

Fuzzy Multi Criterion Decision Making Method to Analyze Performance of Banking Sector

Sheikh Ahmed Hossain

Abstract: Performance evaluation of any financial institution is extremely important to look after the health and prospect of the institution. In many research of performance evaluation analysis of banks, several ratio parameters are used mostly in statistical analysis. Designing effective and comprehensive model for evaluation process of financial matters in banking sector is complex due to multiple criteria and parameters, mostly uncertain in nature. This paper presents a comprehensive process considering several financial criteria of several alternatives on the basis of several expert's (decision maker's) opinion and subjective judgment. Intensity of importance is represented in fuzzy scale. We used fuzzy AHP-preference programming (FPP) to obtain priority weights associated with each criteria and compromise ranking method (VIKOR) considering Market Capital, Net Sales, Net Profit, Total Assets, and Other Income in ranking alternatives. A case study involving ten active Indian Public Sector Unit (PSU) banking industries is undertaken to illustrate the feasibility of the suggested approach. A sensitivity analysis is also carried out for checking the method reliability.

Key words: FAHP; MCDM; FPP, Banking Stocks; Ranking by Adjustment Method (RAM).

I. INTRODUCTION

The fast changing economic scenario, technological developments and the globalization system compelled to face challenges and competition among the different categories of financial institutions like national banks (Public Sector Undertaking (PSU) Banks), private and foreign banks. In Indian scenario, liberalization and reform in financial sector started in 90' when 'Narasimham Committee' was being set up to study the working of the financial system [10]. The monetary policy and financial management system are one of the major issues for efficiency of banking system. Because of intangible nature of measurement like products and services leads difficulties to measure competitiveness and efficiency of financial institutions. The measurement of credentials of a bank is not very simple task, it depends on several factors, some of them are tangible and intangible. The factors may be measurable on the basis of the financial data, trends and some of them are qualitative in nature. Recently it found that the levels of size for the existence of scale economies are higher due to economic development and market liberalization [6]. For banking performance assessment, despite many financial/economic ratios models, models that based on specific objectives of efficiency evaluation yet not fully developed. Besides the models based on financial ratios,

economic ratios, it is necessary to measure efficiency based on qualitative variables like financial positions, management quality, equity structure, and competitive position. Babic et al. [1] evaluates the banks against the following six criteria based on Economic Value Added, organization efficiency, Value Added Intellectual Capital, equity capital, capital/assets ratio, profit/income ratio. Hunjak [3] proposed an AHP model for bank efficient evaluation and rating. The idea of financial efficient rating based on expert views, customer views and news may be recommended instead of conventional numerical method. Reliable news is very effective to take important decision by the decision makers (DMs). In real life problems, conventional AHP decision-making model requires enduring imprecision as fuzziness and vagueness in some or all pair wise comparison values. Shaverdia et al. [9] used AHP in fuzzy environment for to evaluate performance of sectors related to petroleum and petrochemical industry in Iran. Yalcin et al. [11] used MCDM methods for an economic evaluation method in manufacturing industries in Turkey. Yu et al. [12] proposed a model to evaluate and rank e-commerce websites in e-alliance based on AHP, fuzzy sets and TOPSIS. Chatterjee and Kar [2] developed a model for financial institutions in supply chain risk management using hybrid MCDM approach. The model presented in this paper is developed to compare (ranking) the Indian PSU Banks on the basis of five variables, viz. Market Capital, Net Sales, Net Profit, Total Assets, and Other Income. The comparison matrix is based on overall suggestion of eight DMs. For comprehensive analysis of banking performance, the weight of the listed criteria as per DMs are calculated fuzzy AHP based Preferences Programming, whereas the bank rating list is formed using compromise ranking method [7]. This proposed model is designed into five sections. A brief description of fuzzy AHP with prioritization problem, fuzzy preference programming method (FPP) and compromise ranking method is given explaining the use of method that may be appropriate for the Indian PSU banks' performance evaluation.

