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OPTIMIZATION OF FUZZY INTERVALUED FUNCTION IN MEDICINAL MANUFACTURING AND STOCK APPROACHES: REFINEMENT FOR A PHARMA COMPANIES

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Abstract

Each section of the healthcare industry should make an effort to supply excellent service for medical supplies and implement efficient inventory management procedures. Inappropriate drug use and medication deficiencies can hurt individuals & cost businesses money. Because they haven't thought about how pharmaceuticals are handled, delivered, and used to save lives and enhance health, many health systems and hospitals struggle to meet these objectives. Research is necessary to comprehend how the health care sector operates and to develop instruments for decision of pharmaceuticals, improved patient, and public health. The pharmaceutical industry is crucial to the healthcare sector because of the expensive prices of the products and the stringent storage and control requirements. Both buying and distributing can be expensive. Pharmaceutical management must be successful in order to ensuring that goods are always available offered to the relevant customers at the appropriate time, at the acceptable price, and in a good quality. In this study, model's extended to include the manufacturing rate, screening rate, holding cost & selling cost of pharmaceutical company's product as trapezoidal fuzzy values in the overall cost.

Keywords: Kuhn Tucker Techniques, Total Cost, Fuzzy Logic, Numerical Values, Arithmetic Operations, Python Programming.

1. INTRODUCTION

An indeterminate idea is one whereby its scope applications can vary significantly depending on context or disorders rather than being set once and for everyone in the world. This implies that the idea is vague in some manner, absence a determinate, precise meaning, regardless of being completely undefined or meaningless. It has a distinct significance that can only be refined through additional expounding and specification, including a more precise description of the particular situation in which its concept is implemented. Fuzzysets are mathematical groups with various degrees of membership. Lotfi A. Zadeh established fuzzy sets independently in 1965 as an expansion of the classical genre concept of set.

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Simultaneously, Salii (1965) described an L-relation, a more generic sort of structure that he examined in a philosophical algebraic setting. Fuzzy relations are specific examples of L-relations that have relevance in domains such as linguistics, making choices, and clusters.

Optimization of supply chains is now a significant investigation area in manufacturing operations and management. There has been a substantial quantity of study done on facility layout and designing, which is inventory as well as shipment preparing, and the seating capacity and manufacture preparing, and along with exhaustive scheduling. Only a tiny portion of this work explicitly addresses pharmaceutical industry issues. [1] This sector, on the other hand, appears to be both prepared to engage and in an impoverished need of fashionable supply chain optimisation methods of protection [2].

The requirement for balancing future capacity with projected requirements in the face by substantial ambiguity caused by ongoing clinical studies and competitor activity is a particular issue facing this segment of the market at the manufacturing process design stage. [3] As the demands from regulators mount and margins dwindle, effective capabilities utilisation plans and sensible fiscally responsible infrastructure choices will become increasingly important.

[4] The potential to strategically place supply chain nodal points in tax havens and efficient trading and communicate price structures introduces novel degrees of freedom into a typical supply chain design issue. [5] Prior to arranging for capacity, there is the problem of pipeline and reviewing planning, which requires careful risk and possible rewards oversight when making choices of products for investment and arranging the distribution of development tasks.

A purchasing cycle period of 300 days tends to be unusual. In this environment, supply chain removing bottlenecks and a decoupling tactics such as, as well as facilitated inventory administration, are essential for agility in responding to changing developments in the marketplace. [8] A detailed comprehension of what drives the industry's supply chain interaction is also needed. Instead of responding to exterior demand, erratic dynamics tend to be brought in by the processes of a company, and these trends can be prevented by restructuring company operations or supplier/customer connections between individuals. [9]

Raw materials, work-in-progress, and finished commodities are all included in an inventory. For a variety of reasons, industrial companies require effective inventory control.

