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An Innovative TOPSIS Framework in Hesitant Fuzzy Using Multi-Criterion and Multi-Objective Group Decision System for Breast Carcinoma

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ABSTRACT: Breast cancer over the last few years prediction is increasingly developed in the arena of the research. The objective of the work is to predict the variety of breast carcinoma patients and how the patients will be outranking, according to their severity of the disease. Even though the plenty number of methodologies available were prevailing in the research, but a small handful of work, in hesitant fuzzy TOPSIS. The outcome of the research work is to explore the coefficient of closeness between the tuples and to find the ranking of the patients to treat effectively with the latest medicines. The whole hesitant fuzzy TOPSIS comprises with linguistics, intuitionistic, aggregation, ideal positive solution and ideal negative solutions are the components providing high accuracy rate for ranking for diseases. The difficulties in order preference by similarity to an ideal solution have been encountered using Hesitant TOPSIS method. Here the work having post-processing work rather than the other works related to pre-processing work.

Keywords: Hesitant Fuzzy, TOPSIS, Carcinoma, Linguistics, Intuitionistic, Ideal Positive solution and Ideal Negative solution.

I. INTRODUCTION

For women breast cancer is not uncommon. Skin and nipple colour will change where the lump and thickening of the breast are the common symptoms. Treatment for breast cancer involves weekly therapy with paclitaxel. This may involve experiencing deleterious effects for 12 consecutive weeks associated with the use of prophylactic dexamethasone. Dexamethasone injected in the first two weeks can be withdrawn between week 3 and 12 provided there is no serious HSR occurring [1]. Risk factors can be genetic because of some lifestyle factors, such as alcohol, tobacco, drug etc. With the disparities involved with cancer, the survivorship period of African-American breast cancer survivors are predicted. Keeping in mind the components of survivorship, it was concluded that African -American survivors have acute and disparate survivorship, period of negative effects on quality of life and health [2]. The symptoms are the pain in the armpits and breast skin will be redness or pit is the real sign of breast cancer and orange colour rash near the nipple, sometimes discharge in the breast is also the factors of the breast carcinoma. The impact of disclosing the prevalence of cancer over the telephone. Rather than sharing it in person when conveyed through phone, displays features such as group members listed, heterosexual existence [3]. Near the breast or nipple, the size and the shape of the colour will change into peeling or flaking and sometimes scaling will see in the breast. The clinical and sociodemographic factors correlating with the resilience of cancer by women are studied. It was seen that people who have survived for 6 or more years have greater resilience [4]. The types are Ductal carcinoma and invasive lobular carcinoma. In breast cancer main the stage of cancer, the patient's age, overall health, sensitivity to hormones and preferences. The association between sedentary attitude parameters and the cognitive functioning of people who survived of breast cancer, with various multivariable linear regression, it was determined that time spent in standing tends in more information processing [5]. The main treatment options include: surgery, radiation therapy, targeted drug therapy, biological therapy, chemotherapy, hormone therapy and the Surgery types are Mastectomy, Sentinel node biopsy, Lumpectomy, Axillary lymph node dissection, Reconstruction. On determining the sexual dysfunction prevalence among women with the absence of breast cancer, using meta-analyses the confidence interval was found to be 95% [6].In breast cancer, 4 Stages consists of 3, 2, 1, 0. The ER Status, PR Status and HER2 Final Status this 3 Status are divided in to 3 types which are accordingly specific in intermediate, negative, positive and there are Tumor are in 4 types which are T4, T3, T2, T1 and the Nodes are also a part of the cancer and they are also 4 types it will be in N3, N2, N1, N0. Node-Coded is divided into 3 types as similar to Status intermediate, negative, positive. The AJCC Stages are the main those are No Conversion, Stage I, Stage II A, Stage. The Survival Data Form is in 2 types they are Follow-up and enrollment. The Vital Status is that is cancer is living or Not living they are 2 types they are Living and Deceased and the final step in PAM50 mRNA this is main to decide cancer "they are 4 types they are Basal-Like, Luminal A, Luminal B, HER2-Enriched. This paper proposed another MAGDM technique dependent on expanded TOPSIS strategy. It can viably take care of the issue of enormous measure of data bending caused by complex accumulation operators.