II. PROPOSED METHODOLOGY

A. AHP using Fuzzy preference programming Method

When the decision maker's (DM) indirectly give decision elements, weights, pair-wise comparison is used in several MCDM methods like AHP that require construction of Pairwise Comparisons Judgment Matrices (PCJMs). As we have experienced several views that can be assessed with different angles. The influential member in a system that has more weights. Then, the weights or priority vectors of the decision elements are constructed from the PCJM applying some

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Pairwise Comparisons Prioritization Methods (PCPMs). However, to deal with the uncertainty and vagueness in the DMs' judgments, fuzzy PCJMs are used to obtain the priority vectors applying fuzzy Preference Programming (FPP) model. We are considering the Fuzzy Preference Programming (FPP) method proposed by Mikhailov [5], that do not opt for defuzzification procedures rather considers a linear programming formulation.

Consider a group of k DMs $k = 1, 2, 3, \dots, K$ engaged to assess the decision elements in clusters, criteria, sub-criteria or alternatives. For some fixed preference scales, each DMs evaluates the relative importance of any two elements (η_i, η_j) by providing a ratio of triangular fuzzy judgment \tilde{a}_{ijk} , specifying by how much η_i is preferred/not preferred to η_j for k^{th} decision maker. In a vague environment, suppose that each DM provides a set of ϖ fuzzy comparison judgements: $\tilde{A}^k = [\tilde{a}_{ijk}]$, $\varpi \leq \frac{n(n-1)}{2}$, $i = 1, 2, \dots, (n-1)$, $j = 1, 2, \dots, n$, $k = 1, 2, \dots, K$, $\tilde{a}_{ijk} = (l_{ijk}, m_{ijk}, u_{ijk})$ is a triangular fuzzy number with lower value l_{ijk} , most likely value m_{ijk} and upper value u_{ijk} . Then $\tilde{A}^k = [\tilde{a}_{ijk}]$ can be represented as:

$$\begin{bmatrix} (1,1,1) & (l_{12k}, m_{12k}, u_{12k}) & \dots & (l_{1nk}, m_{1nk}, u_{1nk}) \\ (l_{21k}, m_{21k}, u_{21k}) & (1,1,1) & \dots & (l_{2nk}, m_{2nk}, u_{2nk}) \\ \vdots & \vdots & \ddots & \vdots \\ (l_{n1k}, m_{n1k}, u_{n1k}) & (l_{n2k}, m_{n2k}, u_{n2k}) & \dots & (1,1,1) \end{bmatrix} \quad (1)$$

Then, the fuzzy group prioritisation problem is to determine a crisp priority vector (crisp weights) $w = (w_1, w_2, \dots, w_n)$ from all \tilde{A}^k , $k = 1, 2, \dots, K$, which represents the relative importance of the n decision elements. The non-linear FPP method [4] derived a priority vector $w = (w_1, w_2, \dots, w_n)$, which satisfies:

$$l_{ij} \lesssim \frac{w_i}{w_j} \lesssim u_{ij} \quad (2)$$

where \lesssim denotes 'fuzzy less or equal to'. If M is the overall number of fuzzy group comparison judgments, then $2M$ (M constraints for l_{ij} and M constraints for u_{ij}) fuzzy constraints of the type (3) are obtained as

$$\begin{aligned} -w_i + w_j l_{ij} &\lesssim 0 \\ w_i - w_j u_{ij} &\lesssim 0 \end{aligned} \quad (3)$$

For each fuzzy judgment, a membership function which represents the DMs' satisfaction with different crisp solution ratios, is introduced:

$$\mu_{ij}(w_i/w_j) = \begin{cases} \frac{u_{ij} - (w_i/w_j)}{u_{ij} - m_{ij}}, w_i/w_j \leq m_{ij} \\ \frac{(w_i/w_j) - m_{ij}}{m_{ij} - l_{ij}}, w_i/w_j \geq m_{ij} \end{cases} \quad (4)$$

