Ranking the Problems of Women Entrepreneurs in India Using Vikor Method with Lonsm

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Abstract- *In this present scenario the job market is getting detained due to growing competitions in almost all fields. The stratification of gender plays a significant role in getting employed. To overcome the condition of unemployment the state of entrepreneurship came into existence which paved way for the development of new paradigm of self employment. In the earlier days male entrepreneurs were predominant, but now the women folk have also stepped into it. The women entrepreneurs (WE) face several problems in running their dealings which averts the prolonging of long run. This paper takes efforts to investigate the problems of WE and makes use of the Vikor ranking method along with Linguistic Octagonal Neutrosophic Soft matrix (LONSM). The ranking will duly assist in framing suitable strategies to overcome the problems of women entrepreneurs. This research work can be extended with the application of other types of fuzzy numbers.*

Keywords— *women entrepreneurs, VIKOR, LONSM, ranking, decision making*

Introduction

The venture of women folk into entrepreneurship is a challenging task in this male dominated society. Several reformers have presented their research findings after examining the status of WE in various parts of the country, they have also stated the hurdles faced by them in running a business of their own at small scale in a particular context. Suitable stratagems to render assistance to women entrepreneurs can be framed only after making the general analysis of all the problems of WE. This paper aims in making a wide range of investigation to rank the problems of WE with the application of mathematical tools to enable the policy makers formulate appropriate measures.

The chore of ranking is highly tedious as it is multi tasked. There are several methods of ranking one such is VIKOR, which was developed by Opricovic in 1998. Many researchers have developed this method and in this paper the VIKOR method is integrated with LONSM (Linguistic Octagonal Neutrosophic Soft Matrix). Soft set theory was first proposed by Molodstov . Maji applied this theory to handle the risks of impreciseness. Later the matrix representation was developed. The theory of intutionistic soft matrix was introduced by the researchers after which the concept of Neutrosophic soft matrix came into existence. In this paper the notion of linguistic Neutrosophic soft matrix is introduced to represent the realism of the data obtained as expert's opinion.

The paper is organized as follows: section 2 consists of preliminaries; section 3 presents the methodology; section 4 comprises the adaptation of the algorithm to the problem considered for analysis; section 5 presents the results and discussion and section 6 concludes the paper.

Preliminaries

This section consists of the essential definitions pertaining to this research work.

Fuzzy Soft Set

A fuzzy soft set over the universal set U is a pair $(\tilde{F}_A, E)$ where E is the set of parameters, $A \subseteq E$, $\tilde{F}_A : E \to I^U$, I^U denotes the collection of fuzzy subsets of U.

Fuzzy Soft Matrix

A fuzzy soft matrix of a fuzzy soft set $(\tilde{F}_A, E)$ is denoted by A = $[a_{ij}]$, i = 1,2,…m and j =1, 2,…n , where $a_{ij} = \mu_{RA}(u_i, x_j)$ and $\mu_{RA} : U \times E \to [0,1]$

Neutrosophic Soft Set

A neutrosophic soft set F is a mapping from A to I^U, where A is the subset of E, the set of parameters and I^U is the collection of all neutrosophic fuzzy subsets over of the universe set U.

Neutrosophic Soft Matrix

A neutrosophic soft matrix is denoted as N = $[n_{ij}]$, i = 1,2,…m and j =1, 2,…n where $n_{ij} = (T_{ij}, I_{ij}, F_{ij})$, T_{ij} , I_{ij}, F_{ij} represents the truth , indeterminacy and false membership functions respectively

Linguistic Neutrosophic Soft Matrix

A Linguistic Neutrosophic Soft Matrix is a Neutrosophic fuzzy soft matrix in which T_{ij} , I_{ij}, F_{ij} are represented in terms of linguistic variables.