[12] The goal of many inventory problems is to reduce carrying costs as much as possible. As a result, determining an appropriate inventory model to fulfill future demand is critical. [13] EOQ model is the most generally used inventory model, in which subsequent actions are categorised as supply and demand. [14] The simple EOQ model was the first quantitative treatment of inventory. As a result, the EOQ model is quite beneficial in real-life situations. Harris et al. devised this model. [16].

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Wilson expressed an interest in developing EOQ-model in academia and industry. [17] Hadely et al investigated a wide range of inventory models. Uncertainty & imprecision are inherent in real-world inventory problems. Fuzzy set theory is regarded to be more practical than probability theory for defining inventory optimization tasks in such an environment and interpreting optimal solutions. [20] Kumar and Rajput developed a fuzzy commodities model for defective merchandise with fluctuating needs over time to estimate a partial backlog. [21] Fuzzy practical order number for reserves without backorder Huey-Ming Lee and Jing-shing invented fuzzy sets. [22]

2. BASIC DEFINITIONS AND ARITHMETIC OPERATIONS FOR MEDICINAL MANUFACTURING

Definition 2.1: Fuzzy Set

Let X be a nonempty set. Then fuzzy set A in X (ie., a fuzzy subset A of X) is characterized by a function of the form μA: X $\rightarrow$ [0,1]. Such a function μA is called the membership function and for each x $\in X,\ \mu_{\tilde{A}}(x)$ is the membership grade of x in the fuzzy set A.

Definition 2.2: Fuzzy Logic

Fuzzy logic is an ingredient computational a perspective that enables various quantities to be processed by the use of the same variable. Fuzzy logic tries to solve problems by using an unrestricted and imprecise spectral on information to generate a range of precise interpretations.

3. THE KUHN - TUCKER METHOD FOR MEDICINAL MANUFACTURING

Taha (1997) revealed what caused to use the Kuhn-Tucker atmospheres to solve the optimal version of a nonlinear modeling problem with inequality impediments. The Lagrangean methods is used to create the Kuhn-Tucker stipulations.

Assume, Minimize y = f(x)

Subject to $g_i(x) \geq 0$, i = 1,2,……,m.

The Kuhn-Tucker conditions need x and to be the prevention problem's fixed specific, which can be summarized for the following reasons:

$$\begin{cases} \mu \leq 0 \\ \nabla f(x) - \mu \nabla g(x) = 0, \\ \mu_i g_i(x) = 0, i = 1, 2, \ldots\ldots m \\ g_i(x) \geq 0, i = 1, 2, \ldots\ldots m \end{cases}$$

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4. GRADED MEAN INTEGRATION FOR MEDICINAL MANUFACTURING

Chen and Hsieh proposed the graded average integration representation technique for defuzzifying generalised fuzzy numbers based on an integral value of graded mean h - level of generalised fuzzy number. For the manufacturing inventory model, we employed trapezoid numbers that served as fuzzy parameters.

Let $\tilde{Z}$ be a pentagonal fuzzy number and denoted as

$$\tilde{Z} = (Z_1, Z_2, Z_3, Z_4, Z_5)$$

$$P(\tilde{Z}) = \frac{Z_1 + 2Z_2 + 2Z_3 + 2Z_4 + Z_5}{8} \quad \ldots\ldots\ldots\ldots\ldots\ldots(b)$$

4.1 Notations for Medicinal Manufacturing

D $\rightarrow$ Average demand

Q $\rightarrow$ Economic Order Quantity (EOQ).

A $\rightarrow$ Order cost

F $\rightarrow$ Fixed price.

R $\rightarrow$ Screening rate.

L $\rightarrow$ Lead time for all products.

H_b $\rightarrow$ Hold price

p $\rightarrow$ Purchase cost.

Ic $\rightarrow$ Interest charge period.

E $\rightarrow$ Expected demand shortage for the product.

