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A Study on Modified Approach Using MOILPP in Neutrosophic Fuzzy Set by Imprecision Method Using Sagemath Software

D. Jayasri[1], Dr. N. Srinivasan[2], Dr. M. V. Suresh[3], Dr. G. Balaji[4], S. Vijaya[4]

[1]*Research Scholar, Department of Mathematics, St. Peter's Institute of Higher Education and Research, Avadi, India, jayasridhanajahan@gmail.com*
[2]*Professor, Department of Mathematics, St. Peter's Institute of Higher Education and Research, Avadi, India*
[3]*Assistant Professor, Department of Mathematics, Panimalar Engineering College, Poonamallee, India*
[4]*Professor, Department of Mathematics, Thangavelu Engineering college, Karapakkam, India*

In this paper, Multi-objective linear integer programming problem (MOILPPP) by imprecision method is applied to solve a day to day problem in real life. The objective of this problem is to select suitable job for youngsters out of three preferred jobs namely banking sector, teaching field and government that satisfies the four constraints such as career growth, job nature & security, salary and self-respect & identity. In this society, now a day youngsters scare about their career development. So they are having lots of confusion in choosing their job. They are seeking a perfect job to survive in this society with self-respect & identity. Also, the expecting their pay scale

1. Introduction

From the year 1970 onwards, multi-objective linear programming technique have been developed and given many optimal solutions for real life problems for many applications, discrete variables are unavoidable in this technique. In that case, researches created integer linear programming which associated with multi-objective linear programming giving a multi-objective integer linear programming problem. But, it can't be solved by simply combining integer linear programming and multi-objective linear programming techniques, because it has its own specific difficulties. In the year 1986, Atanassov studied and discussed about the intuitionistic fuzzy sets and in 1994, he presented operators over interval-valued intuitionistic fuzzy sets.

2. Application of Multi-Objective Integer Linear Programming Problem

The preference of Job for youngsters are analysed using MOLPP in Neutrosophic fuzzy set. The objective and constraints of a defined problem values are given by decision makers, and it's in the form of neutrosophic number and is presented in the following tables. The objectives of the problem are Banking Sector (j_1), Teaching Field (j_2), and Government Job (j_3). The constraints of the problem are Career Growth (e_1), Job Nature & Security (e_2), Salary (e_3), and Self Respect & Identity (e_4).

Banking Sector (j_1)	Private bank, or Government Bank
Teaching Field (j_2)	Schools , colleges, coaching centres
Government Job (j_3)	TNPSC, RRB, UPSC, and so on

Table 2.1: Denotations of Objectives

Career Growth (e_1)	Pursuing, promotions
Job Nature & Security (e_2)	Qualified job, protection of work rights
Salary (e_3)	Pay scale should satisfy the needs
Self-Respect & Identity (e_4)	Dignity and recognition in company as well as in family & society

Table 2.2: Denotations of Constraints

Neutrosophic scales for linguistic terms are defined as follows,

Linguistic Term	Neutrosophic Set
Extremely Highly Preferred (EXHP)	(0.90,0.10,0.10)
Extremely Preferred (EXP)	(0.85,0.20,0.15)
Very Strongly Preferred (VSP)	(0.85,0.25,0.20)
Strongly Preferred (SP)	(0.75,0.20,0.20)
Moderately Highly Preferred (MHP)	(0.70,0.30,0.30)
Moderately Preferred (MP)	(0.65,0.30,0.35)
Moderately Lowly Preferred (MLP)	(0.60,0.35,0.40)
Lowly Preferred (LP)	(0.55,0.40,0.45)
Equally Preferred (EP)	(0.50,0.50,0.50)

Table 2.3: Linguistic Variables of Neutrosophic Set

	e_1	e_2	e_3	e_4
j_1	EXHP	EP	SP	EXP
j_2	EXHP	EXHP	MP	EXP
j_3	EXP	EP	EXP	MP

Table 2.4: Linguistic Terms for Objectives with Respect to Constraints

	e_1	e_2	e_3	e_4
j_1	(0.90,0.10,0.10)	(0.50,0.50,0.50)	(0.75,0.20,0.20)	(0.85,0.20,0.15)

j_2	(0.90,0.10,0.10)	(0.90,0.10,0.10)	(0.60,0.35,0.40)	(0.85,0.20,0.15)
j_3	(0.85,0.20,0.15)	(0.50,0.50,0.50)	(0.85,0.20,0.15)	(0.60,0.35,0.40)

Table 2.5: Neutrosophic Decision Matrix

Using imprecision membership method, the Neutrosophic fuzzy sets are converted into vague fuzzy values as shown in table 4.6.

