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Application of Topsis in Hostel Allotment Process

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ABSTRACT

Multi-Criteria Decision Making (MCDM) has found a lot of use in everyday life. TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) is one of the MCDM technique which aims to find the optimal solution by finding a solution which is nearest to the ideal solution and is farthest from the negative ideal solution. This paper demonstrates TOPSIS taking a case study of hostel allocation. There are lots of criteria by which hostel allocation can be done to a student. These criteria conflict with each other and to take better decision TOPSIS has been used for decision making.

Keywords: TOPSIS Technique, MCDM, Decision Making, Planning

INTRODUCTION

Multi-Criteria Decision Making is very popular since its inception. Its popularity is due to the ubiquitous requirement of optimal decision making in every aspect of human life & activities where there are often conflicting criteria in selecting alternatives. Its use can be found in managing businesses and marketing, government decision making, student looking for colleges, colleges wanting to sort students based on some criteria, Supply chain management and logistics, engineering, manufacturing systems, environmental, human resources, and water resources management etc. SAW [1, 2], AHP [3], TOPSIS [4, 7], SMART [5], ELECTRE [6], etc. are some of the most used MCDM technique. Different techniques of MCDM are used depending upon the nature of the problem presented i.e. selection, ranking or ordering.

TOPSIS is one of the MCDM technique which was developed in 1981 by Yoon and Hwang. Classical TOPSIS technique requires information, numerical attributes of criteria to be evaluated for analysis and then the solution is derived by selecting and prioritizing criteria based on their relative weights. TOPSIS selects alternative which is nearer to the ideal solution but farthest from the negative ideal solution. An ideal alternative will be one with minimum cost criteria and maximum benefit criteria whereas a negative ideal alternative will have minimum benefit criteria and maximum cost criteria.

In TOPSIS algorithm process, first the decision matrix is created with the satisfaction value of each criteria of each alternative as well as their weights. Then matrix is normalized to allow comparison between dimensional attributes and non-dimensional attributes. Normalization can be performed by any standardized formulas. Then the weighted normalized decision matrix is calculated by multiplying weight with values in normalized matrix. Then the positive ideal and the negative ideal solutions are identified using which separation distance are calculate for each value. At last the relative closeness to the positive ideal solution is calculated and the alternative closes to 1 is determined as optimal

solution.

USE CASE

MCDM can be used in government offices, industries, Universities, personal decision making etc. In this paper an example of hostel allocation has been considered to allocate room to students based on the rank they get from TOPSIS.

Here the criteria includes previous education of a student, number of years for which he is enrolled in the concerned institution, whether he/she has received any award from the concerned institution or any other institution, whether he/she is involved in extracurricular activities, whether he/she is receiving any fellowship/scholarship and finally annual family income of the family.

Education may include diploma, graduate, post graduate, PhD or post doc. To convert these to numerical value form, value 1 has been assigned to diploma or certificate course, 2 to graduate, 3 to post graduate, 4 to PhD and 5 to post doc. Also 25% weight is assigned and criterion is 1 i.e. more the value better it is. Number of years of course is a quantitative value, 15% is the weight assigned to it and criterion 1. Award received means total number of awards received by the student, 10% is the weight assigned to it and criterion 1. Extracurricular activities include number of years of experience is extra activities like NCC, acting, sports etc. This is also a quantitative value and the weight assigned to it is 10% and criterion 1. If he/she is receiving any fellowship or scholarship then amount per year will be a one criterion and 10% is the weight assigned to it and criterion 0. Family income will be per annum and it will be quantitative value, hence 30% is the weight

Table 1: Criterion and weightage for our case study assigned to it and criterion 0 i.e. poor will be preferred.

