A Geometric Programming Solution to an Economic Production Quantity Model with Ranking Fuzzy Numbers Cost Parameters

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Abstract— on this paper, a financial creation quantity is figured to hold up a era framework with restrict, adaptability, unwavering first-class, and circumstance supportability with switch fee of non-appealing object. The cost parameters are spoken to as a trapezoidal fluffy numbers and those fluffy numbers are communicated as positioning fluffy numbers with satisfactory guess period in-between. Geometric programming method is attached to determine the precise selections in close from. A numerical model is given to help the difficulty.

Keywords: Optimal production quantity, Ranking fuzzy number, Best interval approximation for trapezoidal number, Geometric programming technique.

1. INTRODUCTION

All matters considered, it isn't always continuously practicable to get the ideal statistics approximately stock parameters. This sort of free information isn't always in every case all round spoken to by ordinary elements 18 Nirmal Kumar Mandal selected from danger conveyance. So primary leadership techniques underneath vulnerability are required. to manipulate this vulnerability and unsure statistics, the idea of fluffiness may be connected. The stock rate parameters, as an example, request, retaining fee, creation charge, switch value are idea to be adaptable as an example fluffy in nature. those parameters may be spoken to by means of fluffy numbers. a talented method for raking fluffy numbers has a fantastic system to address the fluffy numbers in a fluffy primary management trouble. Hariri and Abou-el-ata [6], Abou-el-ata and kotb [7], Abou-el-ata et al. [8], built up some inventory models with variable inventory expenses and settled them via GP approach.

Duffin et al. [16] first verified that the GP approach can be implemented woth a few factors of interest for improvement troubles of a selected sort. Later [1,6,7,17,18] tackled some stock troubles utilising GP strategy. Cao [19,20] furnished fluffy geometric programming which end up later used by precise analysts in searching after fluffy fundamental control troubles. Roy and Maiti [25] unraveled the vintage style EOQ model for a solitary difficulty in fluffy situation. Roy and Maiti [26] additionally tested the fluffy EOQ model with interest subordinate unit price and uncertain stockpiling region via manner of every fluffy GP and NLP method. Mandal et al. [27] pointed out a multi-issue fluffy stock trouble with 3 limitations and unraveled with the aid of GP device. Mandal and Roy [28] planned a inventory model with inventory ward inventory fees that they have got understood through the use of GP system.

The corporation goes for carrying out maximum intense gain which requires nonstop execution of the creation manner, however certain limitations like device breakdown, deficiency of substances, absence of proficient and semi-gifted specialists exist which is probably overwhelmed by using keeping up a top notch re-appropriating in desire to acquisition. along these strains to maintain up a advent framework with limit, adaptability, unwavering great and situation manageability, we've got precise a financial generation quantity of the framework.

2. MATHEMATICAL MODEL:

2.1 Assumptions:

1. The rate of production and demand remains constant.
2. Continuous replenishment takes place.
3. Deficit and surplus of stock do not take place.
4. The cost of technology is incurred to maintain the standard of production system.

2.2 Notations:

A Fixed set up cost
p production rate
D Demand rate
c unit production cost
h holding cost per unit of time
B Cost of technology, resource and design
E Extra expenditure for cleaner technologies at times of depreciation of machinery
K The expenditure to overcome the limitation of different complexities to increase the reliability.
x D / P
1-x the fraction of time the production process
M_i materials which does not enter the production process (i=1,2,3......)
C_i cost of materials M_i
d disposal cost of non marketable product.
T Processing cost of non product output

O cost of incurring the outsourcing

3. CRISP MODEL

consider a era area which makes single object. The contribution to the creation framework is the crude materials, but not every one of the materials enter the generation technique. finally the age of waste (non-appealing item) takes place at this component which should be taken consideration off. As in in recent times the organizations stroll closer to the shared fear of nature, switch fee is received for such non attractive object honestly as non-object yield (the waste that is created towards the end of the era). The goes for attaining greatest advantage which requires constant execution of the era technique, but at the equal time wonderful limitations like system breakdown, deficiency of substances, absence of gifted experts exist which may be beaten with the useful resource of preserving up a genuinely perfect redistributing in desire to obtainment. on this manner to preserve up a generation framework with restrict, adaptability, dependability and situation manageability an monetary creation amount version is exceptional as pursues.