	e_1	e_2	e_3	e_4
j_1	(0.90,1.3)	(0.50,0.50)	(0.75,0.48)	(0.85,0.71)
j_2	(0.90,1.3)	(0.90,1.3)	(0.60,0.73)	(0.85,0.71)
j_3	(0.85,0.71)	(0.50,0.50)	(0.85,0.71)	(0.60,0.73)

Table 2.6: Vague Fuzzy Values

Using defuzzification method, the above table is defuzzified as follows

	e_1	e_2	e_3	e_4
j_1	0.41	0.5	0.48	0.54
j_2	0.41	0.41	0.47	0.54
j_3	0.54	0.50	0.54	0.47

Table 2.7: Defuzzyfied Matrix

A pair wise comparison is done and by using imprecision membership method as well as defuzzification the single valued matrix is created as shown in table 4.8.

	e_1	e_2	e_3	e_4
e_1	EP	MHP	SP	EXP
e_2	$\frac{1}{MHP}$	EP	MHP	EXP
e_3	$\frac{1}{SP}$	$\frac{1}{MHP}$	EP	EXHP
e_4	$\frac{1}{EXP}$	$\frac{1}{EXP}$	$\frac{1}{EXHP}$	EP

Table 2.8: A Pair Wise Comparison Matrix

	e_1	e_2	e_3	e_4
e_1	0.50	0.6	0.48	0.54
e_2	2	0.50	0.5	0.41
e_3	2.08	2	0.50	0.41
e_4	1.85	2.44	2.44	0.50

Table 2.9: Single Valued Decision Matrix

e_1	e_2	e_3	e_4
(0.85,0.20,0.15)	(0.75,0.20,0.20)	(0.70,0.30,0.30)	(0.90,0.10,0.10)

Table 2.10: Weightage of Constraints

e_1	e_2	e_3	e_4
0.54	0.48	0.5	0.41

Table 2.11: Neutrosophic set to Deffuzyfied Weightage of Constraints Values

Objective function and subject to the constraints of the problem is as follows

$$\text{Max } Z_{j_1} = 0.41e_1 + 0.50e_2 + 0.48e_3 + 0.54e_4$$

$$\text{Max } Z_{j_2} = 0.41e_1 + 0.41e_2 + 0.47e_3 + 0.54e_4$$

$$\text{Max } Z_{j_3} = 0.54e_1 + 0.50e_2 + 0.54e_3 + 0.47e_4$$

Subject to the constraints

$$0.50e_1 + 0.5e_2 + 0.48e_3 + 0.54e_4 \leq 0.54$$

$$2e_1 + 0.50e_2 + 0.5e_3 + 0.41e_4 \geq 0.48$$

$$2.08e_1 + 2e_2 + 0.50e_3 + 0.41e_4 \geq 0.5$$

$$1.85e_1 + 2.44e_2 + 2.44e_3 + 0.50e_4 \geq 0.41$$

To apply Integer Linear Programming method, the following 4 constraints have to be added to the LP model.
$e_1 \leq 1;\ e_2 \leq 1;\ e_3 \leq 1$ and $e_4 \leq 1$

$$\text{Max } Z_{j_1} = 0.41e_1 + 0.50e_2 + 0.48e_3 + 0.54e_4$$

Subject to

$$0.50e_1 + 0.5e_2 + 0.48e_3 + 0.54e_4 \leq 0.54$$

$$2e_1 + 0.50e_2 + 0.5e_3 + 0.41e_4 \geq 0.48$$

$$2.08e_1 + 2e_2 + 0.50e_3 + 0.41e_4 \geq 0.5$$

$$1.85e_1 + 2.44e_2 + 2.44e_3 + 0.50e_4 \geq 0.41$$

$$e_1 \leq 1, e_2 \leq 1, e_3 \leq 1, e_4 \leq 1 \text{ and } e_1, e_2, e_3, e_4 \geq 0$$

