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A study on solution method for multi-objective fuzzy linear programming problems

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Abstract:

The main key technique for resolving the Fuzzy Linear Complementarity Problems is presented in this chapter (FLCP). Also, the issue of linear complementarity with neutrophil triangular fuzzy numbers is resolved. It is an essential tool for NP hard-structured and non-convex optimization problems. It finds applications in many fields in scientific, technical and economics.

This section also presents a novel method to addressing the problem of Fuzzy Quadratic Programming (FQPP). Intuitionist triangular triangle numbers indicate the cost coefficients, restricted coefficients and the right-hand coefficients. We are solving the FLCP issue of quadratic scheduling using intuitionistic three-way fluid numbers and the implementation of the complementary pivot technique, which reduces it to an intuitionist, linear complementarity problem (IFLCP) .

Keywords: Neutrosophic numbers, parametric linear complementarity problems, FQPP, IFLCP, FLCP

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Introduction:

The opposite of the foundation is suggested in order to address the intuitionist issue of linear fluidity. In addition, the issue is resolved via a preventive optimization approach. A numerical example illustrates the efficacy of the suggested techniques.

The parametric linear complementarity issue using derivatives was introduced in 1978 by Ikuyo Kaneko. The one – linear parametrical complementarity issue, Valiaho, H. (1994) offers the method. Jones, C.N. (2006) discussed the multi-parameter linear complementarity problem with the positive semi-detailed arrays, Danao (1997) The linear complementarity issue with the matrix P-. .

Lemke, C.E (1968) proposed a linear complementarity problem solution method. An method has been devised to solve this issue of flat linear complementarity .

In particular, the specific objectives are to form a Multi-level Bi-Level Neutrosophical Linear Programming Problem in a diet situation under Physical fitness field and to solve the formulated BLMONLPP by using Principal pivoting method.

The following are the significance of the study:

(i) The model will help the diet planners to quantify the costs for

various foods and quantity of foods.

(ii) The study will also help to develop medical training programs to educate people about the importance of nutrient diet through implementing the formulated model.

Section 1.1 discusses about the descriptions on Neutrophil number and 5.2 principal Pivoting method algorithm. Section deals with some techniques of Neutrosophic decision making. In section 5.35.4 we provide the Memo on parametric5.5 linear complementarity problem. Section describes the principal pivoting algorithmic approach to solve the linear complementarity problem. Section discusses the complementary basic feasible vector theorem. Section 5.6 discusses the complementary basic feasible vector theorem. Section 5.6 discusses the diet problem using the neutrosophic numbers approach with intuitionistic fuzzy enviromment. Section 5.7 deals enlargement, accomplishment of the

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complementary pivot method using the inverse of the basis for solving fuzzy linear complementarity problem. Finally, a methodology for solving the linear complementarity Problem with illustrative examples is presented in Section 5.8.

1.1. Complementary Basic Feasible Vector Theorem

Theorem 1. 1.1

Statement:

Suppose M is a given P matrix of order n. Principal pivoting method is applied on the linear complementarity problem (q, M). IIt ends in a finite member of pivot steps with a complementary viable fundamental vector. In addition, a complimentary basic vector is used just once in this procedure and does not occur in following phases..

Proof :

Since M is a P-matrix of order n, and all pivot steps in the technique are main pivot steps, the pivot element in all pivot steps is strictly negative.

If n=1, the theorem is simply confirmed as true, and the technique ends in one pivot step at most. Create a hypothesis based on induction..

1.2 Numerical Example -Diet Problem

Consider a simple diet problem in which the nutrients are starch and protein and the following table gives two types of foods with the necessary data

	Nutrient units/ kg of food type		
	Food 1	Food 2	Maximum Requirements
Starch	1	2	1
Protein	1	3	4
Cost/ Kg	6	3	
Procurement Cost/kg	2	3	

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Table 1.1.2

The activities and their levels in the model are given as: activity j, to include 1 kg of food type j in the diet and associated level x_j, for $j = 1,2$.

Constraints are formed by the various nutrients in the model. For example, the amount of starch contained in the diet is $1x_1 + 1x_2$, which must be ≤ 1 for feasibility. Similarly, $2x_1 + 3x_2 \leq 4$.

In this diet issue, both the total cost of food and the expense of obtaining food are reduced.

Because the cost coefficients and other coefficients are undecided and contain the indeterminacy component, the issue is labelled a Bi-Level Multi Objective Neuromorphic Linear Programming Problem (BLMONLPP). As a result, all coefficients are handled as single-valued neuromorphic triangular members at their lowest, highest, and highest values. Above is true both theoretically and practically.

The following is a possible solution.