The solution to the prioritization problem by the FPP method is based on two assumptions. The first, requires existence of non-empty fuzzy feasible area \tilde{P} on $(n-1)$ dimensional simplex $Q^{(n-1)}$

$$Q^{(n-1)} = \{ w = (w_1, w_2, \dots, w_n), w_i > 0, \sum_{i=1}^n w_i = 1 \} \quad (5)$$

The fuzzy feasible area \tilde{P} , defined by intersection of membership functions (4), is given by:

$$\mu_{\tilde{P}} = \left[\text{Min} \{ \mu_1(w), \mu_2(w), \dots, \mu_{2M}(w) \} / \sum_{i=1}^n w_i = 1 \right] \quad (6)$$

The second assumption identifies a selection rule, which determines a priority vector, having the highest degree of membership in the aggregated membership function (6). Thus a new decision variable λ is introduced such that:

$$\begin{aligned} & \text{Max } \lambda \\ & \text{s.t.} \\ & \lambda \leq \mu_{ij} \\ & \sum_{i=1}^n w_i = 1, w_i > 0 \\ & i = 1, 2, \dots, n; j = 1, 2, \dots, n; j > i \end{aligned} \quad (7)$$

The above max-min optimization problem (7) is transformed into following non-linear optimization problem:

$$\begin{aligned} & \text{Max } \lambda \\ & \text{s.t.} \\ & (m_{ij} - l_{ij}) \lambda w_j - w_i + l_{ij} w_j \leq 0 \\ & (u_{ij} - m_{ij}) + w_i - l_{ij} w_j \leq 0 \\ & \sum_{i=1}^n w_i = 1, w_i > 0 \\ & i = 1, 2, \dots, n; j = 1, 2, \dots, n; j > i \end{aligned} \quad (8)$$

Solving (8) we can get the weight vector w for a single decision maker. Thus considering all such DM the problem (8) can be formulated as:

$$\begin{aligned} & \text{Max } \lambda_k \\ & \text{s.t.} \\ & (m_{ijk} - l_{ijk}) \lambda_k w_j - w_i + l_{ijk} w_j \leq 0 \\ & (u_{ijk} - m_{ijk}) + w_i - l_{ijk} w_j \leq 0 \\ & \sum_{i=1}^n w_i = 1, w_i > 0 \\ & i = 1, 2, \dots, n; j = 1, 2, \dots, n; j > i; k = 1, 2, \dots, K \end{aligned} \quad (9)$$

I propose to combine qualitative criteria comparison and quantitative criteria data available. For example, how criterion (1) is influencing criterion (2) by judgement of DMs for a certain alternative at the same time from historical data or experimental result, the numerical value for such combination is available. So we tried to combine the weightage of different criteria for different DMs views and statistical data analysis. Let us consider there are m different alternatives to be ranked on the basis of judgements of K DMs and on the selection of n criteria whose statistical value are $\xi_{ij}, i = 1, 2, \dots, m; j = 1, 2, \dots, n$.

So the quantitative data for different alternatives (A 's) can be put in the following Table I.

B. Ranking through Adjustment (Compromise)

Based on several alternatives and selection criterion, we try to find a feasible solution which is most adjustable and acceptable. The selection criterion ξ_{ij} can be expressed in numerical based on some scale and distance measured by L^p metric space. A normalization process is used and a weight w_i is associated for each alternatives. Opricovic and Tzeng [7] developed an adjustment ranking method known as VIKOR (VIšekriterijumsko KOMPromisno Rangiranje).



The adjusted solution is the closest to the ideal solution and adjustment means an agreement compromised by mutual agreement. In the proposed model an adjustment ranking method is developed by introducing AHP in fuzzy environment in assigning weights of relative importance of attributes and by introducing ranked value judgment on fuzzy conversion scale for the qualitative values of attributes.

$$L_{p,i} = \left[\sum_{j=1}^n \left\{ w_j \frac{(\xi_{ij})_{max} - \xi_{ij}}{(\xi_{ij})_{max} - (\xi_{ij})_{min}} \right\}^p \right]^{\frac{1}{p}} \quad (10)$$

$$1 \leq p < \infty, i = 1, 2, \dots, m$$

Within the VIKOR method $L_{1,i}$ and $L_{\infty,i}$ are used to formulate the ranking measure. The methodology is described in steps given below:

Step-1: Attributes are identified as selection attributes for the given application and then are shortlisted. Take necessary values of criteria ξ_{ij} for each alternative and criteria.