The EPQ cost per unit of time C (Q) = AD/Q + hQ (1-x) /2

The production cost per cycle C_p (Q) = cQ

The costs of materials which do not enter the production

process = $\sum_{i=1}^{n} C_i M_i$

The disposal cost of non-marketable product =

The inventory cost per unit of time is given as

$T(C(Q))$ =

$\frac{AD}{Q} + \frac{hQ(1-x)}{2} + [\sum_{i=1}^{n} C_i M_i + \sum_{i=1}^{n} dM_i + cQ + B + E + K + T + o]\frac{D}{Q}$

The optimal solution is Q =

$$\sqrt{\frac{2D[A + \sum_{i=1}^{n} C_i M_i + \sum_{i=1}^{n} dM_i + B + K + E + T + O]}{h(1-x)}}$$

4. FUZZY MODEL

Here, D, C_i, d, B, K, E, T, O, h are assumed as fuzzy numbers.

The fuzzy inventory total cost per unit of time is given as

$\overline{T(C(Q))} = [A + \sum_{i=1}^{n} C_i M_i + \sum_{i=1}^{n} dM_i + cQ + B + E + K + T + o]\frac{\overline{D}}{Q} + \frac{\overline{h}Q(1-x)}{2}$

5. NEAREST INTERVAL APPROXIMATION

Suppose $\overline{A}$ is fuzzy number with α cut [$A_L(\alpha)$, A_R (α)]. Then

The interval $C_d(\overline{A}) = [\int_0^1 [A_L(\alpha) d\alpha, \int_0^1 A_R(\alpha) d\alpha]$

with respect to the metric d. Let $\overline{A}$ = (a,b,c,d,) be a

trapezoidal fuzzy number. The $\cdot$ - cut interval of is defined as [$A_L(\alpha)$, A_R (α)] where $A_L(\alpha)$ a+ (b-a) α and A_R (α) = d- (d-c) α. By nearest interval approximation method the lower limit of the interval is $C_L = \frac{a+b}{2}$ and upper limit of the interval is $C_R = \frac{c+d}{2}$.

6. RANKING FUZZY NUMBERS OF COST PARAMETERS WITH BEST APPROXIMATION INTERVAL

The best approximation interval of $\overline{A}$ is [$A_L(\alpha)$, A_R (α)]. The ranking fuzzy number of the best approximation interval [$A_L(\alpha)$, A_R (α)] is defined as a convex combination of lower and upper boundary of the best approximation interval. Let $\lambda \in [0,1]$ is pre-assigned parameter, called degree of optimism. Therefore, the ranking fuzzy number of $\overline{A}$ is defined by $R_{\lambda,f}(\overline{A}) = \lambda A_R(\alpha) + (1-\lambda)A_L(\alpha)$.

A large value of λ specifies the higher degree of optimism. When $\lambda = 0$, R $(\overline{A})$ = $A_L(\alpha)$ expresses that the decision maker`s viewpoint is completely pessimistic. When $\lambda = 1$, R $(\overline{A})$ = $A_R$ $(\alpha)$ expresses that the decision maker`s attitude is completely optimistic. When $\lambda = 1/2$, R $(\overline{A})$ ½, ($A_L(\alpha)$ +(A_R (α))) reflects moderately optimistic or neutral attitude of the decision maker.

