

Multi-Criteria Decision Making and Applications

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Week 09

Lecture 42

Welcome back my dear friends, very good morning, good afternoon, good evening to all of you who are watching this set of videos. The course title is multi criteria decision making which is a NPTEL MOOC course spread over 12 weeks which consists of 60 lectures. And as you know each week there are 5 lectures each for half an hour and as the norm is after each week we have assignments that is there are 12 assignments and obviously there is one final examination. And my good name is Raghunandan Sengupta from the IME department at IIT Kanpur. This is the 42nd lecture that means we are in the 9th week and if you can see this slide obviously the broader points still continues to be the same. The main umbrella point or set of points is multi criteria decision making under the other one which was multi objective we have discussed.

Now we this is the third week we are third class sorry we are considering the concepts of multi attribute concepts or the decisions where more qualitative and subjective concepts come to in the picture. Now if you remember we were discussing about the Topsis method and the idea of putting the criteria's what were the values. If you remember I did use the word there as a hypothetical example. Now the answer may change say for example, the decision based on buying a car and considering the set of number of cars which are there in front of me may be same as they are in front of any one of you who is going to take a decision.

But the way we both individually will try to analyze the weightages as well as the overall importance of say for example, one criteria safety or consider the color or consider the price or consider the maintenance they would be different from different persons. The criteria is even the same the overall importance over the way you look over the amount of value which you accrue and add up to the criteria corresponding to the alternatives would definitely change. Somebody say for example, likes a German engineering car because they are very sturdy, very safe. So, obviously for him or her safety features for a German car would be much more than say for example, for any other type of make of car from any other country. Or somebody say for example, he or she wants to buy only Indian car because Indian cars are quite good some of them are really good.

So, in that case any Indian car depending on the importance he or she wants to place on the safety features, price, maintenance cost, mileage would differ. So, there is no absolute right, absolute wrong in trying to analyze the answers that is point one. Point number two if you remember we have put weights and in the last problem both in buying the house as well in the excel sheet we were doing I was mentioning the total weight should add up to one which is the criteria's importance. But what importance you or me place on the criteria say for example, for the case when we are planning to buy a car may differ. So, say for example, again I am trying to highlight in the same example for me safety features is important.

Mileage is important, cost is fine because even if I get a very safe car a little bit costly I am fine, mileage is good a little bit costly is fine. But say for example, for some other person who is also going to make a decision of buying the car he or she would basically think on the cost. So, there is nothing as I said sacrosanct absolute truth. So, based on that the analysis are is being done. And this the ideas which we I am talking about, about TOPSIS and how you give the weights, how you give the utilities, how you do the normalization would more or less remain the same only the way trying to analyze the problems for the TOPSIS method, Elektra method, VIKOR method each will change at the last set of steps.

So, considering the problem which we were discussing buying an apartment four choices and the different type of parameters and criteria are given here. There are 11 in number I will read the first and the last one you can have a look which is already discussed there in in the slide the last lecture. They are starting from city and goes on to resell conditions. Now if you remember I have also highlighted say for example, price loan availability I highlighted with red because more the price, stricter the loan availabilities are or conditions are higher it is a negative cost for me. So, I will basically try to analyze them from the point of view of NIS, how close or how far they are from the negative solution.

While number of bedrooms higher good, safety features for the locality where the flat is apartment is quite good and is good positive. If the facilities available is quite high there is gym, there is a doctor, there is a medical store, there are there are is there is a walking way park, this is a place for children to play, this is a place for elderly people to come and gossip and chit chat. So, those would basically add up as a positive point hence I will try to find out the PIS the how close it is. So, even if in the problem as we solve we will be following one procedure, but that categorization into two subsets of positive and negative can be done and the analysis can be done accordingly. Now here considering the example we will continue so this would be I will consider the square.

So based on the x values which I have so there are and write it on this side and 3, 4, 5, 6, 7, 8, 9, 10, 11. So, the same problem buying the house so alternate is 4, 11 criteria and here the size of the matrix as you can easily fathom and understand your off size 4×11 , 4 being the number of rows, 11 being the number of columns, 4 is basically number of alternatives, 11 being the number of criteria I normalize them. The normalization I use is basically square so this square is missing, but square. Now again I am repeating please bear with me the normalization could have been like r_{ij} is equal to \ln of x_{ij} divided by sum of $\ln x_{ij}$. Other could have been like using just the norm so in place of 1, I can use of x_{ij} divided by the sum of x_{ij} 's only, but remembering the fact the sum adds to up to 1.