Step-2: Find $(\xi_{ij})_{max}$ and $(\xi_{ij})_{min}$ for a given i , i.e., the best and worst values among the attributes for i^{th} alternative $i = 1, 2, \dots, m$.

Step-3: Select number of experts (DMs). Take opinion about pair wise comparison by asking questionnaire, answer of which will be in logistic terms (Table-III). As these answers contain a certain level of uncertainties and fuzziness, we may scale these answers/ opinions of DM in terms of a triangular fuzzy numbers (TFN). Then we find pairwise comparison matrix of the type (1) and we use FPP method to find weight vector w corresponding to each decision maker.

Step 4: Calculate the values of E_i and F_i .

$$E_i = L_{1,i} = \sum_{j=1}^n \left\{ w_j \frac{(\xi_{ij})_{max} - \xi_{ij}}{(\xi_{ij})_{max} - (\xi_{ij})_{min}} \right\}, i = 1, 2, \dots, m$$

$$F_i = L_{\infty,i} = \text{Max}_j \left\{ w_j \frac{(\xi_{ij})_{max} - \xi_{ij}}{(\xi_{ij})_{max} - (\xi_{ij})_{min}} \right\} i = 1, 2, \dots, m$$

Equation (11) is applicable to beneficial attributes (i.e., whose higher values are desirable). For non-beneficial attributes (i.e., whose lower values are desirable), $[(\xi_{ij})_{max} - \xi_{ij}]$ of (11) will be replaced by $[(\xi_{ij}) - (\xi_{ij})_{min}]$.

Step 5: Calculate the values of P_i

$$P_i = v \frac{(E_i - (E_i)_{min})}{((E_i)_{max} - (E_i)_{min})} + (1-v) \frac{(F_i - (F_i)_{min})}{((F_i)_{max} - (F_i)_{min})}$$

$(E_i)_{max}$, $(F_i)_{max}$ are the corresponding maximum and $(E_i)_{min}$, $(F_i)_{min}$ are the minimum value of E_i and F_i respectively. v is introduced as weight of the strategy of 'the majority of attributes'. Normally, the value of v is taken as 0.5. However, v can take any value from 0 to 1.

Step 6: The alternatives are arranged in the ascending order, with the values of P_i . Adjusting ranking list for given v can

be obtained by ranking with P_i measure. The best alternative, ranked by P_i is the one with the minimum value of P_i .

Step 7: A adjustable solution is proposed and its solution for the alternative (a') which is ranked the best by the measure Q (minimum) if the following two conditions are satisfied:

C1: Acceptable advantage- $Q(a'') - Q(a') \geq DQ$ where (a'') is the alternative with second position in the ranking list by Q ; $DQ = 1 / (J - 1)$; J is the number of alternatives.

C2: Acceptable stability in decision making- Alternative (a') must also be the best ranked by E or/and F . This compromise solution is stable within a decision making process, which could be: "voting by majority rule" (when $v > 0.5$ is needed) or "by consensus" (when $v \approx 0.5$) is needed or "with veto" ($v < 0.5$). Here v is the weight of the decision making strategy "the majority of criteria" (or "the maximum group utility").