5. MATHEMATICAL MODEL FOR MEDICINAL MANUFACTURING

The Derived total cost for medicinal manufacturing is,

$$\mathbf{ETC_h\,(Q, L)} = \frac{D}{E}(A + F + R(L)) + \frac{h_b Q}{2} + (h_b + pI_c)K\sigma\sqrt{L} + D(dC_d(L) + V) - \frac{D^2 t_c^2 SI_d}{2Q} - \frac{St_d I_d D}{Q} E$$

Partially differentiating with respect to Q and solving Q is

$$\text{Let} \quad \frac{\partial P(\tilde{JTC}(Q))}{\partial Q} = 0. \; We \;\; get$$

$$Q^* = \sqrt{\frac{2[2D(A+F+R(L)) - D^2 t_c^2 SI_d - St_c I_d D E]}{2h_b}}$$

The lot size (LS) of the medicinal manufacturing industry are derived above. The cost of obtaining and the cost of purchasing establish the optimal order size Q. To increase demand, it is critical to minimise the suggested model's expiry rates per cycle, the amount of orders per period, holding fees, and optimal order quantity. The total manufacturing cost of the model that was suggested has been reduced as a result of modifying the loan terms.

5.1 A Crisp Production Quantity Integrated Storage Model for Medicinal Manufacturing

The variables listed below are used to facilitate the treatment of integrated inventory models.

$\tilde{D}, \tilde{h}_b, \tilde{L}$ = fuzzy parameters.

Annual Integrated Total Inventory Cost (AITIC),

$$\tilde{JTC}(Q) =$$

$$\left[\frac{D_1}{Q} (A+F+R(L_1)) + \frac{h_{b_1} Q_1}{2} + (h_{b_1} + pI_c) k\sigma \sqrt{L_1} + D_1 (dC_d (L_1) + V) - \frac{D_1^2 t_c^2 SI_d}{2Q} - \frac{St_c I_d D_1}{Q} E \right],$$

$$\left[\frac{D_2}{Q} (A+F+R(L_2)) + \frac{h_b Q_2}{2} + (h_{b_2} + pI_c) k\sigma \sqrt{L_2} + D_2 (dC_d (L_2) + V) - \frac{D_2^2 t_c^2 SI_d}{2Q} - \frac{St_c I_d D_2}{Q} E \right],$$

$$\left[\frac{D_3}{Q} (A+F+R(L_3)) + \frac{h_b Q_3}{2} + (h_{b3} + pI_c) k\sigma \sqrt{L_3} + D_3 (dC_d (L_3) + V) - \frac{D_3^2 t_c^2 SI_d}{2Q} - \frac{St_c I_d D_3}{Q} E \right],$$

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$$\left[\frac{D_4}{Q}(A+F+R(L_4))+\frac{h_{b_4}Q_4}{2}+(h_{b_4}+pI_c)k\sigma\sqrt{L_4}+D_4(dC_d(L_4)+V)-\frac{D_4^2t_c^2SI_d}{2Q}-\frac{St_cI_dD_4}{Q}E\right],$$

$$\left[\frac{D_5}{Q}(A+F+R(L_5))+\frac{h_{b_5}Q_5}{2}+(h_{b_5}+pI_c)k\sigma\sqrt{L_5}+D_5(dC_d(L_5)+V)-\frac{D_5^2t_c^2SI_d}{2Q}-\frac{St_cI_dD_5}{Q}E\right]\}$$

$$P(J\tilde{T}C(Q))\bar{A}=$$

$$\frac{1}{8}\{\left[\frac{D_1}{Q}(A+F+R(L_1))+\frac{h_{b_1}Q_1}{2}+(h+\ldots\right.$$

$$+2\left[\frac{D_2}{Q}(A+F+R(L_2))+\frac{h_{b_2}Q_2}{2}+(h_{b_2}+pI\ldots\right.$$

$$+2\left[\frac{D_3}{Q}(A+F+R(L_3))+\frac{h_{b_3}Q_3}{2}+(h+pI\ldots\right.$$

$$+2\left[\frac{D_4}{Q}(A+F+R(L_4))+\frac{h_{b_4}Q_4}{2}+(h+pI\ldots\right.$$

$$\left[\frac{D_5}{Q}(A+F+R(L_5))+\frac{h_{b_5}Q_5}{2}+(h_{5}+pI_c\ldots\right.$$