Criterion	Weightage (in %)
Education	25
Duration of course in Years	15
Total Award Received	10
Experience in extracurricular activities	10
Fellowship/Scholarship amount	10
Annual Income	30

IMPLEMENTATION DETAILS

We have to convert the given details to matrix form for different students. As shown below, columns represent criterion, i.e., Education, Duration of course in Years, Total Award Received, Experience in extracurricular activities, Fellowship/Scholarship amount, Annual Income respectively. Similarly, rows represent different students. Here below is our decision matrix:

	1	2	3	4	5	6
1	3	3	0	4	0	300000
2	3	4	2	2	0	400000
3	4	2	3	3	0	250000
4	6	2	1	0	50000	320000
5	4	3	4	5	0	100000
6	5	5	1	1	30000	450000

Weights for each criterion are shown below:

	1	2	3	4	5	6
1	0.2500	0.1500	0.1000	0.1000	0.1000	0.3000

Similarly weight criterion is shown below:

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

MATLAB Function:

```
function Topsis(X,W,Wcriteria)
Xval=length(X(:,1));
Y = zeros([Xval,length(W)]);
%% calculating the normalized matrix
for j=1:length(W)
    for i=1:Xval
        Y(i,j)=X(i,j)/sqrt(sum((X(:,j).^2)));
    end
end
Normalized_Matrix = num2str([Y]);
disp('Normalised Matrix')
disp(Normalized_Matrix)
%% calculating the weighted mormalized matrix
for j=1:length(W)
    for i=1:Xval
        Yw(i,j)=Y(i,j).*W(j);
    end
end
Weighted_Normalized_Matrix = num2str([Yw]);
disp('Weighted Normalized Matrix')
disp(Weighted_Normalized_Matrix)
%% calculating the positive and negative best
```

```
for j=1:length(W)
    if Wcriteria(1,j)== 0
        Vp(1,j)= min(Yw(:,j));
        Vn(1,j)= max(Yw(:,j));
    else
        Vp(1,j)= max(Yw(:,j));
        Vn(1,j)= min(Yw(:,j));
    end
end
 Positive_best = num2str([Vp]);
 Negative_best = num2str([Vn]);
disp('Positive best')
disp(Positive_best)

disp('Negative best')
disp(Negative_best)
%% Euclidean distance from Ideal Best and Worst
for j=1:length(W)
    for i=1:Xval
        Sp(i,j)=((Yw(i,j)-Vp(j)).^2);
        Sn(i,j)=((Yw(i,j)-Vn(j)).^2);
    end
end

for i=1:Xval
    Splus(i)=sqrt(sum(Sp(i,:)));
    Snegative(i)=sqrt(sum(Sn(i,:)));
end
%% calculating the performance score
P=zeros(Xval,1);
for i=1:Xval
```

```
    P(i)=Snegative(i)/(Splus(i)+Snegative(i));
end
Performance_Score =  num2str(P);
[~, p]=sort(P,'descend');
rank = 1:length(P);
rank(p)=rank;
disp('Score : ');
disp( P.');
disp('Ranks are :');
disp(rank);
```

EXECUTION

```
>> Topsis(X,W,WCriterion)
```

OUTPUT

```
Normalised Matrix
0.28475     0.36651           0     0.53936           0     0.37875
0.28475     0.48868     0.35921     0.26968           0       0.505
0.37966     0.24434     0.53882     0.40452           0     0.31562
0.56949     0.24434     0.17961           0     0.85749       0.404
0.37966     0.36651     0.71842      0.6742           0     0.12625
0.47458     0.61085     0.17961     0.13484      0.5145     0.56812
Weighted Normalized Matrix
0.071187    0.054976           0    0.053936           0     0.11362
0.071187    0.073302    0.035921    0.026968           0      0.1515
0.094916    0.036651    0.053882    0.040452           0    0.094687
 0.14237    0.036651    0.017961           0    0.085749      0.1212
0.094916    0.054976    0.071842     0.06742           0    0.037875
 0.11864    0.091627    0.017961    0.013484     0.05145     0.17044
Positive best
0.14237    0.091627    0.071842     0.06742           0    0.037875
Negative best
0.071187    0.036651           0           0    0.085749     0.17044
Score :
    0.4706    0.4193    0.5798    0.3597    0.7587    0.3384

Ranks are :
     3     4     2     5     1     6
```

RESULTS

Finally, a rank of every student has been obtained. Higher the rank higher will be the chances of allocation the room to that student. So according to experimental result Student 5 will get room first then student 3 then Student 1 then Student

2 then Student 4 and finally the Student 6.

CONCLUSION

By using TOPSIS in this case, it is found that which student is a better choice for the allocation of available hostel room. Code is implemented in MATLAB where criteria, their corresponding weights, and students can be easily modified, and still, results can be obtained efficiently.

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