Malaya Journal of Matematik, Vol. 9, No. 1, 251-255, 2021

https://doi.org/10.26637/MJM0901/0041

Determination of fridge from the selected brand using multi criteria fuzzy decision making

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Abstract

Decision making is an important aspect of our life to decide a selection of object with suitable choice.Every decision should be made over the particularfield such as a selection of fridge, washing machine, Air conditioner, etc., Effective decision have been suggested under the category of Multiple Criteria Decision Making. This paper presents a selection of fridge with suitable brand and this selection must be preferred by using Analytic Hierarchical Process (AHP). A technique for complex decision making used for large scale multi criteria decision analysis. AHP converts comparative evaluations to numerical values that can be processed under the weighted with primary vectors over the entire range of the problem. A numerical weight or priority is derived for each element of the hierarchy for the criteria and alternatives often incommensurable elements to be compared to one another in a rational and consistent way.A relationship between criteria and alternatives should be selected, with the types of fridge and its characteristic respectively. The problem is to determine the best alternative as characteristic of fridge with calculated rank using AHP.

Keywords

Multi Criteria Decision Making, pair wise comparison matrices, fridge with characteristic, criteria and alternatives.

AMS Subject Classification

03B72.

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Article History: Received **17** October **2020**; Accepted **13** January **2021**

Contents

1. Introduction

Decision makers take decisions from the priorities on set of alternatives based on a set of criteria called Multiple Criteria Decision Making(MCDM). It plays a important role in many real life problem. Each criterion induces a particular ordering of the alternatives and we need a procedure by which to construct one overall preference ordering. The number of criteria in MCDM is always assumed to be finite and we assume that the number of alternatives is also finite. A decision should also consider issues such as cost, performance characteristics, availability of software, maintenance expendability, etc. These may be some of the decision criteria for particular problems. In such problems we are interested in determining the best alternative. In some other situation, however, one may be interested in determining the relative importance of all the alternatives under consideration.

The AHP combines the criteria weights and the alternatives scores, thus determining a global score for each alternative. The global score for given alternative is a weighted sum of the scores it obtained with respect to all the criteria. Thus we have ranking for a set of objectives. Data are collected from decision-makers corresponding to hierarchical structure in the pairwise comparison of criteria and alternatives on a scale of relative importance(weighted)as described below table[1].

2. Main Result

In order to compute the weights for the different criteria, we start creating a pairwise comparison matrix A. The matrix A is a $n\times n$ real matrix, where n is the number of criteria for considered problem. Each entry a i i of the matrix A represents the importance of the ith criterion, relative to the j^{th} criterion. If $a_{ii}>1$, then the ith criterion is more important

Table 1. Scale of relative importance.

Importance	Definition
1	Equally important
3	Moderately importance
5	Strong importance
7	Very strong and proven importance
9	Extreme importance
2,4,6,8	Inter-values
Reciprocals of above nonzero	If activity I has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.

than the j^{th} criterion. while if $a_{ii} < 1$, then the ith criterion is less important than the jth criterion. If two criteria have the same importance, then the entry a_{ij} is 1. The entries a_{ij} and a $_{ii}$ satisfy the following constraint:

$$a_{ij} \cdot a_{ji} = 1$$

The procedure for obtaining the following values of the criterion is as follows: In the AHP the pairwise comparison matrix is considered to adequately consistent if the corresponding consistency ratio (CR) is less than 10% (saaty, 1980). This yields an approximation of the maximum eigenvalue, denoted by λ. Then, the CI value is calculated by using the formula: $CI = (\lambda - n)/(n-1)$.Next the consistency ratio CR is obtained by dividing the CI value by the Random consistency index (RCI) as given in table[2] (i.e) $CR = CI/RCI$. If $CR > 0.10$, we must reevaluate the pairwise comparison for the criterion.

Table 2. RCI values for different values of N

N	1	2	3	4	5	6	7	8	9
RCI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Every decision should be made over the particular field such as a selection of fridge, washing machine, Air conditioner, etc.....Effective decision have been suggested under the category of Multiple Criteria Decision Making. This paper presents a selection of fridge with suitable brand and this selection must be preferred by using Analytic Hierarchical Process (AHP). A technique for complex decision making used for large scale multi criteria decision analysis. AHP converts comparative evaluations to numerical values that can be processed under the weighted with primary vectors over the entire range of the problem. A numerical weight or priority is derived for each element of the hierarchy for the criteria and alternatives often incommensurable elements to be compared to one another in a rational and consistent way. A relationship between criteria and alternatives should be selected, with the types of fridge and its characteristic respectively. The problem is to determine the best alternative as characteristic of fridge with calculated rank using AHP.