Table- I: Quantitative data of criteria

Alternatives	Selection Criteria			
	C_1	C_2	...	C_n
A_1	ξ_{11}	ξ_{12}	...	ξ_{1n}
A_2	ξ_{21}	ξ_{22}	...	ξ_{2n}
.....
A_m	ξ_{m1}	ξ_{m2}	...	ξ_{mn}

Table- II: Scale of Importance on Language (Scale of point 5)

Linguistic Scales of Importance	Abbreviation (11)	Triangular Fuzzy Scale
Important (Equal)	E	(1,1,1)
Important (Moderate)	M	((2,3,4)
Important	I	(4,5,6)
Very Important	V (12)	(6,7,8)
Absolutely Important	A	(9,9,9)

III. NUMERICAL EXAMPLE

A real example investigated to illustrate the applications of the proposed FAHP–VIKOR methodology. In our case study we have chosen 16 Indian PSU Banks: Allahabad Bank, Andhra Bank, Bank of Baroda, Bank of India, Bank of Maharashtra, Canara Bank, Central Bank of India, Corporation Bank, Dena Bank, IDBI Bank, Indian Bank, IOB, Oriental Bank of Commerce, Punjab National Bank, Punjab & Sind Bank, State Bank of India as our study. Several similar economic parameters of the banks can be found such as Market Capitalization, Net Sales, Net Profit, Total Assets, Other Income, Employee Costs, PBDIT, Interest, Tax Paid, Earnings per share (EPS), Investments, Cash & Bank holdings, Debt, Contingencies Liabilities etc. Some or all of these parameters can be selected as to study bank performances.



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By some expert opinion to illustrate our proposed model we have considered five parameters such as Market Capitalization, Net Sales, Net Profit, Total Assets and Other Income of each of these banks. The data analysis of the

information got from the balance sheets of the banks and take help from several financial websites such as www.moneycontrol.com, www.investopedia.com etc.

Table- III: Values of Financial parameters of PSU banks)

Sl. No	Bank Name	Market Cap (Rs.cr)	Net Sales (Rs.cr)	Net Profit (Rs. Cr.)	Total Assets (Rs Cr)	Other Income (Rs Cr)
1	Allahabad Bank	5,625.81	18,746.68	1,172.02	1,97,616.83	2,165.75
2	Andhra Bank	4,239.33	14,297.32	435.58	1,49,861.49	1,332.84
3	Bank of Baroda	37,561.67	38,939.71	4,541.08	4,98,041.09	4,462.74
4	Bank of India	16,563.68	37,910.10	2,729.27	4,72,806.48	4,291.84
5	Bank of Maharashtra	4,273.99	11,956.66	385.97	1,23,793.64	894.19
6	Canara Bank	17,691.58	39,547.61	2,438.19	4,20,189.01	3,932.76
7	Central Bank	8,706.78	24,427.55	1,262.84	2,54,695.80	1,922.58
8	Corporation Bank	5,409.09	17,958.57	561.72	1,98,193.87	1,647.72
9	Dena Bank	3,154.29	9,978.48	551.66	1,12,778.28	916.73
10	IDBI Bank	9,880.37	26,597.51	1,121.40	2,95,005.31	2,978.75
11	Indian Bank	7,163.32	15,249.21	1,158.95	1,65,834.61	1,371.68
12	IOB	7,257.67	22,683.73	601.74	2,42,426.40	2,169.34
13	Oriental Bank	7,398.77	19,017.48	1,139.41	1,96,288.38	1,945.27
14	PNB	33,285.09	43,223.25	3,342.58	4,81,380.93	4,576.71
15	Punjab & Sind	2,170.23	7,972.71	300.63	84,073.24	427.28
16	SBI	1,88,308.13	1,36,350.80	10,891.17	15,19,726.11	18,552.92

Source: www.moneycontrol.com

* Data taken from recent balance sheet for financial year 2013-14.

A number of DMs who can comment on the qualitative questionnaire is taken and decision made by DM1 is given in Table IV.