(a) **HER2:** In breast cancer, HER2 plays a vital role. First, we have to check the report of pathology whether HER2 is present or not.
(b) **Tumour:** It is a collection of abnormal cells accumulated in the breast. The malignant grow of carcinoma can be identified through the abnormal cells, so usually, lymph node first is invaded by that disease.
(c) **Node:** Lymph Node is the bottleneck for the blood passing into the body. Once it spreads in that lymph node, the chance of getting cancer is very high in the body.
(d) **AJCC Stage:** The American Joint Committee on Cancer express the growing rate of the tumour and the progression and describes the classification of the disease. Lumpy node, TNM scoring rate and more often affects the metastasis.
(e) **PAM50 mRNA:** Unlike traditional clinic pathological variables, PAM50 intrinsic breast cancer subtypes are prognostic independent. CALGB 9741 showed better recurrence-free (RFS) and overall survival (OS) with 2-week sedative-dense (DD) compared with 3-week treatment. A major association was hypothesized between intrinsic subtypes and the value of DD-therapy. Appropriate tumour samples were available from 1,471 (73%) of 2,005 subjects. For the evaluable subset of 1,311 patients treated, synchronous gene expression profiling generated the PAM50 subtype call, dissemination score and recurrence score risk (ROR-PT)".

II. RELATED WORKS

"On studying the feasibility of 8-week Qigongto gentle exercise, on breast cancer survivors, reduction in distress was reported. And the self-report of cognitive function improved [7]. Breast cancer treatment initiating a new chemotherapy course with a high (> 20%) FN risk, with pegfilgrastim in cycle 1 was initiated. Out of the 86% who completed the study, 3% had all FN events [8]. To determine the effect of IMCSN biopsy on recurrence-free survival (RFS) and Overall Survival (OS) and to identify predictive factors for IMCSN and distant metastasis. When a biopsy was performed on 86% of patients, it was seen that the result was tumour negative [9]. Methods were proposed to optimize the surgical resection of the axilla in patients with negative sentinel lymph node (SLN) to eradicate false-negative (FN) events of SLND. With methylene blue, ICG, and its combination there were 13 FN. With Surgical resection of LOQ 'en bloc' showed an FNR of zero [10]. To understand the risk factors involved with poor sleep reported by women with breast cancer. With cross-sectional study, it was seen that younger age, lower physical activity, and higher fatigue resulted in poor quality sleep [11]. A study was conducted to investigate the effect of vitamin D and E vaginal suppositories on vaginal atrophy in women with breast cancer receiving tamoxifen. With Vaginal Maturation Index (VMI) an increase is seen at the end of 8^{th} week of the intervention [12]. The effectiveness of photobiomodulation therapy (PBMT) for the prevention of acute radiation dermatitis (ARD) by using biophysical skin measurements was studied. Photobiomodulation therapy (PBMT) for the prevention of acute radiation dermatitis (ARD) by using biophysical skin measurements was used. Logistic regression analysis revealed that the risk on moist desquamation was significantly increased for patients with a large (> 800 cc) breast volume (odds ratio = 4, p = 0.017) [13]. The application is Optimal primary febrile neutropenia (FN) prophylaxis for patients receiving docetaxel-cyclophosphamide (TC) chemotherapy is unknown. The method is treatment-related hospitalization or chemotherapy dose reduction/delay/discontinuation. The result is 91.2% (186/204) agreed to randomization treatment-related hospitalization (11/186, 13.10%), chemotherapy reduction (19/186, 22.62%), chemotherapy discontinuation (16/186, 19.05%), and chemotherapy delays (5/186, 5.95%) [14].Application is complex decongestive therapy (CDT) and breast cancer-related lymphedema (BCRL). The method is upper limb excess volume (EV) and percentage reduction of excess volume (%REV). The result after treatment (EV, − 521 ml vs − 256 ml, P < 0.0001; %REV, − 66.4% vs. − 34%, P = 0.02) and at 3-month follow-up (EV, − 59 ml vs + 24 ml, P < 0.0001; %REV, − 73.6% vs − 31.4%, P = 0.004) [15]".

III. PROPOSED METHODOLOGY

This procedure is easily applicable for solving DM problem under fuzzy atmosphere. This technique gives the magnitude to weights of different conditions and the rankings of qualitative conditions are described as linguistic variables. These are denoted as the triangular numbers displayed in the Table 1 and 2.

Table 1: The importance of the fuzzy weight of each condition.

