_i{}''^N + \frac{bQ}{2e}c_i{}''^N d_i{}''^N - \frac{bQ}{2}c_i{}''^N q_i{}''^N - \left(\frac{a}{Q}+w\right)\frac{d_i{}''^N}{q_i{}''^N} - \frac{bQ}{2e}\frac{c_i{}''^N d_i{}''^N}{q_i{}''^N})]$$

By taking the derivative $D(P^N(Q))$ and equating it to zero, we have

$$\frac{1}{8}\sum_{i=1}^{4}\{\frac{b^N}{2e^N}[(c_i^N d_i^N + c''^N_i d''^N_i) - e^N(c_i^N q_i^N + c''^N_i q''^N_i) - (\frac{c_i^N d_i^N}{q_i^N} + \frac{c''^N_i d''^N_i}{q''^N_i})] + \frac{a^N}{Q^{2N}}(\frac{d_i^N}{q_i^N} + \frac{d''^N_i}{q''^N_i})\} = 0$$

$$\Rightarrow \frac{1}{8}\sum_{i=1}^{4}\frac{b^N}{2e^N}(\frac{1}{q_i^N + q''^N_i})[(c_i^N d_i^N + c''^N_i d''^N_i) - e^N(c_i^N q_i{}^{2N} + c''^N_i q''_i{}^{2N}) - (c_i^N d_i^N + c''^N_i d''^N_i)] + \frac{a^N}{Q^{2N}}(\frac{d_i^N}{q_i^N} + \frac{d''^N_i}{q''^N_i}) = 0$$

$$\Rightarrow \frac{1}{8}\sum_{i=1}^{4}\frac{a^N}{Q^2}(\frac{d_i^N}{q_i^N} + \frac{d''^N_i}{q''^N_i}) = \frac{1}{8}\sum_{i=1}^{4}\frac{b^N}{2e^N}(\frac{1}{q_i^N + q''^N_i})[(c_i^N d_i^N + c''^N_i d''^N_i)$$

$$-e^N(c_i^N {q_i}^{2^N} + c''^N_i {q''_i}^{2^N}) - (c_i^N d_i^N q_i^N + c''^N_i d''^N_i q''^N_i)]$$

$$\Rightarrow \frac{1}{Q^{2^N}} \sum_{i=1}^{4} (\frac{d_i^N}{q_i^N} + \frac{d''^N_i}{q''^N_i}) = \frac{b^N}{2a^N e^N} \sum_{i=1}^{4} \{(\frac{c_i^N}{q_i^N} + \frac{c''^N_i}{q''^N_i})[(1-(q_i^N + q''^N_i))(d_i^N + d''^N_i) + e^N({q_i}^{2^N} + {q''_i}^{2^N})]\}$$

we get,

$$Q^{N^*} = \sqrt{\frac{\sum_{i=1}^{4} 2a^N e^N (d_i^N + d''^N_i)}{\sum_{i=1}^{4} \{b^N(c_i^N + c''^N_i)[(1-(q_i^N + q''^N_i))(d_i^N + d''^N_i) + e^N({q_i}^{2^N} + {q''_i}^{2^N})]\}}} \quad (2)$$

4.NUMERICAL EXAMPLE

A firm desires to estimate the EOQ. But, the firm has coverage with immediately return for deficient items. The business enterprise expected that the annual demand(D) is likely to be 45000 units per year. The purchasing cost (c) is approximately 20 per order, and the perfective rate (q) is 0.95 for every order and the deficient rate (p) is 0.05 for every order. The ordering cost (a) is projected to be around 100 per order, holding cost (b) is estimated to be around 0.25 per unit, the selling price (s) is 175200 and the screening cost (w) is 0.5.

Solution:

The optimal order quantity for crisp set, fuzzy set, intuitionistic fuzzy set and neutrosophic set are calculated and tabulated as follows:

Table1. Optimal order quantity by using triangular number

	Crisp Set	Fuzzy Set	Intuitionistic Fuzzy Set	Neutrosophic Set
D	45000	(43000, 45000, 46000)	(43000, 45000, 46000) (41000, 45000, 48000)	(43000, 45000, 46000) (41000, 45000, 48000) (39000, 45000, 50000)

Table1.Continued

	Crisp Set	Fuzzy Set	Intuitionistic Fuzzy Set	Neutrosophic Set
Q	0.95	(0.75, 0.95, 1.05)	(0.75, 0.95, 1.05) (0.35, 0.95, 1.15)	(0.75, 0.95, 1.05) (0.35, 0.95, 1.15) (0.15, 0.95, 1.35)
C	20	(18, 20, 21)	(18, 20, 21) (16, 20, 23) (14, 20, 25)	(18, 20, 21) (16, 20, 23) (14, 20, 25)
Optimal order quantity	1376.49	518.864	222.83	215.637