Ranking fuzzy numbers of $\overline{A}$ is $R_{\lambda,f}(\overline{A}) = \int_1^0 [\lambda A_R(\alpha) + (1-\lambda)A_L(\alpha)]f(\alpha)d\alpha / \int_1^0 f(\alpha)d\alpha$

And we let f (α). If $\overline{A}$ = (a,b,c,d,) is a trapezoidal fuzzy number, then $A_L(\alpha)$= a+α (b-a) and A_R (α) = d-α (d-c). The lower limit of the interval is $A_L(\alpha)$= (a+2b) / 3, and the upper limit of the interval is A_R (α) = (2c+d) / 3. Then the corresponding ranking fuzzy number is

$R_{\lambda,f}(\overline{A}) = 2\int_1^0 [\lambda(\frac{2c+d}{3}) + (1-\lambda)(\frac{a+2b}{3})]\alpha d\alpha$

$R_{\lambda,f}(\overline{A}) = \frac{1}{3}\lambda(2c+d) + (1-\lambda)(a+2b)$ ....(1)

7. GEOMETRIC PROGRAMMING PROBLEM

Primal problem: Primal Geometric programming (PGP) problem is

Minimize $g_o(t)\sum_{K=1}^{T_o} C_{Ok}\prod_{k=1}^{m} t_j^{\alpha_{okj}}$

Subject to $\sum_{K=1}^{T_o} C_{rk}\prod_{j=1}^{m} t_j^{\alpha_{rkj}} \leq 1$, (r = 1,2,.....I) , j = (1,2,3,.....m) $t_j > 0$

Where $C_{0k} > 0$ (k=1,2,... T_0) C_{rk} and α_{rk} are real numbers. It is constrained polynomial

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geometric problem. The number of term each polynomial constrained functions varies and it is denoted by T, for each r = 0,1,2,..... Let T= T_0 +T_1+T_2+.....+T_1 be the total number of terms in the primal program. The Degree of difficulty is (DD) = T – (m+1)

Dual problem:

Maximize = $\prod_{r=0}^{l}\prod_{k=1}^{T^r}(\frac{C_{rk}}{\delta_{rk}})^{\delta rk}(\sum_{S=1+T_{r+1}}^{T}(\delta_{rs})^{\delta rk}$

Subject to $\sum_{k=1}^{T_0}\delta_{0k}=1$ (Normality condition)

$\sum_{r=0}^{l}\sum_{k=1}^{T_r}\alpha_{rkj}\delta_{rk}=0$ (Orthogonally conditions)

$\delta_{rk}>0$, (Positive constant)

8. GEOMETRIC PROGRAMMING TECHNIQUE TO SOLVE FUZZY INVENTORY PROBLEM & TESTING RESULTS

The trapezoidal fuzzy number is $\bar{A}$ (a,b,c,d,) and the objective function is

$\overline{T(C(Q))}=[A+\sum_{i=1}^{n}C_iM_i+\sum_{i=1}^{n}dM_i+cQ+B+E+K+T+o]\frac{\bar{D}}{Q}+\frac{\bar{h}Q(1-x)}{2}$

Now, using ranking fuzzy numbers cost parameters, objective function becomes

$\overline{R_{\lambda,f}(T(C(Q))}=$

$[A+\sum_{i=1}^{n}(\bar{C}_i)M_i+\sum_{i=1}^{n}R_{\lambda,f}(\bar{d})M_i+cQ+R_{\lambda,f}(B)+R_{\lambda,f}(E)+R_{\lambda,f}(K)+R_{\lambda,f}(T)+R_{\lambda,f}(o)]$

Applying Geometric programming technique, we get,

$\prod_{i=1}^{n}=\{[A+\sum_{i=1}^{n}(\bar{C}_i)M_i+\sum_{i=1}^{n}R_{\lambda,f}(\bar{d})M_i+cQ+R_{\lambda,f}(B)+R_{\lambda,f}(E)+R_{\lambda,f}(K)+R_{\lambda,f}(T)+R_{\lambda,f}(o)]\frac{R_{\lambda,f}(\bar{D})}{Q}$