To find the minimization of

$$\frac{\partial P(J\tilde{T}C(Q))}{\partial Q}=\frac{1}{8}\{\left[-\frac{D_1}{Q^2}(A+F+R(L_1))+\ldots\right.$$

$$+2\left[-\frac{D_2}{Q^2}(A+F+R(L_2))+\ldots\right.$$

$$+2\left[-\frac{D_3}{Q^2}(A+F+R(L_3))+\ldots\right.$$

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$$+2\left[-\frac{D_4}{Q^2}(A+F+R(L_4))+\frac{h_b}{2}+\frac{D_4^2 t_c^2 SI_d}{2Q^2}-\frac{St_c I_d D_4 E}{Q^2}\right]$$
$$+\left[-\frac{D_3}{Q^2}(A+F+R(L_3))+\frac{h_b}{2}+\frac{D_5^2 t_c^2 SI_d}{2Q^2}+\frac{St_c I_d D_5 E}{Q^2}\right]$$

Let $\frac{\partial P(JTC(\tilde{Q}))}{\partial Q}=0$. We get,

$$-\left\{\left[\frac{D_1}{Q^2}(A+F+R(L_1))+2\frac{D_2}{Q^2}(A+F+R(L_2))+2\frac{D_3}{Q^2}(A+F+R(L_3))+2\frac{D_4}{Q^2}(A+F+R(L_4))+\frac{D_5}{Q^2}(A+F+R(L_5))\right]\right.$$
$$\left[-\frac{D_1}{Q^2}(A+F+R(L_1))+2\frac{D_2^2 t_c^2 SI_d}{2Q^2}+2\frac{D_3^2 t_c^2 SI_d}{2Q^2}+2\frac{D_4^2 t_c^2 SI_d}{2Q^2}+\frac{D_5}{Q^2}(A+F+R(L_5))\right]$$

$-\ [St \quad I \quad D \quad E+2 \quad St \quad I$

$\Rightarrow \frac{1}{2Q} \quad +4D \quad (A+F+R(L$

$[D \quad SI \quad 2D \quad SI$

$-\ [2St \quad I \quad D E+4St \quad I \quad D E$

$2| \quad +4D$

$-\ [D \quad ^2 \quad t \quad _c$

$\Rightarrow Q^2 = \quad -\ [2St_c \quad I$

$2hb$

We find the optimal production quantity,

$$Q^* = \sqrt{\frac{2\begin{bmatrix}2D_1(A+F+R(L_1))+4D_2(A+F+R(L_2))+4D_3(A+F+R(L_3))\\+4D_4(A+F+R(L_4))+2D_5(A+F+R(L_5))\end{bmatrix} - \left[D_1^2t_c^2SI_d+2D_2^2t_c^2SI_d+2D_3^2t_c^2SI_d+2D_4^2t_c^2SI_d+D_5^2t_c^2SI_d\right] - \left[2St_cI_dD_1E+4St_cI_dD_2E+4St_cI_dD_3E+4St_cI_dD_4E+2St_cI_dD_5E\right]}{2hb_1+4hb_2+4hb_3+4hb_4+2hb_5}}$$

The cost of order & the cost of purchasing determine the appropriate order size Q. It is necessary to decrease amount of suggested model's expiration rate each cycle, order volume per cycle, holding cost, and ideal order quantity that improves demand. So, the suggested model's overall production cost has lowered as a result of modifying credit periods.