Table- IV: Decisions given by decision makers on questioning

	C ₁	C ₂	C ₃	C ₄	C ₅
C ₁	E	A	M	A	I
C ₂		E	V	A	E
C ₃			E	I	V
C ₄				E	V
C ₅					E

Since each answer contains a certain level of uncertainties, we use TFNs to scale the answers from the decision makers. We now use (8) to formulate a FPP to find weights w_1, w_2, w_3, w_4, w_5 corresponding to the criteria C_1, C_2, C_3, C_4 and C_5 respectively. The FPP problem on the basis of Table IV and (8) can be written as:

Maximize λ

such that

$$0*\lambda*w_2-1*w_1+9*w_2<=0;$$

$$0*\lambda*w_2+1*w_1-9*w_2<=0;$$

$$1*\lambda*w_3-1*w_1+2*w_3<=0;$$

$$1*1*w_3+1*w_1-4*w_3<=0;$$

$$0*\lambda*w_4-1*w_1+9*w_4<=0;$$

$$0*\lambda*w_4+1*w_1-9*w_4<=0;$$

$$1*\lambda*w_5-1*w_1+4*w_5<=0;$$

$$1*\lambda*w_5+1*w_1-6*w_5<=0;$$

$$1*\lambda*w_3-1*w_2+6*w_3<=0;$$

$$1*\lambda*w_3+1*w_2-8*w_3<=0;$$

$$0*\lambda*w_4-1*w_2+9*w_4<=0;$$

$$0*\lambda*w_4+1*w_2-9*w_4<=0;$$

$$0*\lambda*w_5-1*w_2+1*w_5<=0;$$

$$0*\lambda*w_5+1*w_2-1*w_5<=0;$$

$$1*\lambda*w_4-1*w_3+4*w_4<=0;$$

$$1*\lambda*w_4+1*w_3-6*w_4<=0;$$

$$1*\lambda*w_5-1*w_3+6*w_5<=0;$$

$$1*\lambda*w_5+1*w_3-8*w_5<=0;$$

$$1*\lambda*w_5-1*w_4+6*w_5<=0;$$

$$1*\lambda*w_5+1*w_4-8*w_5<=0;$$

$$w_1+w_2+w_3+w_4+w_5=1;$$

$$w_1>0, w_2>0, w_3>0, w_4>0, w_5>0.$$

Solving the above problem using LINGO software we get the solution as given in Table V and use compromise VIKOR technique to get result in Table VI.



Table- V: Weight for different Criteria

Criteria (C_i)	C_1	C_2	C_3	C_4	C_5
Weight (w_i)	0.529412	0.088235	0.235294	0.058824	0.088235