$+\frac{R_{\lambda,f}(\bar{h})(1-x)Q}{2}\}w1r/Qw_{1r}*\{\frac{Q(1-x)R_{\lambda,f}(h)}{2w_{2r}}\}w2r*(\frac{cR_{\lambda,f}(D)}{w_{3r}})^{w_{3r}}$

Subject to the conditions

$W_{1r} + W_{2r} + W_{3r} = 1$
$-W_{1r} + W_{2r} = 0$
$W_{1r} + W_{3r} = 0$

Solving these conditions, we get the values of W1r = W2r = 1 and W3r = -1

By applying Duffin`s and peterson`s theorem,

$[A+\sum_{i=1}^{n}(\bar{C}_i)M_i+\sum_{i=1}^{n}R_{\lambda,f}(\bar{d})M_i+cQ+R_{\lambda,f}(B)+R_{\lambda,f}(E)+R_{\lambda,f}(K)+R_{\lambda,f}(T)+R_{\lambda,f}(o)]\frac{R_{\lambda,f}(\bar{D})}{Q}$

$= w_{1r}g(w_{1r},w_{2r})\frac{R_{\lambda,f}(\bar{h})(1-x)Q}{2}=w_{2r}g(w_{1r},w_{2r})$

From this, we obtain the optimal production quantity,

$Q^*=\{2*[A+\sum_{i=1}^{n}(\bar{C}_i)M_i+\sum_{i=1}^{n}R_{\lambda,f}(\bar{d})M_i+cQ+R_{\lambda,f}(B)+R_{\lambda,f}(E)+R_{\lambda,f}(K)]\frac{R_{\lambda,f}(\bar{D})}{Q}/$

$\frac{R_{\lambda,f}(\bar{h})(1-x)\}^{1/2}}{2}$ ....(2)

9. NUMERICAL EXAMPLE & RESULTS

Crisp Model:
The following parametric values are allowed in appropriate units:

P= 150 units/time, A = 100ς, D =100 units/time, B = 250ς, d ς15, h = ς0.5 units/time, k = ς75, E = ς50, C_1 = ς1.5, C_2 = ς 2/unit M_1 = 15units, T = ς 873, O = ς 300.

The optimal solution is 1637 units.
Fuzzy Model: From (1), when λ= 0.6

$\bar{D}$ = (96,98,102,104) $R(\bar{D})$ = 100.5 $\sum_{i=1}^{n}R(C_i)M_i=$

(40,50,70,80) = 62.6 $\sum_{i=1}^{n}R(d)M_i=526.3$

$\bar{B}$ = (240,245,255,260) $R(\bar{B})=251$ $\bar{E}$ = (48,49,51,52) $R(\bar{E})=50.6$

$\bar{K}$ = (73,74,76,77) $R(\bar{K})=75.26$ $\bar{T}$ = (871,872,874,875) $R(\bar{T})=873.26$

$\bar{O}$ = (298,299,301,302) $R(\bar{O})$ = 300.26 $\bar{h}$ = (0.3,0.4,0.6,0.7) $R(\bar{h})=0.52$

$\bar{P}$ = (148,149,151,152) $R(\bar{P})=150.1$

From (2)
Q* = 1617 units.

10. SENSITIVITY ANALYSIS:

The affectability research is completed for checking the adequacy of the financial introduction amount version with condition cost effective adaptable and strong generation framework utilizing Geometric programming approach. This condition mirror the genuine desires of the creation framework and this assist the makers in handling each the internal and outdoor difficulties, client upkeep.

CONCLUSION

on this paper, a fluffy monetary generation amount version quantity model with circumstance supportable adaptable and strong of the creation framework utilising geometric programming strategy is gotten. The expenses are regarded as a trapezoidal fluffy quantity and after that these fluffy numbers are characterized by means of positioning fluffy quantity as for the high-quality wager meantime quantity . here, we've taken the estimation of · = 0.6 which ensures that the organisation can accomplish the idealistic stage. therefore the agency enables a few adaptability to perform his goal.

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