5.2 For Medicinal Manufacturing

A Fuzzy Production Quantity Integrated Storage Model

We bring the fuzzy inventories EOQ models to let the numbers (Q1, Q2, Q3, Q4, Q5) with0Q1Q2Q3Q4Q5. Individual cost as crisp order quantity be atrapezoidal fuzzy Then we get the retailer's hazy average

$$P(\tilde{JTC}(Q)) =$$

$$\frac{1}{8}\left\{\begin{matrix}\left[\frac{D_1}{Q}(A+F+R(L_1))+\frac{h_{b1}Q_1}{2}+(h_{b1}+pI_c)k\sigma\sqrt{L_1}+D_1(dC_d(L_1)+V)-\frac{D_1^2t_c^2SI_d}{2Q}-\frac{St_cI_dD_1}{Q}E\right],\\ \left[\frac{D_2}{Q}(A+F+R(L_2))+\frac{h_{b2}Q_2}{2}+(h_{b2}+pI_c)k\sigma\sqrt{L_2}+D_2(dC_d(L_2)+V)-\frac{D_2^2t_c^2SI_d}{2Q}-\frac{St_cI_dD_2}{Q}E\right],\\ \left[\frac{D_3}{Q}(A+F+R(L_3))+\frac{h_{b3}Q_3}{2}+(h_{b3}+pI_c)k\sigma\sqrt{L_3}+D_3(dC_d(L_3)+V)-\frac{D_3^2t_c^2SI_d}{2Q}-\frac{St_cI_dD_3}{Q}E\right],\\ \left[\frac{D_4}{Q}(A+F+R(L_4))+\frac{h_{b4}Q_4}{2}+(h_{b4}+pI_c)k\sigma\sqrt{L_4}+D_4(dC_d(L_4)+V)-\frac{D_4^2t_c^2SI_d}{2Q}-\frac{St_cI_dD_4}{Q}E\right],\\ \left[\frac{D_5}{Q}(A+F+R(L_5))+\frac{h_{b5}Q_5}{2}+(h_{b5}+pI_c)k\sigma\sqrt{L_5}+D_5(dC_d(L_5)+V)-\frac{D_5^2t_c^2SI_d}{2Q}-\frac{St_cI_dD_5}{Q}E\right]\end{matrix}\right\}$$

$$P(\tilde{JTC}_1(Q)) =$$

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$$
\begin{aligned}
\frac{1}{8}\Bigg\{ & \left[\frac{D_1}{Q_5}(A+F+R(L_1))+\frac{h_{b_1}Q_1}{2}+(h_{b_1}+pI_c)k\sigma\sqrt{L_1}+D_1(dC_d(L_1)+V)-\frac{D_1^2 t_c^2 SI_d}{2Q_5}-\frac{St_c I_d D_1}{Q_5}E\right] \\
+2 & \left[\frac{D_2}{Q_4}(A+F+R(L_2))+\frac{h_{b_2}Q_2}{2}+(h_{b_2}+pI_c)k\sigma\sqrt{L_2}+D_2(dC_d(L_2)+V)-\frac{D_2^2 t_c^2 SI_d}{2Q_4}-\frac{St_c I_d D_2}{Q_4}E\right] \\
+2 & \left[\frac{D_3}{Q_3}(A+F+R(L_3))+\frac{h_{b_3}Q_3}{2}+(h_{b_3}+pI_c)k\sigma\sqrt{L_3}+D_3(dC_d(L_3)+V)-\frac{D_3^2 t_c^2 SI_d}{2Q_3}-\frac{St_c I_d D_3}{Q_3}E\right] \\
+2 & \left[\frac{D_4}{Q_2}(A+F+R(L_4))+\frac{h_{b_4}Q_4}{2}+(h_{b_4}+pI_c)k\sigma\sqrt{L_4}+D_4(dC_d(L_4)+V)-\frac{D_4^2 t_c^2 SI_d}{2Q_2}-\frac{St_c I_d D_4}{Q_2}E\right] \\
& \left[\frac{D_5}{Q_1}(A+F+R(L_5))+\frac{h_{b_5}Q_5}{2}+(h_{b_5}+pI_c)k\sigma\sqrt{L_5}+D_5(dC_d(L_5)+V)-\frac{D_5^2 t_c^2 SI_d}{2Q_1}-\frac{St_c I_d D_5}{Q_1}E\right]\Bigg\}
\end{aligned}
$$

With $0 < Q1 \leq Q2 \leq Q3 \leq Q4 \leq Q5$.