Octagonal Fuzzy Number

An octagonal fuzzy number is of the form (a1,a2,a3,a4,a5,a6,a7,a8), where ai, i = 1 to 8are real numbers a1 ≤ a2 ≤ a3 ≤ a4 ≤ a5 ≤ a6 ≤ a7 ≤ a8 whose membership function $\mu_{A(x)}$ is defined as follows

$$\mu_{A(x)} = \begin{cases} 0 & if\ \ x \prec a_1 \\ k\left(\dfrac{x-a_1}{a_2-a_1}\right) & if\ a_1 \le x \le a_2 \\ k & if\ a_2 \le x \le a_3 \\ k+(1-k)\left(\dfrac{x-a_3}{a_4-a_3}\right) & if\ a_3 \le x \le a_4 \\ 1 & if\ a_4 \le x \le a_5 \\ k+(1-k)\left(\dfrac{a_6-x}{a_6-a_5}\right) & if\ a_5 \le x \le a_6 \\ k & if\ a_6 \le x \le a_7 \\ k+(1-k)\left(\dfrac{a_8-x}{a_8-a_7}\right) & if\ a_7 \le x \le a_8 \end{cases}$$

Where 0 < k < 1

Methodology of VIKOR with LONSM

The steps involved are as follows

1. The expert's opinion for each factor is represented as linguistic Neutrosophic soft matrix (LNSM).

2. The linguistic variables are quantified in terms of octagonal fuzzy numbers which transforms LNSM to LONSM.

3. The values of LONSM are modified to crisp values by using the defuzzification formula 1 /2 h ($a_8 - a_1$) + ($a_7 - a_2$) + 1/2 h ($a_6 - a_3$) + ($a_5 - a_4$)
4. The positive and negative solution is determined.

   Where $q^+ = \{\tilde{r}_1^+, \tilde{r}_2^+, ...rn^+\}$ where $\tilde{r}_j^+ = \max\{S(\tilde{r}_{1j})...S(\tilde{r}_{mj})\}\ j = 1,2,..n$

   $q^- = \{\tilde{r}_1^-, \tilde{r}_2^-, ...rn^-\}$ where $\tilde{r}_j^- = \min\{S(\tilde{r}_{1j})...S(\tilde{r}_{mj})\}\ j = 1,2,..n$
5. Determine the values of S_i and T_i

   $$S_i = \sum_{j=1}^{n} \frac{w_j \left\| \tilde{r}_j^+ - \tilde{r}_{ij} \right\|}{\left\| \tilde{r}_j^+ - \tilde{r}_j^- \right\|}$$ i = 1,2…m

$$T_i = \max_j \frac{w_j \left\| \tilde{r}_j^{+} - \tilde{r}_{ij} \right\|}{\left\| \tilde{r}_j^{+} - \tilde{r}_j^{-} \right\|} \quad i = 1,2\ldots m$$

6. Calculate E_i where
   $E_i = v(S_i - S^-)/(S^+ - S^-) + (1-v)(T_i - T^-)/(T^+ - T^-)$
   Where $S^- = \min S_i$, $S^+ = \max S_i$, $T^- = \min T_i$, $T^+ = \max T_i$

Adaptation of the proposed method to the problem of women entrepreneurs

The problems of WE are listed and the proposed method of VIKOR with LONSM is applied to determine the ranking of the problems.

Problems of Women Entrepreneurs

P1 Economic Constraint
P2 shortage of Inputs
P3 Family Bonds
P4 Social Discrimination
P5 Gender bias
P6 Lack of Higher Education
P7 Scarce of exposure to the external environment
P8 Deficit of skills to tackle the risks
P9 Discontinuous Supportive network
P10 Fright of Failure

Table.1. Quantification of Linguistic variable

Linguistic Variable	**Octagonal Fuzzy Representation**	**Crisp Value**
Very Low VL	(0.01,0.02,0.03,0.04,0.05,0.06,0.07,0.08)	0.085
Low L	(0.04,0.06,0.08,0.10,0.12,0.14,0.16,0.18)	0.17
Medium M	(0.16,0.22,0.28,0.34,0.4,0.42,0.45,0.5)	0.41
High H	(0.5,0.63,0.69,0.75,0.81,0.87,0.87,0.9)	0.445
Very High VH	(0.7,0.75,0.8,0.85,0.95,0.95,1,1)	0.4625

