MCDM: A Case Study for Selecting College for Admission

Arman Rasool Faridi*

Department of Computer Science, Aligarh Muslim University, Aligarh

Abstract – Humans & systems make multiple decisions in everyday life. Often these decision consists of a lot of criteria in which some criteria are conflicting. Multi-criteria decision making (MCDM) technique was devised to tackle these types of problems i.e. decisions having conflicting criteria. In this paper, Simple Additive Weighting (SAW), one of the MCDM technique, is used to solve the problem which is faced by every students due to their extensive search of a desirable college. A related case study has been discussed, experimental results and conclusions of the findings are provided at the end of the paper.

Keywords: SAW Technique, MCDM, Decision Making, Planning

----------♦----------

INTRODUCTION

Critical and non-critical decisions are continuously being made by humans, business, organisations, governments, civil societies, supply chain systems, logistics & inventory systems, engineering, manufacturing, resource management systems, environmental systems etc. Every decisions have many criteria to decide upon, in which some criteria may overlap other criteria. When criteria are overlapping, they are called as conflicting criteria. Decisions which have conflicting criteria are the most difficult to resolve. Multi-criteria decision making (MCDM) techniques were developed to resolve these types of decisions. MCDM techniques can calculate the impact of different conflicting criteria when they are subject to a change and then assess the effective desired option to counter the negative consequence associated with the decision. Different MCDM techniques are useful in different types of scenarios. Some of the most used MCDM techniques are: SAW [1, 2], TOPSIS [3], AHP [4], SMART [5], ELECTRE [6], MAXMIN, etc. Researchers have extensively studied upon the different MCDM technique [7, 8, 9, 10] and they conclusively found that SAW, TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) and ELECTRE (Elimination and Choice Expressing reality) are the most effective technique which gives optimized solutions.

SAW is based on multi-attribute value method. In this, a value function is generated based on a simple addition of outcomes that represent the realization of the goal under each criterion, multiplied by their corresponding particular weights. A one dimensional value function $v_k(f(a_n))$ is created which consists of interval of values between [0, 1] by normalizing the outcomes where best outcome gets utility value of $v_k = 1$ and the worst outcome gets $v_k = 0$. The mathematical representation of SAW can be given as:

$$\mathrm{v}(a_n) = \frac{1}{N}\sum_{k=1}^{k} w_k . v_k\left(f_k(a_n)\right)$$

$$\text{with } w_k \geq 0 \text{ and } \sum_{k=1}^{k} w_k = 1$$

where w_k denotes the weight assigned to the criterion k. k means the total number of considered criteria.

$$f_k(a_n) \rightarrow \max,$$

$$v_k\left(f_k(a_n)\right) = \frac{f_k(a_n) - \min\left(f_k(a_n)\right)}{max\left(f_k(a_n) - \min\left(f_k(a_n)\right)\right)}$$

As can be seen from above, the higher the sum of the weighted values, the better is the alternative. SAW method also allows to adjust the criteria according to the decision makers need. Since it is basically addition of weighted value, it is very intuitive for the decision makers.

CRITERIA FOR COLLEGE SELECTION

The biggest worry for any student after passing school is to get his/her admission in the best available college. There are lots of options for selecting college such as:

Distance of college from home: This is required to assess whether it will be economically feasible to commute the college daily or one's ability to visit home in vacations. Though it is an important criterion but it has small impact in the decision making.

Total admission expense for the desired course: A student generally tries to apply in such colleges that he/she can easily financially afford. Though they can opt for colleges which may cost higher but provide lots of good features for the students. Students can also apply for scholarships or education loans to attend their desired college. This factor is important and has a balanced impact on the decision making.

Accommodation options available and its cost: Students from outer states or even outer districts needs good accommodation for living. Some colleges provide hostels inside campus whereas other colleges may suggest you to take room outside the college. It is an important criterion but it has somewhat less impact than others in the decision making.

Quality of faculty available in the college: Students prefers admission in college which have better faculty even if they cost slightly higher. A good teacher can successfully guide his/her students in the right direction. So this criterion has a large impact in decision making.

Number of students studying in the same course: Students generally avoid colleges which have lots of students as the teacher is not able to provide ample amount of time to each student in classroom. Sometimes students may not be able to ask their queries due to teacher's differential focus on large number of students. So it has a high impact on decision making.

Quality of food available or presence of college dining facilities: For the resident students of the college, good food is a huge deal breaker. So this criterion is important and has high impact on decision making.

On-campus placement record of the college and the course: The overall goal of a student is to get placed in a job after college. Generally colleges are expensive around the world and students attend these college solely to build their career and to get a decent stable job. Hence this criterion plays an important role in a student's decision making.

College Infrastructure: Students often opt for college which has better infrastructure compared to their alternatives. Libraries, Learning tools & facilities, availability of sports complex & activities and recreational areas are some infrastructure requirements for any student.