A

e1=0,e2=0.0133,e3=0.5046,e4=0.5392
ZA=0.54
ZL=0

e4=0 | e4=1

B

e1=0,e2=0.12,e3=1,e4=0
ZB=0.54
ZL=0.48

C

Infeasible Solution

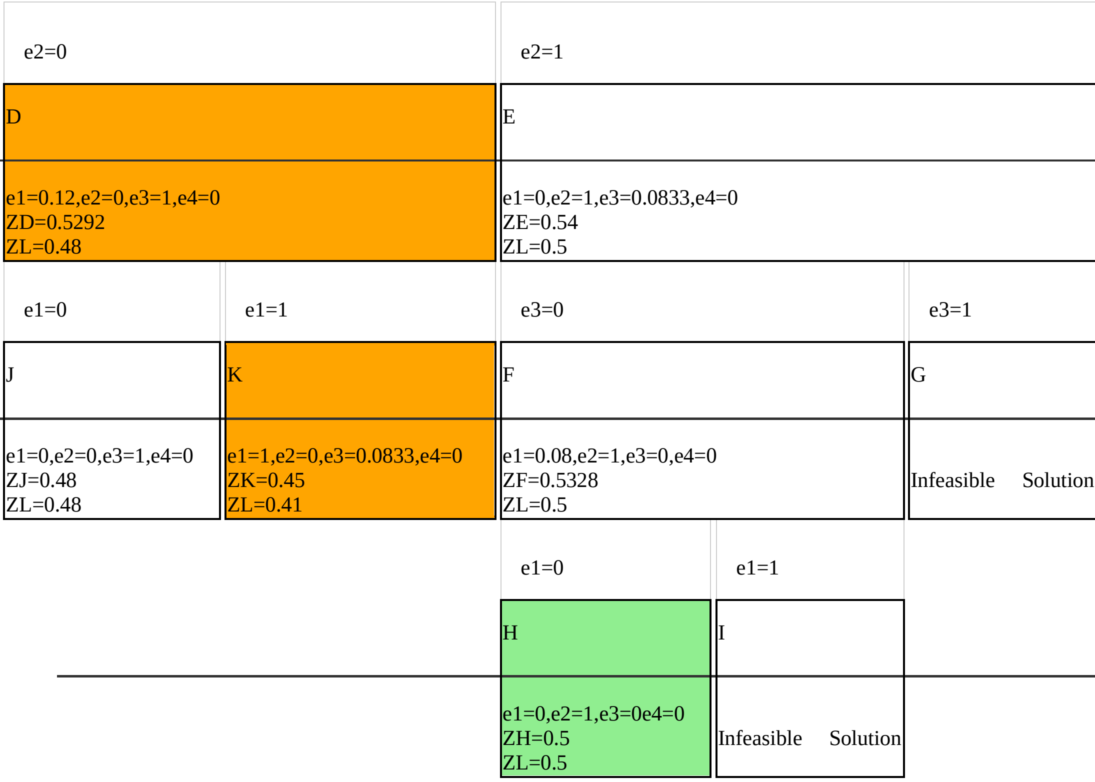

Figure 2.1: The Branch and Bound Diagram

Showing the result of H in the above figure as follows, after introducing slack, surplus, artificial variables

$$\text{Max } Z = 0.41e1 + 0.5e2 + 0.48e3 + 0.54e4 + 0s1 + 0s2 + 0s$$

Max Z = 0.41 e1 + 0.5 e2 + 0.48 e3 + 0.54 e4 + 0 S1 + 0 S2 + 0 S3 + 0 S4 + 0 S5 + 0 S6 + 0 S7 + 0 S8 - M A1 - M A2 - M A3 - M A4 - M A5 - M A6 - M A7

subject to

0.5 e1 + 0.5 e2 + 0.48 e3 + 0.54 e4 + S1 = 0.54

0.5 e2 + 0.5 e3 + 0.41 e4 - S2 + A1 = 0.48

2.08 e1 + 2 e2 + 0.5 e3 + 0.41 e4 - S3 + A2 = 0.5

1.85 e1 + 2.44 e2 + 2.44 e3 + 0.5 e4 - S4 + A3 = 0.41

e1 + S5 = 1; e2 + S6 = 1; e3 + S7 = 1;

e4 + S8 = 1;

e4 + A4 = 0; e2 + A5 = 1; e3 + A6 = 0;

e1 + A7 = 0

and e1,e2,e3,e4,S1,S2,S3,S4,S5,S6,S7,S8,A1,A2,A3,A4,A5,A6,A7≥0

Iteration-1:

		Cj	0.41	0.5	0.48	0.54	0	0	0	0	0	0	0	0	-M	-M	-M	-M	-M	-M	-M	
B	CB	XB	e1	e2	e3	e4	S1	S2	S3	S4	S5	S6	S7	S8	A1	A2	A3	A4	A5	A6	A7	Min Ratio
S1	0	0.54	0.5	0.5	0.48	0.54	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.08
A1	-M	0.48	0	0.5	0.5	0.41	0	-1	0	0	0	0	0	0	1	0	0	0	0	0	0	0.96
A2	-M	0.5	2.08	2	0.5	0.41	0	0	-1	0	0	0	0	0	0	1	0	0	0	0	0	0.25
A3	-M	0.41	1.85	(2.44)	2.44	0.5	0	0	0	-1	0	0	0	0	0	0	1	0	0	0	0	0.168 →
S5	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	---
S6	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
S7	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	---
S8	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	---
A4	-M	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	---
A5	-M	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
A6	-M	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	---
A7	-M	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	---

Z=-2.39M		Zj	-4.93M	-5.94M	-4.44M	-2.32M	0	M	M	M	0	0	0	0	-M	-M	-M	-M	-M	-M	-M	
		Zj-Cj	-4.93M-0.41	-5.94M-0.5↑	-4.44M-0.48	-2.32M-0.54	0	M	M	M	0	0	0	0	0	0	0	0	0	0	0	