The objective function is

$$\text{Min } \tilde{z}_1 = \langle(5,6,7); 0.6,0.5,0.5\rangle\tilde{x}_1 + \langle(2,3,4),0.5,0.7,0.5\rangle\tilde{x}_2$$

$$\text{Min } \tilde{z}_2 = \langle(1,2,3); 0.6,0.5,0.5\rangle\tilde{x}_1 + \langle(2,3,4),0.6,0.5,0.5\rangle\tilde{x}_2$$

subject to the constraints

$$\langle(1,1,1),0.5,0.7,0.5\rangle\tilde{x}_1 + \langle(1,1,1),0.5,0.7,0.5\rangle\tilde{x}_2 \geq \langle(1,1,1); 0.5,0.7,0.5)$$
$$\langle(1,2,3); 0.5,0.7,0.5\rangle\tilde{x}_1 + \langle(2,3,4),0.6,0.5,0.5\rangle\tilde{x}_2 \geq \langle(3,4,5); 0.6,0.5,0.5\rangle$$
$$\& \tilde{x}_1, \tilde{x}_2 \geq 0$$

The Intuitionistic Linear Complementarity fuzzy matrix $\tilde{M} \& \tilde{q}$ is given by

$$\tilde{M} = \begin{bmatrix} 0 & -\tilde{A} \\ \tilde{A}^{\curlyvee} & \hat{H} \end{bmatrix} = \begin{bmatrix} \tilde{0} & \tilde{0} & -\tilde{1} & -\tilde{1} \\ \tilde{0} & \tilde{0} & -\tilde{2} & -\tilde{3} \\ \tilde{1} & 2 & 4 & 4 \\ \tilde{I} & 3 & 4 & 6 \end{bmatrix}$$

$$\tilde{q} = \begin{bmatrix} \tilde{b} \\ -\tilde{c} \end{bmatrix} = \begin{bmatrix} \tilde{1} \\ \tilde{4} \\ -\tilde{6} \\ -3 \end{bmatrix}$$

Now, using the suggested approach, the fuzzy linear complementary issue is solved as follows:.

The Initial iteration table is as given below

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C_B	$\widetilde{W}_1$	$\widetilde{W}_2$	$\widetilde{W}_3$	$\widetilde{W}_4$	$\widetilde{Z}_1$	$\widetilde{Z}_2$	$\widetilde{Z}_3$	$\widetilde{Z}_4$	Q
$\widetilde{W}_1$	[(1,1,1] .5,3,.5]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	−[(1,1,1 .5,3,.5]	−[(1,1,1 .5,.3,.5]	[(1,1,1); .5,.3,.5]
$\widetilde{W}_2$	[(0,0,0] 0,0,0]	[(1,1,1] .5,.3,.5	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	−[(1,2,3 .5,.7,.5]	−[(2,3,4 .6,.5,.5]	[(3,4,5); .6,5,.5]
$\widetilde{W}_3$	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(1,1,1] .5,.3,.5	[(0,0,0] 0,0,0]	[(1,1,1] .5,.3,.5	[(1,2,3] .5,.7,.5	[(3,4,5); .6,.5,.5]	[(3,4,5); .6,.5,.5]	−[(5,6,7 .5,.6,.5]
$\widetilde{W}_4$	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(1,1,1] .5,3,.5]	[(1,1,1] .5,3,.5]	[(2,3,4] .6,.5,.5	[(3,4,5); .6,.5,.5]	[(3,6,9); .5,.7,.5	−[(2,3,4 .6,5,.5]

Table 1. 1.3 - Initial Iteration

In the above iteration, the fuzzy variable $\widetilde{W}_3$ leaves the basis and the fuzzy variable $\tilde{Z}_4$ enters the basis

C_B	$\widetilde{W}_1$	$\widetilde{W}_2$	$\widetilde{W}_3$	$\widetilde{W}_4$	$\widetilde{Z}_1$	$\widetilde{Z}_2$	$\widetilde{Z}_3$	$\widetilde{Z}_4$	Q
$\widetilde{W}_1$	[(1,1,1] .5,3,.5]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	−[(1,1,1 .5,3,.5]	−[(0,0,0 .0,0,0]	[(2,5,8); .5,.3,.5]
$\widetilde{W}_2$	[(0,0,0] 0,0,0]	[(1,1,1] .5,.3,.5	[(1,1,1] 0,0,0]	[(0,0,0] 0,0,0]	[(0,0,0] 0,0,0]	[(1,2,3] 0,0,0]	−[(1,2,3 .5,.7,.5]	−[(2,3,4 .6,.5,.5]	[(1,3,5); .6,5,.5]
$\tilde{z}_3$	[(0,0,0]	[(0,0,0]	[(1,1,1]	[(0,0,0]	[(1,1,1]	[(1,2,3]	[(3,4,5);	[(3,4,5);	−[(5,6,7

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	0,0,0]	0,0,0]	.5,.3,.5	0,0,0]	.5,.3,.5	.5,.7,.5	.6,.5,.5]	.6,.5,.5]	.5,.6,.5]
$\widetilde{W}_4$	[(0,0,0) 0,0,0]	[(0,0,0) 0,0,0]	[(0,0,0) 0,0,0]	[(1,1,1) .5,3,.5]	[(1,1,1) .5,3,.5]	[(2,3,4) .6,.5,.5	[(3,4,5); .6,.5,.5]	[(3,6,9); .5,.7,.5	−[(2,3,4 .6,5,.5]

Table 1. 1.3 - Initial Iteration

Hence, the optimality condition shows that $\tilde{y}_n = \tilde{z}_2$ is the entering variable, $\widetilde{W}_4$ leaves the basis. From the feasibility conditions, We conclude that Min $f = [(-893, -10.27, 2858.12); 0.5, 0.6, 0.7]$.