So, I use this normalization and if you remember the normalization is being done based on the concepts of the rows. Now remember one thing in the excel sheet which we did the initial the normalization was done column wise and then the sum was found out. So, here we will be doing the normalization row wise and then the sum of the max would be found out. So, the normalizations are based on the fact that I consider the values as here. So, let me take the values for better analysis.

$\frac{x_{ij}}{\sum x_{ij}}$. Now, I want to find out the multiplication value which we I will mention as per the slide let me mention as V. So, now, if you remember the size given for the normalized one this is the normalized one which is r and w are different. So, in the case of r it is basically 4×11 and for w it is 11×11 . So, if I want to multiply I will start the little multiplication here.

So, the product of two rows. So, I will basically consider whole set here comma whole set value here. So, if you see this is the cell of v I have. So, I highlighted with red I would not put all the cells red because it will be difficult to visualize.

So, I will put red. So, these are the values which I have. Now, once I have the values of v what I do is that. So, this cell I use as a slightly different color it comes no if it is not visible. So, these are the cell values which I have corresponding to the fact another thing I should show here. So, technically this is A1 to A4 and this is C1 to C11. So, what this cell values mean is basically the overall effect of each criteria depending on which cell it is multiplied by the corresponding weightage which I am going to give as a decision maker for each criteria.

Remember weightages are based on the criteria only not on the alternatives. So, once I have that I go back here. So, I have found out the values. So, if you by the way the values which you see here are and the for the cell value which is here are different because the normalization concepts are different.

So, consider if I use the normalization like this. So, let me verify that. So, there should be any confusion if I find out the square and I find out the sum of the squares. So, it will be so, this is the first cell $(C29)^2 + I$ am using a totally different normalization. So, this is C30. So, this is D30. So, then next value would be it will be E because I am going row wise. It is F, it is G, it is H, it is I, it is J because again row wise if you follow K, L, M. So, all squared up values. So, if I find out the value would come out to be 250963. If you go back to the normalization which we did earlier obviously, it would be different. So, if I want to copy again and keep a look at the dead values they will change weights are not changing the overall V matrix is changing.

So, in this case if I have I have to freeze the cell values row wise. So, I have frozen them. So, I once I copy double check double check what I said that see the sum is 1. So, different normalization is used, but the sum would definitely turn out to be 1. Now, if I want to follow the same concept.

So, obviously, here normalizations are based on the fact is 29 place now is 30. So, this becomes 30, this again becomes 30 because the row has shifted by 1, 1 unit gone below. So, is H 30 now then it is I 30, J 30, L 30 and 30. So, if I follow again this again the values come out to be 1 right hand side. And obviously, if you if you have checked which I said the cell values are also changing.

Now, let me go back to the calculations which we did. So, they are back to the case which I considered for simple normalization. Normalization means the value divided by the total

sum of that ρ . So, this is the initial part. So, again the sums are 1 as they should be. Now, considering V why I showed that because different normalization will give you different results.

Now, having found out V let us proceed. So, once I have multiplied this multiplication already done I found out the V matrix which is here where column and ρ for A and C A being alternative C B being criteria are marked in yellow and the cell values are in red. Now, I proceed to the case. So, basically I find out the max, the max would be based on the corresponding criteria's which are basically utilized. So, I find out it will be for j is equal to 1 to N and considering that the values of the cells which I have.

So, I will try to find out the max and min. Max here, min here I find out the max, max weightages for each criteria. I put it I find out the min. Now, considering for this lecture I have a short time I will explain few things and do it in the next lecture. Now, remember in the C 1 to C 5, so here which I am highlighting I have not mentioning mentioned anything about the importance of the positive side or the negative side like the cost, maintenance, higher bad, lower good, safety, maintenance considers safety, facilities higher they are number of rooms higher they are better, lower they are worse, maintenance cost higher it is bad, lower it is good. So, I can basically classify them into two categories of criteria which I am not doing here.

So, once I find the max and min I can go ahead and find out the S plus and S minus and do the ranking accordingly. So, with this I will close the class and continue discussing in the same set of slides and obviously, the slides would be shared the moment much before you start and so for and obviously, you are going through the lectures. So, pay at an only in this part of top 6 lecture and whatever we are basically discussing from the slides also and in the excel sheet because different ideas would give you different ways of trying to normalize it and also answers would change. There is no right or wrong answer there is a way subjectivity is considered in these examples. Thank you very much and have a nice day. .