Therefore,

$$
\begin{aligned}
\Rightarrow \frac{1}{8}\Bigg\{ & \left[\frac{D_1}{Q_5}(A+F+R(L_1))+\frac{h_{b_1}Q_1}{2}+(h_{b_1}+pI_c)k\sigma\sqrt{L_1}+D_1(dC_d(L_1)+V)-\frac{D_1^2 t_c^2 SI_d}{2Q_5}-\frac{St_c I_d D_1}{Q_5}E\right] \\
+2 & \left[\frac{D_2}{Q_4}(A+F+R(L_2))+\frac{h_{b_2}Q_2}{2}+(h_{b_2}+pI_c)k\sigma\sqrt{L_2}+D_2(dC_d(L_2)+V)-\frac{D_2^2 t_c^2 SI_d}{2Q_4}-\frac{St_c I_d D_2}{Q_4}E\right] \\
+2 & \left[\frac{D_3}{Q_3}(A+F+R(L_3))+\frac{h_{b_3}Q_3}{2}+(h_{b_3}+pI_c)k\sigma\sqrt{L_3}+D_3(dC_d(L_3)+V)-\frac{D_3^2 t_c^2 SI_d}{2Q_3}-\frac{St_c I_d D_3}{Q_3}E\right] \\
+2 & \left[\frac{D_4}{Q_2}(A+F+R(L_4))+\frac{h_{b_4}Q_4}{2}+(h_{b_4}+pI_c)k\sigma\sqrt{L_4}+D_4(dC_d(L_4)+V)-\frac{D_4^2 t_c^2 SI_d}{2Q_2}-\frac{St_c I_d D_4}{Q_2}E\right] \\
& \left[\frac{D_5}{Q_1}(A+F+R(L_5))+\frac{h_{b_5}Q_5}{2}+(h_{b_5}+pI_c)k\sigma\sqrt{L_5}+D_5(dC_d(L_5)+V)-\frac{D_5^2 t_c^2 SI_d}{2Q_1}-\frac{St_c I_d D_5}{Q_1}E\right]\Bigg\} \\
& -\mu_1(Q_2-Q_1)-\mu_2(Q_3-Q_2)-\mu_3(Q_4-Q_3)-\mu_4(Q_5-Q_4)-\mu_5(Q_1)=0
\end{aligned}
$$

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Which implies,

$$= \frac{1}{8}\left\{ \left[\frac{D_1}{Q_5}(A+F+R(L_1))+\frac{h_b Q_1}{2}+(h_1+pI_{c1})k\sigma\sqrt{L_1}+D_1(dC_d(L_1)+V)-\frac{D_1^2 t_c^2 SI_d}{2Q_5}-\frac{St_cI_dD_1E}{Q_5}\right] + \mu_1 - \mu_4 = 0\right.$$

$$+2\left[\frac{D_2}{Q_4}(A+F+R(L_2))+\frac{h_b Q_2}{2}+(h_2+pI_{c2})k\sigma\sqrt{L_2}+D_2(dC_d(L_2)+V)-\frac{D_2^2 t_c^2 SI_d}{2Q_4}-\frac{St_cI_dD_2E}{Q_4}\right]-\mu_1+\mu_2=0$$

$$+2\left[\frac{D_3}{Q_3}(A+F+R(L_3))+\frac{h_b Q_3}{2}+(h_3+pI_c)k\sigma\sqrt{L_3}+D_3(dC_d(L_3)+V)-\frac{D_3^2 t_c^2 SI_d}{2Q_3}-\frac{St_cI_dD_3E}{Q_3}\right]-\mu_2+\mu_3=0$$

$$+2\left[\frac{D_4}{Q_2}(A+F+R(L_4))+\frac{h_b Q_4}{2}+(h_4+pI_{c4})k\sigma\sqrt{L_4}+D_4(dC_{d4}(L_4)+V)-\frac{D_4^2 t_c^2 SI_d}{2Q_2}-\frac{St_cI_dD_4E}{Q_2}\right]-\mu_3+\mu_4=0$$