1.2 Implementation of The Complementary Pivot Method

Solving the provided fuzzy linear complementarity issue follows the steps below to construct the implementation of the complementary pivot technique utilizing the inverse of the basis:,

Step 1: Introduce the fuzzy artificial variable $\tilde{z}_0{}^{I}$ with the column vector I_t, in order to provide a workable foundation

Step 2: Identify row t such that $\tilde{q}'_t =$ minimum $\{\tilde{q}'_1/1 \leq i \leq n\}$. Break ties for t in this equation arbitranly and we assume $\tilde{q}^{I}_t < 0$. When a pivot is made with the column vector of z'_0 as the pivot column and the t^{th} row as the pivot row, the right hand side constant vectors becomes a non negative vector. Therefore, here the initial basic vector is ($\tilde{W}'_1, \dots \dots \tilde{\tilde{W}}'_{t-1}, \tilde{z}^{l}_0, W\tilde{W}^{l}_{t+1}, \dots W\tilde{W}^{I}_n\big)$

Step 3: The starting tableau for this approach is obtained after executing the pivot using row t as the pivot row and column vector Z 0' as the pivot column..

	$\tilde{z}'$	$\tilde{z}^{l}_0$	
P_o	$-M^r$	I_1	$\tilde{q}^J$

The Initial Basic Vector is $\left(\tilde{W}'_1, \dots \dots \dots \tilde{W}^1_{t-1}, \tilde{z}'_0, \tilde{W}^1_{t+1}, \dots \tilde{W}'_n\right)$

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Step 5 : Let B be the basis from (4.1), corresponding to the present basic Vector. Let $\beta = \beta_{ij} = \mathrm{B}^{-1}$ and $\vec{\alpha} = \mathrm{B}^{-1}\mathrm{q}^1$. Then the inverse tableau is

Basic Vector	Inverse	
B	$\beta = \beta_{ij} = B^{-}$	$\tilde{q}^l$

Step 6 : To find the entering variable. The updated column of $\tilde{Y}_s t$ is $\beta P_0 I_s$ if $\tilde{Y}_s^l = \tilde{W}_x^I$ Suppose the pivot column is $(\tilde{a}'_{\perp x}, \ldots \ldots \ldots . \tilde{a}'_m)^T \leq 0.$ We have ray termination and the method has been unable to solve this IFLCP. Otherwise go to next step. Step 7:

To find the leaving

$$\theta = \mathrm{m} \left\{ \frac{\tilde{q}_t^l}{\tilde{a}_{tx}^I} ; \tilde{a}_{is}^1 \geq 0 \right\}$$

It determines the pivot row uniquely if the value of I reaches a minimum that is unique. The leaving variable is the current fundamental variable in the pivot row. If I isn't unique, see if z 0l may be dropped and, if so, use it as the leaving variable. We can select arbitrarily if z _0' isn't qualified to drop. After identifying the departing variable, pivoting leads to the next basis inverse, and the following step's entering variable is the complement of the leaving variable, and so on..

Basic vector	Inverse				$\tilde{q}^I$	Pivot Column	Ratio
$\tilde{z}_1^I$	−{(1,1,1); (.5,1,1.5)}	{(0,0,0); (0,0,0)}	{(1,1,1); (.5,1,1.5)}	{(7,8,9); (6.7,8,9.9)	−	−	
$\widetilde{W}_2'$	−{(1,2,3); (.5,2,3.5)}	{(1,1,1); (.5,1,1.5)}	{(1,1,1); (.5,1,1.5)}	{(3,4,5); (2.5,4,5.6)}	− −	−	

$\widetilde{W}_3'$	$-\{(1,2,3);$ $(.5,2,3.5)\}$	$\{(0,0,0);$ $(0,0,0)\}$	$\{(1,1,1);$ $(.5,1,1.5)\}$	$(1,2,3);$ $(.5,2,3.5)\}$	–	–	

Table 1.2.9 - Iteration 8

The fuzzy linear complementarity problem's solution is intuitionistic

$$\tilde{W}_1^I = \{(0,0,0);(0,0,0)\}$$
$$\tilde{W}_2' = \{(3,4,5);(2.5,4,5.6)\}$$
$$\tilde{W}_3' = (1,2,3);(.5,2,3.5)\}$$
$$\tilde{z}_1' = \{(7,8,9);(6.7,8,9.9)$$
$$\tilde{z}_2' = \{(0,0,0);(0,0,0)\}$$
$$\tilde{z}_3^I = \{(0,0,0);(0,0,0)\}$$

Conclusion:

This chapter studies BLMOIFNLPP, MOLP with neuromorphic triangular fuzzy numbers. It has been assumed that different decision makers choose their objective. The problem has been solved by preemptive optimization method by using Principal Pivoting algorithm. This approach may be extended to multi objective programming problems with neuromorphic Trapezoidal fuzzy coefficients, even if we are discussing a single valued neuromorphic Triangular Number.

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