The LNSM representing the expert's opinion is presented below

	Expert 1	Expert 2	Expert 3
P1	(H,VL,VL)	(H,L,VL)	(H,VL,VL)
P2	(H,M,L)	(VH,L,VL)	(VH,L,L)
P3	(H,L,M)	(H,M,L)	(VH,M,L)
P4	(L,M,H)	(L,VL,VH)	(L,M,VH)
P5	(VH,VL,L)	(VH,L,VL)	(H,VL,L)
P6	(M,L,M)	(L,M,H)	(H,L,M)
P7	(L,L,H)	(L,VL,VH)	(M,L,M)
P8	(L,M,VH)	(M,L,M)	(H,M,L)
P9	(H,M,L)	(VH,M,L)	(H,L,VL)
P10	(M,L,M)	(M,L,VL)	(H,M,M)

The linguistic Octagonal Neutrosophic Soft Matrix is

	Expert 1	**Expert 2**	**Expert 3**
P1	(0.445,0.085,0.085)	(0.445,0.17,0.085)	(0.445,0.085,0.085)
P2	(0.445,0.41,0.17)	(0.4625,0.17,0.085)	(0.4625,0.17,0.17)
P3	(0.445,0.17,0.41)	(0.445,0.41,0.17)	(0.4625,0.41,0.17)
P4	(0.17,0.41,0.445)	(0.17,0.085,0.4625)	(0.17,0.41,0.4625)
P5	(0.4625,0.085,0.17)	(0.4625,0.17,0.085)	(0.445,0.085,0.17)
P6	(0.41,0.17,0.41)	(0.17,0.41,0.445)	(0.445,0.17,0.41)
P7	(0.17,0.17,0.445)	(0.17,0.085,0.4625)	(0.41,0.17,0.41)
P8	(0.17,0.41,0.4625)	(0.41,0.17,0.41)	(0.445,0.41,0.17)
P9	(0.445,0.41,0.17)	(0.4625,0.41,0.17)	(0.445,0.17,0.085)
P10	(0.41,0.17,0.41)	(0.41,0.17,0.085)	(0.445,0.41,0.41)

The positive and negative ideal solutions
q^+ = {(0.4625,0.085,0.17) (0.4625,0.17,0.085) (0.4625,0.17,0.17)}
q^- ={(0.17,0.17,0.445) (0.17,0.085,0.4625) (0.17,0.41,0.4625)

Table 2. Values of Si, Ti & Ei

S1	0.250754	T1	0.126979	E1	0.780313
S2	0.396555	T2	0.396555	E2	0.338002
S3	0.824887	T3	0.310947	E3	0.410457
S4	1.628851	T4	0.629346	E4	0.92018
S5	0.090715	T5	0.090715	E5	0.8452
S6	1.106622	T6	0.538342	E6	0.679429
S7	1.256806	T7	0.5	E7	0.698339
S8	1.231841	T8	0.640952	E8	0.800179
S9	0.749717	T9	0.396555	E9	0.452804
S10	0.726118	T10	0.35526	E10	0.412918

Table.3. Ranking of P_i

P1	4
P2	10
P3	9
P4	1
P5	2
P6	6
P7	5
P8	3
P9	7
P10	8

Results and Discussion

From the Table 3. The ranking of the problems of women entrepreneurs is vivid. Social Discrimination (P4), Gender Bias (P5), Deficit of skills to tackle the risks (P8) are the three major problems faced by WE. Therefore the reformers and the policy makers should make the essential provisions to make the women entrepreneurs overcome these prime hurdles.

Conclusion

This paper introduces the concept of linguistic Neutrosophic soft matrix and linguistic octagonal Neutrosophic soft matrix which presents the data in the realistic form. These new notions facilitate the data handling and assist in making feasible decisions. This research work also aids in ranking the problems of WE in systematic manner. This work can also be extended by using other types of fuzzy numbers and a comparative analysis can also be made with different types of fuzzy numbers.

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