Narrative	Assessment
Low (L)	(0.1; 0.2; 0.3)
Medium (M)	(0.2; 0.3; 0.4)
High Medium (HM)	(0.3; 0.4; 0.5)
High (H)	(0.4; 0.5; 0.6)
Very High (VH)	(0.5; 0.6; 0.7)

Table 2: Linguistic rating parameters.

Narrative	Assessment
Low (L)	(1; 2; 3)
Medium (M)	(2; 3; 4)
High Medium (HM)	(3; 4; 5)
High (H)	(4; 5; 6)
Very High (VH)	(5; 6; 7)

The rank weight of each condition can be attained from directly assigned or indirectly taking pairwise association. The procedure adopted here that, the assessment makers utilize the above table to calculate the rank for existing, the ranking of alternatives concerning a different condition. consider that an assessment group has n individuals, then the position of the condition and the ranking of alternatives concerning every condition can be formulated as

$$x_{ij} = \frac{1}{n}\left(y_{lm}^{1} + y_{lm}^{2} + \ldots + y_{lm}^{n}\right),\ w_{ij} = \frac{1}{n}\left(z_{lm}^{1} + z_{lm}^{2} + \ldots + z_{lm}^{n}\right) \quad (1)$$

where x_{ij} and w_{ij} denote the ranking and the arrangement weight of the nth assessment maker. A

fuzzy multi-condition decision-making problem described in a matrix format

$$D = \begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ . \\ . \\ A_n \end{array} \begin{pmatrix} x_{11} & x_{12} & . & . & . & x_{1n-1} & x_{1n} \\ x_{21} & x_{22} & . & . & . & x_{2n-1} & x_{2n} \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ x_{n-11} & x_{n-22} & . & . & . & x_{n-1n-1} & x_{n-1n} \\ x_{n1} & x_{n2} & . & . & . & x_{nn-1} & x_{nn} \end{pmatrix}$$

where x_{ij} , i, j and w_j , j =1, 2, … , n are linguistic variables. These are expressed by fuzzy numbers of triangles, $x_{ij} = (a_{ij}, b_{ij}, c_{ij})$ with $w_j = (w_{j1}, w_{j2}, w_{j3})$. Only the linear scale transformation is applied here to convert the various condition levels into a comparable measure. This result, the nfdm denoted by R given below.

$R = \left[r_{ij} \right]_{mxn}$, where B and C denote the set of gain condition and expenditure condition respectively, and

$$r_{ij} = \left(\frac{\alpha_{ij}}{c_j}, \frac{\beta_{ij}}{c_j}, \frac{\delta_{ij}}{c_j} \right) , j \in B, c_j = \max c_{ij}, j \in B \quad (2)$$

To maintain the possessions that obtained from normalized triangular fuzzy numbers Ɛ [0, 1] are discussed. Utilize different levels in each condition, to develop the WNFDM as

$V = [v_{ij}]_{mxn}$, i = 1, 2, ... m and j = 1, 2, ..., n.

From the basis of the WNFDM, the resultant elements v_{ij}, i, j are standardized positive triangular fuzzy numbers Ɛ [0, 1]. An FPIS, A* and FNIS, $A^{\#}$ results from

$$d_i^* = \sum_{j=1}^{n} d(v_{ij}, v_j^*), d_i^{\#} = \sum_{j=1}^{n} d(v_{ij}, v_j^{\#}), \quad i = 1, 2, ..., m.$$ In which, d denotes distinct value among two fuzzy values. A relative factor is obtained by the ranking possibilities obtained from d_i^* and $d_i^{\#}$ of each substitute A_i (i=1, 2, …, m) has been calculated. The relative factor of each alternative is designed as

$$RFi = \frac{d_i^*}{d_i^* + d_i^{\#}} , i = 1, 2, ..., m \quad (3)$$

a choice A_i is closer to the FPIS (A*) and more than that FNIS($A^{\#}$) as RFi moves to 1. This result the relative factor is possible to find the ranking order of all possibilities and conclude the appropriate one among the reasonable alternatives.

IV. RESULTS AND DISCUSSION

In the application of breast cancer, fuzzy hesitant relation set with TOPSIS methodology applied given below using linguistics and intuitionistic measures to find them outranking for the above-said disease. In the method, a new ideology was incorporated in the TOPSIS to get the precise out ranking using final positive ideal solution and final negative ideal solution.

Table 3: Trained Dataset for Breast Cancer.