In the same way, the seven iteration is done and the last iteration is given as

Iteration-8		Cj	0.41	0.5	0.48	0.54	0	0	0	0	0	0	0	0	
B	CB	XB	e1	e2	e3	e4	S1	S2	S3	S4	S5	S6	S7	S8	MinRatio
S1	0	0.04	0	0	0	0	1	0	0	0	0	0	0	0	
S3	0	1.5	0	0	0	0	0	0	1	0	0	0	0	0	
S4	0	2.03	0	0	0	0	0	0	0	1	0	0	0	0	
e2	0.5	1	0	1	0	0	0	0	0	0	0	0	0	0	
S5	0	1	0	0	0	0	0	0	0	0	1	0	0	0	
S6	0	0	0	0	0	0	0	0	0	0	0	1	0	0	
S7	0	1	0	0	0	0	0	0	0	0	0	0	1	0	
S8	0	1	0	0	0	0	0	0	0	0	0	0	0	1	
e4	0.54	0	0	0	0	1	0	0	0	0	0	0	0	0	
S2	0	0.02	0	0	0	0	0	1	0	0	0	0	0	0	
e3	0.48	0	0	0	1	0	0	0	0	0	0	0	0	0	
e1	0.41	0	1	0	0	0	0	0	0	0	0	0	0	0	
Z=0.5		Zj	0.41	0.5	0.48	0.54	0	0	0	0	0	0	0	0	
		Zj-Cj	0	0	0	0	0	0	0	0	0	0	0	0	

Since all Zj-Cj≥0. Hence, optimal integer solution is as follows:

$e_1 = 0, e_2 = 1, e_3 = 0, e_4 = 0$

$\text{Max } Z_{j_1} = 0.5$

In The same way, we get $\text{Max } Z_{j_2} = 0.47$ and $\text{Max } Z_{j_3} = 0.54$

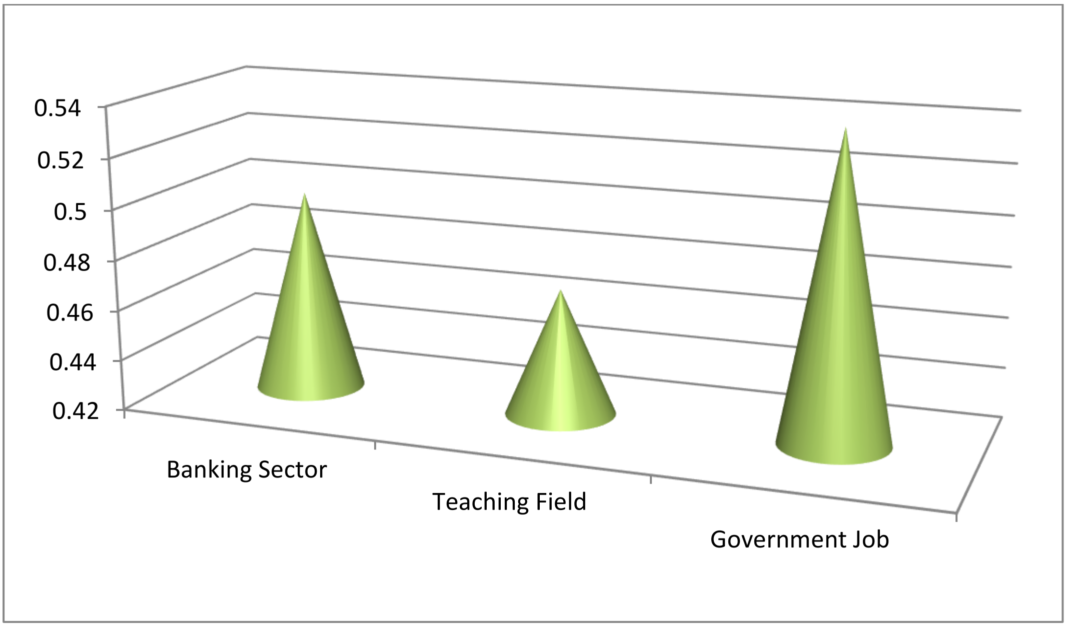

Figure 2.2: Optimal Solutions of Objectives

3. Conclusion:

By above result, it clearly shows that the government job is the best choice for the job seeking youngsters. Safety of life long monthly salary and self-respect among society & family members those are the first thing we need to concentrate. Considering these we analysed and provided a suitable optimized solution for youngsters. Every youngster, who seeking for job will have lots of things on mind, and have a lot of confusion in choosing a right decision for their career. Here, MOILPP in Neutrosophic fuzzy set is helped to solve a situation based decision making problem. This modified technique provides us a more efficient to deal a real life multiple decision making problems.

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