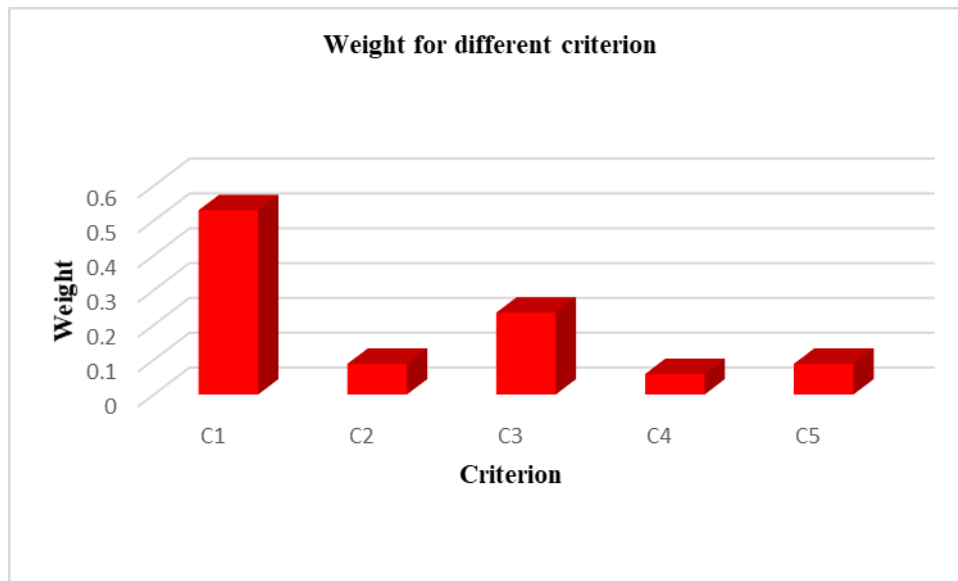


Figure I: Weight for different criterion

Table- VI: Result of the Analysis

Sl. No	Bank Name	E_i		F_i		P_i	
		Value	Rank	Value	Rank	Value	Rank
1	Allahabad Bank	0.950	9	0.520	11	0.966	11
2	Andhra Bank	0.980	13	0.524	14	0.984	13
3	Bank of Baroda	0.747	2	0.429	2	0.779	2
4	Bank of India	0.850	4	0.488	5	0.886	5
5	Bank of Maharashtra	0.985	14	0.523	13	0.987	14
6	Canara Bank	0.856	5	0.485	4	0.885	4
7	Central Bank	0.934	7	0.511	7	0.950	7
8	Corporation Bank	0.968	12	0.520	12	0.975	12
9	Dena Bank	0.987	15	0.527	15	0.991	15
10	IDBI Bank	0.926	6	0.507	6	0.942	6
11	Indian Bank	0.954	11	0.515	10	0.963	9
12	IOB	0.954	10	0.515	9	0.963	10
13	Oriental Bank	0.947	8	0.515	8	0.959	8
14	PNB	0.783	3	0.441	3	0.808	3
15	Punjab & Sind	1.000	16	0.529	16	1.000	16
16	SBI	0.000	1	0.000	1	0.000	1

Based on the ranked obtained in the Table VI, we check the two conditions of Step7 of VIKOR. Here, **SBI (16)** has got first rank with score (0.000) followed by **Bank of Baroda (3)** with second place with score value (0.779). Also number of alternative banks is 16.

$$C1: Q(3) - Q(16) = 0.779 \geq \frac{1}{(16-1)} = 0.066 = DQ$$

C2: Alternative bank (SBI) is also ranked best by both E_i and F_i .

So, the ranking satisfied both the conditions as mentioned in Step 7 of VIKOR

IV. SENSITIVITY ANALYSIS

To measure the influence of expert's risks to the final product ranking, sensitivity analysis is conducted which is shown in Table VII, for various values of ranging from 0 to 1. The results shown that concept SBI (16) has a maximum priority at all the situations.



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When, there is a change in position of Andhra Bank (2) and Bank of Maharashtra (5), otherwise, the final ranking is obtained in Table VI. Obviously, Andhra Bank (2) and Bank of Maharashtra (5), are dependent of the risk preferences of DM's.

Table VII. Rank of the alternatives for different scenarios of weight criteria.

Alternative	Ranking of the alternatives by scenario									
	A	B	C	D	E	F	G	H	I	J
Allahabad Bank	11	11	11	11	11	11	11	11	11	11
Andhra Bank	14	13	13	13	13	13	13	13	13	13
Bank of Baroda	2	2	2	2	2	2	2	2	2	2
Bank of India	5	5	5	5	5	5	5	5	5	5
Bank of Maharashtra	13	14	14	14	14	14	14	14	14	14
Canara Bank	4	4	4	4	4	4	4	4	4	4
Central Bank	7	7	7	7	7	7	7	7	7	7
Corporation Bank	12	12	12	12	12	12	12	12	12	12
Dena Bank	15	15	15	15	15	15	15	15	15	15
IDBI Bank	6	6	6	6	6	6	6	6	6	6
Indian Bank	10	10	10	10	10	10	10	10	10	10
IOB	9	9	9	9	9	9	9	9	9	9
Oriental Bank	8	8	8	8	8	8	8	8	8	8
PNB	3	3	3	3	3	3	3	3	3	3
Punjab & Sind	16	16	16	16	16	16	16	16	16	16
SBI	1	1	1	1	1	1	1	1	1	1

V. RESULT AND DISCUSSION

The main objective of this paper is to propose comprehensive model using fuzzy VIKOR and AHP based fuzzy preference programming to develop a more accurate selection methodology. The model presented in this model has in the first place been developed with the purpose to compare (rank) the Indian PSU Banks based on which people will buy banking stocks. But when the number of criteria is increased, the process of personnel selection will be very complicated, but this MCDM model is easy to handle and respond more quickly.

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