TCGA ID	AGE	ER Status	PR Status	HER2 Status	Tumor	Node	Node-Coded	AJCC Stage
TCGA-A2-A02	66	0.0208	0.0222	0.0243	0.0625	0.0967	0.0425	0
TCGA-A2-A0CM	40	0.0208	0.0222	0.0243	0.0312	0	0.0212	0.0606
TCGA-BH-A0E0	38	0.0208	0.0222	0.0243	0.0625	0.0967	0.0425	0
TCGA-AN-A0FL	62	0.0208	0.0222	0.0243	0.0312	0	0.0212	0
TCGA-A2-A0YM	67	0.0208	0.0222	0.0243	0.0312	0	0.0212	0.0606
TCGA-A2-A0SX	48	0.0208	0.0222	0.0243	0	0	0.0212	0.0303
TCGA-AO-A12F	36	0.0208	0.0222	0.0243	0.0312	0	0.0212	0.0606
TCGA-AN-A0AL	41	0.0208	0.0222	0.0243	0.0967	0	0.0212	0
TCGA-A8-A09G	79	0.0416	0.0222	0.0487	0.0625	0.0967	0.0425	0.1212
TCGA-C8-A12T	43	0.0416	0.0444	0.0487	0.0312	0	0.0212	0.0606
TCGA-C8-A12L	67	0.0208	0.0222	0.0487	0.0312	0	0.0212	0.0606
TCGA-A2-A0D1	76	0.0208	0.0222	0.0487	0.0312	0	0.0212	0.0606
TCGA-AO-A12D	43	0.0208	0.0222	0.0487	0	0.0322	0.0425	0
TCGA-AR-A0TR	68	0.0416	0.0444	0.0243	0.0312	0.0322	0.0425	0
TCGA-BH-A18R	50	0	0.0222	0.0487	0.0312	0.0322	0.0425	0
TCGA-A2-A01	55	0.0208	0.0222	0.0487	0.0625	0.0967	0.0425	0
TCGA-BH-A0DD	58	0.0416	0.0444	0.0487	0.0312	0.0322	0.0425	0.0606
TCGA-C8-A12U	46	0.0416	0.0444	0.0243	0.0312	0.0322	0.0425	0.0606
TCGA-E2-A15A	45	0.0416	0.0444	0.0243	0.0312	0.0967	0.0425	0.1212
TCGA-A2-A0EX	46	0.0416	0.0444	0.0243	0.0625	0	0.0212	0.0606
TCGA-AN-A04A	36	0.0416	0.0444	0.0243	0.0312	0.0645	0.0425	0
TCGA-A8-A09I	84	0.0416	0.0444	0.0487	0.0312	0	0.0212	0.0606
TCGA-AN-A0AM	56	0.0416	0.0222	0.0243	0.0312	0	0.0212	0.0909
TCGA-AO-A0J9	61	0.0416	0.0444	0.0243	0.0312	0.0967	0.0425	0
TCGA-BH-A0HP	65	0.0416	0.0222	0.0243	0.0625	0.0645	0.0425	0.0909
TCGA-A2-A0YI	62	0.0416	0.0444	0.0243	0	0	0.0212	0.0303
TCGA-E2-A154	68	0.0416	0.0444	0.0243	0	0	0.0212	0.0303
TCGA-A2-A0SW	82	0.0416	0.0222	0.0243	0.0312	0.0645	0.0425	0
TCGA-BH-A0C0	62	0.0416	0.0444	0.0487	0	0.0322	0.0425	0.0909
TCGA-D8-A13Y	52	0.0416	0.0444	0.0243	0	0	0.0212	0
TCGA-A2-A03	37	0.0416	0.0444	0.0243	0	0.0322	0.0425	0.0606