$$\left.\left[\frac{D_5}{Q_1}(A+F+R(L_5))+\frac{h_{b5} Q_5}{2}+(h_{b5}+pI_{c5})k\sigma\sqrt{L_5}+D_5(dC_{d5}(L_5)+V)-\frac{D_5^2 t_c^2 SI_d}{2Q_1}-\frac{St_cI_dD_5E}{Q_1}\right]-\mu_5=0\right\}$$

That is, $Q_1 = Q_2 = Q_3 = Q_4 = Q_5 = Q^*$.

Hence, we find the optimal order quantity Q^* as

$$\tilde{Q}^* = (Q^*, Q^*, Q^*, Q^*)$$

$$\tilde{Q}^* = \sqrt{\frac{2\left[\begin{array}{l}2D_1(A+F+R(L_1))+4D_2(A+F+R(L_2))+4D_3(A+F+R(L_3))\\+4D_4(A+F+R(L_4))+2D_5(A+F+R(L_5))\end{array}\right] - \left[D_1^2t_c^2SI_d+2D_2^2t_c^2SI_d+2D_3^2t_c^2SI_d+2D_4^2t_c^2SI_d+D_5^2t_c^2SI_d\right] - \left[2St_cI_dD_1E+4St_cI_dD_2E+4St_cI_dD_3E+4St_cI_dD_4E+2St_cI_dD_5E\right]}{2hb_1+4hb_2+4hb_3+4hb_4+2h_b}}$$

The fuzzified total expense for medicinal produce is derived above. The optimum order size Q is determined by the cost of requesting and the price of purchasing. It is important to reduce the suggested model's expiry rates each cycle, number of orders per period, holding expenses, and ideal order quantity to boost demand. As a result of changing the credit terms, the overall production cost of the suggested model has been reduced.

6. NUMERICAL ILLUSTRATION FOR MEDICINAL MANUFACTURING

The provided analytic solution is used to solve a numerical case in this study.

Consider the following inventory system features.

6.1 Crisp Model for Medicinal Manufacturing

The Crisp Parameters are

h_b = 1250, D = 5, L = 400, A = 500, F = 300, R = 150, p = 14, I_c = 10, K = 8, = 7, d = 2, C_d = 9, V = 20, t_c = 4, S = 2, I_d = 3, E = 12.

By Substituting these values in Q* and JTC(Q), we get as,

Q* = 22.02006358 and JTC(Q) = 1623107.919.

6.2 Fuzzy Model for Medicinal Manufacturing

In this situation, we define value as the type of a pentagonal fuzzy number.

Let the values are A = 500, F = 300, R = 150, p = 14, I_c = 10, K = 8, = 7, d = 2, C_d = 9, V = 20, t_c = 4, S = 2, I_d = 3, E = 12.

Fuzzy Production quantity,

$$\tilde{Q} = (Q_1, Q_2, Q_3, Q_4) \text{ With } 0 \leq Q_1 \leq Q_2 \leq Q_3 \leq Q_4.$$

The above fuzzy parameter values replace into the formula, we find the optimal fuzzy **production quantity, by substituting the above values in $\tilde{Q}*$ we get as,**

$$\tilde{Q}* = 22.29955. \; J\tilde{T}C(Q) = 1620348.190$$

6.3 Python Coding In Inventory Cost

The Economic order quantity for the inventory system is derived by minimizing the total cost inventory function. The notations are taken as trapezoidal fuzzy numbers, Kuhn-Tucker method has been applied and defuzzification has been done by graded-mean representation.

```
import numpy as np
import matplotlib.pyplot as plt
x = np.array([298, 299, 300, 301, 302])
y = np.array([1620349.909, 1620350.136, 1620350.364, 1620350.591, 1620350.818])
plt.plot(x, y)
plt.xlabel("F")
plt.ylabel("JC(t)(Q)*")
plt.show()
```