Table 1: Decision Matrix for college selection

Criteria / College	Distance (in kms)	Enrolled Students	Total Fees (in lacs)	Academics (Scale 1 to 5)	Placement (Scale 1 to 5)	Quality of food (Scale 1 to 5)
1	200	1000	2.5	4	3	2
2	250	6500	1	5	4	1
3	50	2500	1.45	3	3	5
4	10	16000	3.5	2	2	4
5	2	24000	2.75	1	4	3
6	1200	3000	0.5	4	5	2

Application of SAW for college selection

For implementing SAW first a decision matrix is created. In this case, the decision matrix consists of six different colleges namely college 1, college 2, college 3, college 4, college 5, and college 6. Each college has six criteria: Distance of college from home, Number of students studying in the same course, Total admission expense for the desired course, Quality of faculty available in the college, On-campus placement record of the college & the course and finally the Quality of food available or presence of college dining facilities. The value associated with each criteria is already mentioned in table 1. Weights of each criterion is determined and mentioned in figure 1.

	1	2	3	4	5	6
1	0.1000	0.0500	0.2500	0.2500	0.3000	0.0500

Fig 1: Weights associated with each criterion

Finally the criterion weight matrix is created by approximating whether the given criterion carries higher impact to emphasize its need in the decision making. Its values are shown in figure 2.

	1	2	3	4	5	6
1	0	1	0	1	1	1

Fig 2: Criterion Weights

MATLAB CODE

```
1  function SAW(X,W,Wcriteria)
2  Xval=length(X(:,1));
3  for i=1:Xval
4  for j= 1:length(W)
5  if Wcriteria(1,j)== 0
```

```
6   Y(i,j)=min(X(:,j))/X(i,j);
7   else
8   Y(i,j)=X(i,j)/max(X(:,j));
9   end
10  end
11  end
12  for i=1:Xval
13  PWSM(i,1)=sum(Y(i,:).*W);
14  end
15  [~, p]=sort(PWSM,'descend');
16  rank = 1:length(PWSM);
17  rank(p)=rank;
18  disp(PWSM);
19  disp(['Ranks are :']);
20  disp(rank);
21  end
```

Output

SAW $(v_k(f_k(a_n)))$

1	2	3	4	5	6
0.4531	0.6393	0.4754	0.3490	0.5155	0.7764

Rank Matrix

Col 1	Col 2	Col 3	Col 4	Col 5	Col 6
5	2	4	6	3	1

RESULTS

After applying SAW finally the rank matrix is obtained. The rank matrix assigns ranks to each college where college having rank 1 is the best among all college following to the rank 6 college which is the worst as per the given criteria and their respective weights assigned. The rank matrix arranges the college in to the following order:

College 6 > College 2 > College 5 > College 3 > College 1 > College 4

According to the order described by the rank Matrix College 6 is turn out to be the best college for the student whereas College 4 is the worst as per the criteria described and the weights of those criteria are defined.

CONCLUSION

SAW is a very simple algorithm. Its ability to allow slight adjustment to a criteria value & weights helps decision maker in deriving the optimum value for their decisions. A decision maker can very easily add or remove criteria to get better results. In scenarios like college selection, SAW algorithms efficiently gives optimal results.

REFERENCES

1. Qin, X. S., Huang, G. H., Chakma, A., Nie, X. H., & Lin, Q. G. (2008). A MCDM-based expert system for climate-change impact assessment and adaptation planning–A case study for the Georgia Basin, Canada. Expert Systems with Applications, 34(3), pp. 2164-2179.

2. Afshari, A., Mojahed, M., & Yusuff, R. M. (2010). Simple additive weighting approach to personnel selection problem. International Journal of Innovation, Management and Technology, 1(5), pp. 511.

3. Opricovic, S., & Tzeng, G. H. (2004). Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS. European journal of operational research, 156(2), pp. 445-455.

4. Lee, G. K., & Chan, E. H. (2008). The analytic hierarchy process (AHP) approach for assessment of urban renewal proposals. Social indicators research, 89(1), pp. 155-168.

5. Chou, S. Y., & Chang, Y. H. (2008). A decision support system for supplier selection based on a strategy-aligned fuzzy SMART approach. Expert systems with applications, 34(4), pp. 2241-2253.

6. Roy, B. (1968). Classement et choix en présence de points de vue multiples. Revue française d'informatique et de recherche opérationnelle, 2(8), pp. 57-75.

7. Simanaviciene, R., & Ustinovichius, L. (2010). Sensitivity analysis for multiple criteria decision making methods: TOPSIS and SAW. Procedia-Social and Behavioral Sciences, 2(6), pp. 7743-7744.

8. Chiang, Z. (2009, April). Developing an online finanical decision support module based on fuzzy mcdm method and open source tools. In 2009 International Conference on Information and Financial Engineering (pp. 22-26). IEEE.

9. Lee, C. C., Chiang, C., & Tzeng, G. H. (2009, December). The evaluation of travel website service quality by fuzzy MCDM. In Proceedings of 17th Fuzzy Theory and Its Applications Symposium, Kaohsiung City, Taiwan (pp. 18-19).

10. Huang, C. Y., Hung, M. C., Jhu, T. L., & Tzeng, G. H. (2010, July). Selecting a CMOS sensor by using a fuzzy MCDM framework. In 2010 International

Conference on System Science and Engineering (pp. 119-123). IEEE.

Corresponding Author

Arman Rasool Faridi*

Department of Computer Science, Aligarh Muslim University, Aligarh

arman.faridi@gmail.com