Table:2 Optimal order quantity by using trapezoidal number

	Crisp Set	Fuzzy Set	Intuitionistic Fuzzy Set	Neutrosophic Set
D	45000	(43000, 44000, 46000, 47000)	(43000, 44000, 46000, 47000) (41000, 42000, 48000, 49000)	(43000, 44000, 46000, 47000) (41000, 42000, 48000, 49000) (39000, 40000, 50000, 51000)
Q	0.95	(0.75, 0.85, 1.05, 1.15)	(0.75, 0.85, 1.05, 1.15) (0.35, 0.65, 0.95, 1.25)	(0.75, 0.85, 1.05, 1.15) (0.35, 0.65, 0.95, 1.25) (0.15, 0.55, 1.35, 1.75)
C	20	(18, 19, 21, 22)	(18, 19, 21, 22) (16, 17, 23, 24)	(18, 19, 21, 22) (16, 17, 23, 24) (14, 15, 25, 26)
Optimal order quantity	1376.49	509.64	215.165	208.918

5. SENSITIVITY ANALYSIS AND OBSERVATIONS

In this section, the analysis of optimal order quantity for crisp set, fuzzy set, intuitionistic fuzzy set and neutrosophic set is analysed from tables 1 & 2 and the results are compared graphically.

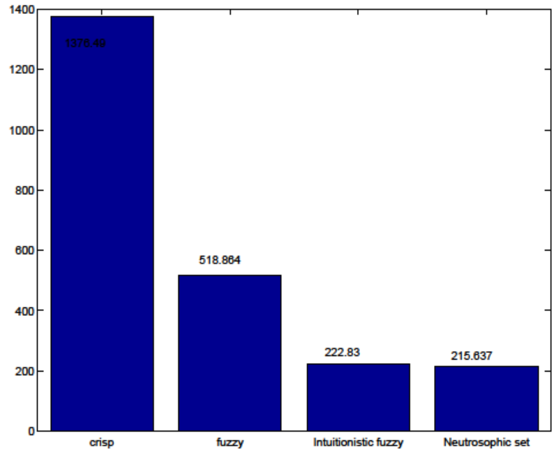

Figure 1. Sensitivity Analysis for crisp set, fuzzy set, intuitionistic fuzzy set and neutrosophic set by using triangular method

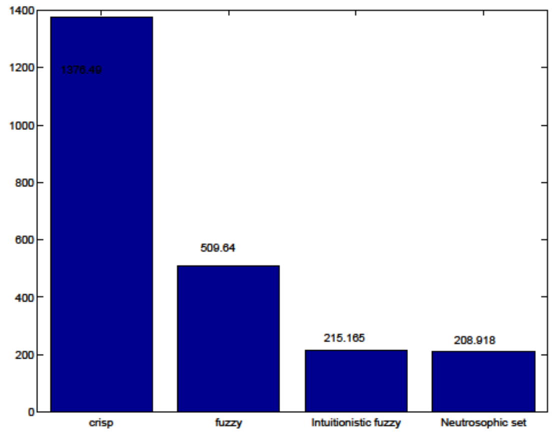

Figure 2. Sensitivity Analysis for crisp set, fuzzy set, intuitionistic fuzzy set and neutrosophic set by using trapezoidal method

Observations from Sensitivity Analysis:

• From the above analysis, we observed that neutrosophic set gives the better solution to optimal order quantity than a crisp set, fuzzy set and intuitionistic fuzzy set.

• It is also analyzed that the trapezoidal neutrosophic method gives a better solution for optimal order quantity compared with the triangular neutrosophic method.

• From figures, it is observed that neutrosophic optimal order quantity is low.

6. CONCLUSION

The inventory control problem with immediate return for deficient items in neutrosophic senses is introduced in this paper. For neutrosophic model, the neutrosophic perfective rate, neutrosophic demand rate and neutrosophic purchasing cost are calculated by triangular and trapezoidal neutrosophic numbers. The median rule is used for defuzzification and the neutrosophic optimal order quantity is derived by both triangular and trapezoidal neutrosophic numbers. From the analysis, trapezoidal neutrosophic number gives the better solution for optimal order quantity compared with triangular neutrosophic number. To maintain the stock level of neutrosophic inventory and to increase total neutrosophic profit, trapezoidal neutrosophic method is highly beneficial. The proposed model is very useful than other existing models for all companies to maintain the level of inventory under immediate return for deficient items.

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REFERENCES

1. Chang, H. C. (2004). An application of fuzzy sets theory to the EOQ model with imperfect quality items. Computers & Operations Research, 31(12), 2079-2092.
2. Eroglu, A., &Ozdemir, G. (2007). An economic order quantity model with defective items and shortages. International journal of production economics, 106(2), 544-549.
3. F. Smarandache, “Neutrosophic set - a generalization of the intuitionistic fuzzy set,” Granular Computing, 2006 IEEE International Conference, 38- 42, 2006.
4. H. M. Wee, F. Tu and M. C. Chen, “Optimal inventory model for items with imperfect quality and shortage backordering,” Omega, 35, 7-11, 2007.
5. Mullai, M., &Broumi, S. (2018). Neutrosophic inventory model without shortages. Asian Journal of Mathematics and Computer Research, 214-219
6. Ranganathan, V., &Thirunavukarasu, P. (2015). Fuzzy inventory model under immediate return for deficient items. International Journal of Mathematical Analysis, 9(7), 307-316.
7. Salameh, M. K., &Jaber, M. Y. (2000). Economic production quantity model for items with imperfect quality. International journal of production economics, 64(1-3), 59-64.

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