To be continued…

Survival Data	Vital Status	PAM50 mRNA	Total	Class
0	0.2	0	0.6562	H
0	0.2	0	0.5801	H
0	0	0	0.4688	M
0.0666	0	0	0.1863	L
0	0	0	0	L
0	0	0	0	B
0	0	0	0	L
0.0666	0	0	0.0666	L
0.0666	0	0.0212	0.0878	M
0.0666	0	0.0212	0.0878	L
0.0666	0	0.0212	0.0878	L
0	0	0.0212	0.0212	L
0	0	0.0212	0.0212	L
0.0666	0.2	0.0425	0.3091	M
0.0666	0.2	0.0212	0.2878	M
0	0	0.0212	0.0212	L
0.0666	0	0.0638	0.1304	M
0.0666	0	0.0638	0.1304	M
0.0666	0	0.0638	0.1304	M
0.0666	0	0.0425	0.1091	M
0.0666	0	0.0425	0.1091	L
0.0666	0	0.0638	0.1304	M
0.0666	0	0.0638	0.1304	M
0	0	0.0425	0.0425	L
0	0	0.0425	0.0425	M
0	0	0.0425	0.0425	L
0.0666	0	0.0425	0.1091	L
0	0.2	0.0638	0.2638	M
0	0	0.0638	0.0638	M
0	0	0.0638	0.0638	L
0	0	0.0638	0.0638	L

A. Illustration work

	HER2 Final Status	Tumor	Node	AJCC	PAM50 mRNA
BC1	H	VH	L	M	L
BC2	VH	H	M	L	HM
BC3	HM	L	VH	H	M
BC4	H	M	L	HM	VH

DM1	HER2 Final Status	Tumor	Node	AJCC	PAM50 mRNA
BC1	4,5,6	5,6,7	1,2,3	2,3,4	1,2,3
BC2	5,6,7	4,5,6	2,3,4	1,2,3	3,4,5
BC3	3,4,5	1,2,3	5,6,7	4,5,6	2,3,4
BC4	5,6,7	2,3,4	1,2,3	3,4,5	5,6,7

DM2	HER2 Final Status	Tumor	Node	AJCC	PAM50 mRNA
BC1	5,6,7	6,7,8	2,3,4	3,4,5	2,3,4
BC2	6,7,8	5,6,7	3,4,5	2,3,4	4,5,6
BC3	4,5,6	2,3,4	6,7,8	5,6,7	3,4,5
BC4	5,6,7	3,4,5	2,3,4	4,5,6	6,7,8

DM3	HER2 Final Status	Tumor	Node	AJCC	PAM50 mRNA
BC1	6,7,8	7,8,9	3,4,5	4,5,6	3,4,5
BC2	7,8,9	6,7,8	4,5,6	3,4,5	5,6,7
BC3	5,6,7	3,4,5	7,8,9	6,7,8	4,5,6
BC4	6,7,8	4,5,6	3,4,5	5,6,7	7,8,9

	HER2 Final Status	Tumor	Node	AJCC	PAM50 mRNA
BC1	192	315	15	2,4,6	15
BC2	315	192	48	1,3,5	105
BC3	105	15	288	288	48
BC4	192	48	15	105	315

	HER2 Final Status	Tumor	Node	AJCC	PAM50 mRNA
BESTCASE	105	15	15	288	315
WORSTCASE	315	315	315	15	15

Weightage	0.1	0.3	0.5	0.7	0.9
	HER2 Final Status	Tumor	Node	AJCC	PAM50 mRNA
BC1	0.04142	0.3	0	0.61538	0.9
BC2	0.1	0.177	0.055	0.7	0.63
BC3	0	0	0.5	0	0.801
BC4	0.04142	0.033	0	0.46923	0

	S_i	R_i	Q_i	rank
BC1	1.8568	0.9	1	4
BC2	1.662	0.7	0.6936	3
BC3	1.301	0.801	0.6769	2
BC4	0.54365	0.46923	0	1

Max	1.8568	0.9
Min	0.54365	0.46923

V. CONCLUSION AND FUTURE WORKS

In the breast cancer application, hesitant fuzzy tops is were deployed to find the ranking of the disease, where we can find the severity of the disease. Using the distinct measure of linguistics and intuitionistic s. the different decision-makers have got their linguistics for the criterions. In this work, we have done an aggregation and summarize the decision-maker data using in tuitionistic values. Two objectives were employed with beneficial and not -beneficial for the criterions. The second objective is the weight of the last final positive ideal solution and final negative ideal solution were found. Through the above said coefficients of closeness were measured for the outranking the breast cancer disease. The ranking provides the intensity of the disease and makes the physician to get alert and to know the condition of the breast cancer stage. In the future, hesitant fuzzy other methods like Promothee, Dematel, Normalized Dematel, and AHP Normalized Hesitant fuzzy can also be used to find the out ranking of the breast carcinoma disease. Fuzzy relation can be used for future prediction and avoids uncertainty about the disease of the patients suffering through the disease.

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