A large number of research papers and articles were studied and analyzed specifically in knowing to how AHP as decision making tool have been used and applied in recent times. As can be seen the literature review focuses on the latest work and application of AHP especially post (2000). Boucher, T.O. and McStratic, E.L. (1991). Multiattribute Evaluation within a Present Value Frame work and its Relation to the analytic Hierarchy Process. The Engineering Economist,[1]. Andries van der Merwew NinhamShand (pty) Ltd: Ideal Mode Analytic Hierarchy Process Pairwise Comparison Model [2].

In the application of electrical and electronic media, we select various brands of fridges. In which we choose a best and economical among the brands in various companies like brand A, brand B, brand C, and brand D as criteria for that models we construct the pair wise comparison matrix for this criteria. These brands must be selected with the preferences using,

Capacity $\rightarrow$ X, Frost Free as $\rightarrow$ Y, Energy Rating as $\rightarrow$ W, Price as $\rightarrow$ Z.

As alternatives for the selection with qualitative and quantitative characters using the pair wise comparison matrices. The selection for the brands of the fridge in the hierarchical order with following diagram.

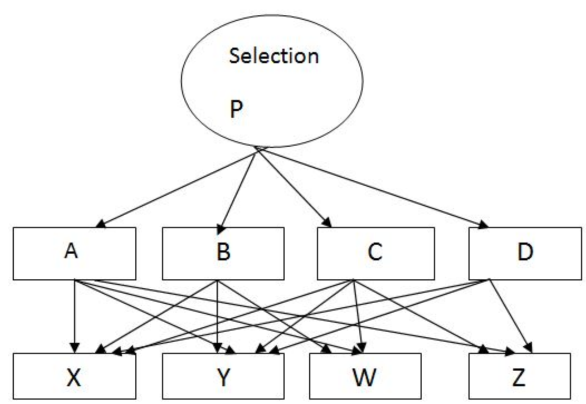

Figure 1

Construct the pairwise comparison matrix for the alternatives A, B, C, D, with respect to selection criterion P and obtain the cube of that pairwise comparison matrix for the alternatives A,B,C,D. whose priority vectors are also got and λ, CI and CR are evaluated. The corresponding matrices are given in Table 3 and Table 4.

Table 4. Cube of the matrix for above comparison matrix.

CRITERIA	A	B	C	D	ROW SUM	NORMALIZED VALUES
A	17.9166	13.8332	28.3332	8.4721	68.5539	0.1807
B	25.8327	20.8327	41.3324	12.9163	100.2195	0.2643
C	12.2220	9.1664	19.3051	5.4999	46.1934	0.1218
D	42.2220	30.8324	69.996	20.552	164.2121	0.4330
TOTAL					379.1802	1.0000

Table 5. Pairwise comparison matrix for the alternatives X, Y, W, and Z, with respect to brand A using the AHP CGI scale.

A	X	Y	W	Z	Priority vectors
X	1	1 / 3	2	1 / 2	0.1530
Y	3	1	3	5	0.5426
W	1 / 2	1 / 3	1	1 / 2	0.1092
Z	2	1 / 5	2	1	0.1950

Maximum Eigen value =4.2471, C.I value =0.0823

Table 6. Cube of the above matrix for above comparisons matrix.

B	X	Y	W	Z	ROW SUM	NORMALIZED VALUES
X	21.3326	6.3990	28.3325	20.3308	76.3949	0.1324
Y	93.4994	28.7651	94.9992	97.7490	315.0127	0.5461
W	20.8323	5.2327	24.8326	16.8323	67.7299	0.1174
Z	28.4996	9.0659	38.3996	41.6660	117.6311	0.2039
TOTAL					576.7686	1.0000

Table 7. Pairwise comparisons matrix for the alternatives X, Y, W, and Z with respect to B using the AHP CGI scale.

B	X	Y	W	Z	Priority vectors
X	1	1 / 2	6	1 / 2	0.2392
Y	2	1	3	2	0.3918
W	1 / 6	1 / 3	1	1 / 4	0.0741
Z	2	1 / 2	4	1	0.2947

Maximum Eigen value=4.2937, C.I value =0.0979

Table 8. Cube of the above matrix for above comparison matrix.

C	X	Y	W	Z	*ROW SUM*	NORMALIZED VALUES
X	20.0779	12.1639	63.2254	15.8756	111.3398	0.2391
Y	32.3274	19.7905	111.9982	24.4995	188.6156	0.4051
W	6.5815	3.8827	21.6145	9.9982	36.5890	0.0785
Z	21.9147	14.3323	70.4980	123.4948	123.4948	0.2652
TOTAL					465.5271	1.0000

Table 9. Pairwise comparisons matrix for the alternatives X, Y, W, and Z with respect to C using the AHP CGI scale.