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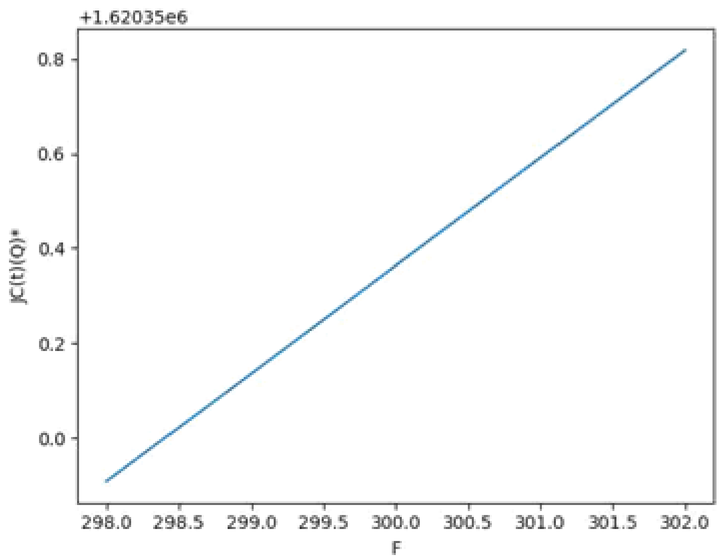

Figure 6.3: Inventory cost in programming

[x,y] = meshgrid(1:22,1:22);

z = peaks(22);

T = delaunay(x,y);

trimesh(T,x,y,z)

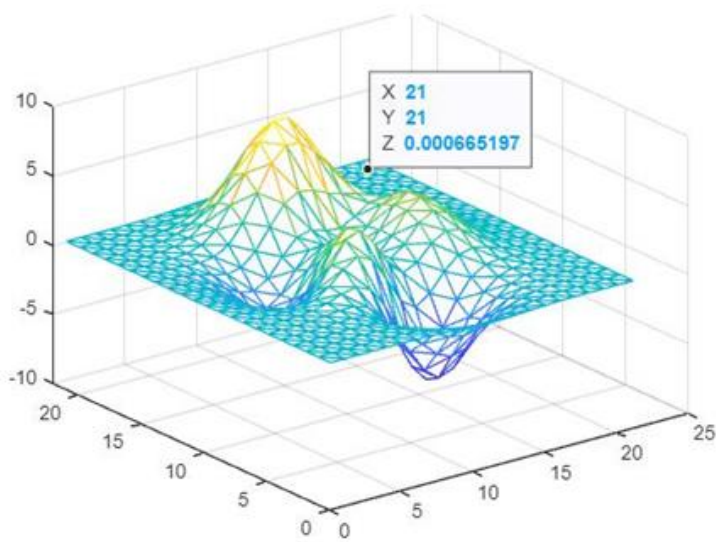

Figure 6.4: Mesh Triangular Inventory Cost

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The numerical examples are contingently showcasing the difference between increased crisp cases against the fuzzy model the Economic order quantity for the inventory system is derived by minimizing the total cost inventory function. The notations are taken as trapezoidal fuzzy numbers, Kuhn-Tucker method has been applied and defuzzification has been done by graded-mean representation. The numerical examples are contingently showcasing the difference between increased crisp cases against the fuzzy model.

7. CONCLUSION

The pharmaceutical supply chain was formerly thought to be a resource that could be used to efficiently deliver service offerings to consumers, with an emphasis on supply security. As a result of the most recent changes in their operating circumstances, operators are reexamining all of the aspects of the supply network in which they operate and looking for ways to gain even more benefits from their identities. We also evaluated hazy overall expenditure and perplexing order quantity. Cost elements are fuzzified with imprecise trapezoidal values and defuzzied with the signed distance technique. In response to Kuhn-Tucker conditions, this construction method was devised. Individuals conclude that the fuzzy hypotheses are all more accurate than the crisp assessments.

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