C	X	Y	W	Z	Priority vectors
X	1	1 / 3	3	1 / 2	0.1591
Y	3	1	6	1 / 2	0.3274
W	1 / 3	1 / 6	1	1 / 9	0.0512
Z	2	2	9	1	0.4621

Maximum Eigen value =4.1136C.I value =0.0378

Table 3. Pair wise comparison matrix for the brands A, B, C, and D using appropriate value scale and using the AHP CGI evaluation.

CRITERIA	A	B	C	D	Priority vectors
A	1	1 / 2	2	1 / 2	0.1610
B	2	1	3	1 / 3	0.2576
C	1 / 2	1 / 3	1	1 / 2	0.1215
D	2	3	2	1	0.4597

Maximum Eigen value =4.2605, C.I value =0.0868

Table 10. Cube of the above vectors for above comparisons matrix.

C	X	Y	W	Z	*ROW SUM*	NORMALIZED VALUES
X	19.6649	10.0817	55.4976	6.8716	92.1158	0.1759
Y	35.8315	17.5827	104.9976	12.4439	170.8557	0.3262
W	17.4661	6.6731	44.4823	5.3981	74.0196	0.1413
Z	34.8847	18.9619	112.9887	19.2204	186.0557	0.3553
TOTAL					523.6468	1.0000

Table 11. Pairwise comparisons matrix for the alternatives X, Y, W, andZ with respect to D using the AHP CGI scale.

	X	Y	W	Z	Priority vectors
X	1	1 / 3	2	1 / 9	0.0929
Y	3	1	5	1 / 2	0.2846
W	1 / 2	1 / 5	1	1 / 5	0.0680
Z	9	2	5	1	0.5544

Maximum Eigen value =4.1245, C.I value =0.0415

Table 12. Cube of the above matrix for above comparisons matrix.

D	X	Y	W	Z	*ROW SUM*	NORMALISED VALUES
X	59.9613	26.9451	73.7429	24.5039	185.1532	0.1650
Y	40.2437	36.0214	82.8328	27.2551	177.3530	0.1580
W	15.3747	4.3830	200.9900	6.0823	226.8300	0.2021
Z	195.488	52.4302	226.5867	57.9868	532.4917	0.4746
TOTAL					1121.8279	1.0000

Table 13. Original AHP decision matrix with weights.

CRITERIA	A	B	C	D
ALTERNATIVE	0.1807	0.2643	0.1218	0.4330
X	0.1306	0.2309	0.1644	0.1933
Y	0.5358	0.3894	0.3236	0.2443
W	0.1102	0.0671	0.1046	0.0487
Z	0.1774	0.3036	0.4073	0.5134

Table 14. Find AHP decision matrix.

CRITERIA	A	B	C	D	ROW	NORMALISED
ALTERNATIVE					SUM	VALUES
X	0.0235	0.0160	0.0200	0.0836	0.1432	0.1518
Y	0.0966	0.1029	0.0394	0.1057	0.3446	0.3653
W	0.0199	0.0177	0.0127	0.0210	0.0713	0.0755
Z	0.0320	0.0802	0.0496	0.2223	0.3841	0.4072
TOTAL					0.9432	1.0000

Construct the pairwise comparison matrix for the alternatives A, B, C, D, with respect to selection criterion P and obtain the cube of that pairwise comparison matrix for the alternatives A,B,C,D. whose priority vectors are also got and λ, CI and CR are evaluated. The corresponding matrices are given in Table 5 and Table 6.

Construct the pairwise comparison matrix for the alternatives X, Y, W, Z with respect to criterion A. Obtain the priority vector are also got a λ, CI and CR are evaluated.Pairwise comparison matrix for the alternatives X, Y, W, and Z, with respect to brand B using the AHP CGI scale. (See Table 7 and Table 8.)

Construct the pairwise comparison matrix for the alternatives A, B, C, D, with respect to selection criterion P and obtain the cube of that pairwise comparison matrix for the alternatives A, B, C, D. whose priority vectors are also got and λ, CI and CR are evaluated. The corresponding matrices are given in Table 9 and Table 10.

Construct the pairwise comparison matrix for the alternatives A, B, C, D, with respect to selection criterion P and obtain the cube of that pairwise comparison matrix for the alternatives A, B, C, D, whose priority vectors are also got and λ, CI and CR are evaluated. The corresponding matrices are given in Table 11, Table 12, Table 13 and Table 14.

3. Conclusion

From the above table brand must be selected according to the preference of the characteristic of fridge. From this rule, brand can be selected with preference of the price of the fridge, next the brand can be selected with preference of frost free of the fridge, then the brand can be selected with preference of capacity of the fridge and finally the brand can be selected with preference of energy rating. From the above preference the brand D must be selected first, the brand B, next and then A finally a brand C can be selected with last using that preference.

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ISSN(P):2319 − 3786

Malaya Journal of Matematik

ISSN(O):2321 − 5666

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