Modelling And Analytics For Supply Chain Management
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Lecture - 9
Supplier Selection Analytics (Contd.)

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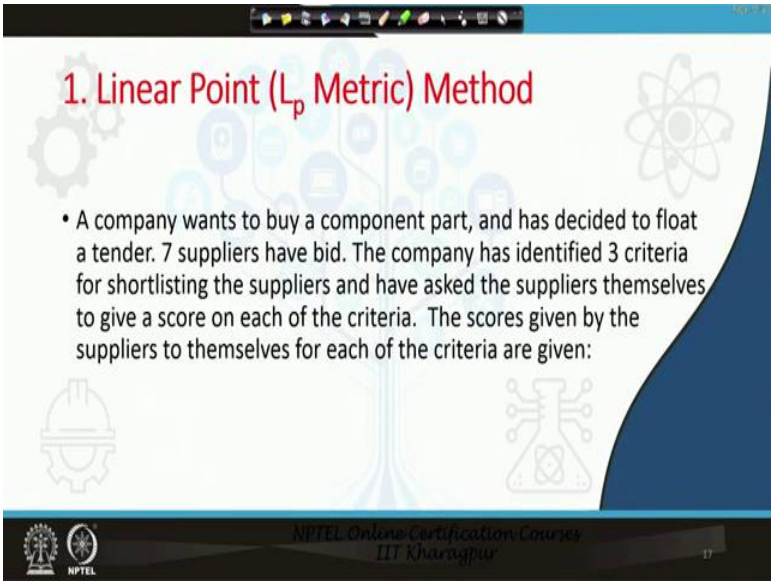

Hello, we had started off with supplier selection analytics and in lecture 1, we gave you a brief about linear programming, and lecture 2 we have done linear point method of supplier selection, if you remember this is what we started off with linear point method and we have used these formulas, hope you remember.

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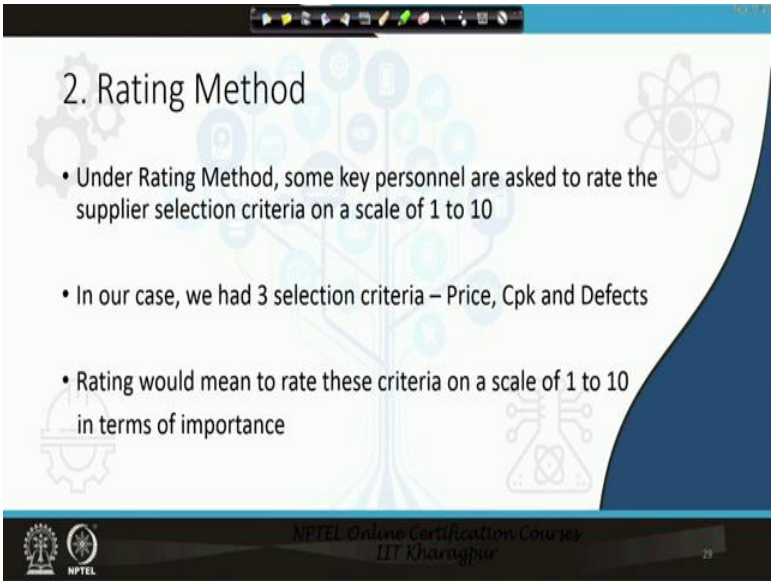

Now, this lecture we will deal with the rating method of supplier selection. Now, see in the previous linear point method, we had three criteria for supplier selection, one was price, second was Cpk and the third was the defects, defective parts per million. Now, what did we assume? We assume that all the three factors or all the three criteria were having equal weightage or equal importance for the buying organization. They were not distinguishing between, price is more important, defects are more important, etcetera, etcetera.

Now, rating method brings in that differentiation. When we specifically know that price is more important than the other or something is more important than the other, etcetera. So, basically we are rating. Now, under the rating method, some key personnel are asked to rate the supplier selection criteria on a scale of 1 to 10.

In our case, we had 3 selection criteria, just remember price, Cpk and defects. Rating would mean to rate these three criteria on a scale of 1 to 10 in terms of importance. 10 being the highest and 1 being the lowest. Just I am distinguishing, linear point method we assume that price, Cpk and defects all are equal in terms of importance.

Now, we are saying, no, let us give them a rating. Now, normally since rating, different people give different ratings. So, two things you will have to be very careful about. Suppose, price I give a rating of 6 and another manager at the same hierarchy gives a rating of 7, it is pretty fine, but price I give 7 and another manager gives a rating of 2 that means that might be they have not

understand our question properly or might be the person does not know that much about this functioning of the organization or the criteria for supplier selection. So, we will have to be very careful about the type of rating and what rating the person has given. So, long as it is within a normal range or normal limit, acceptable limit, the ratings are fine.

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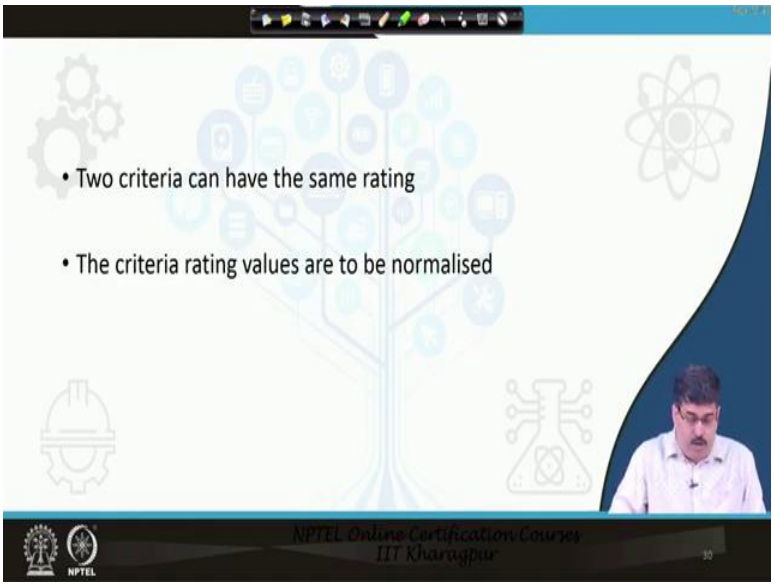

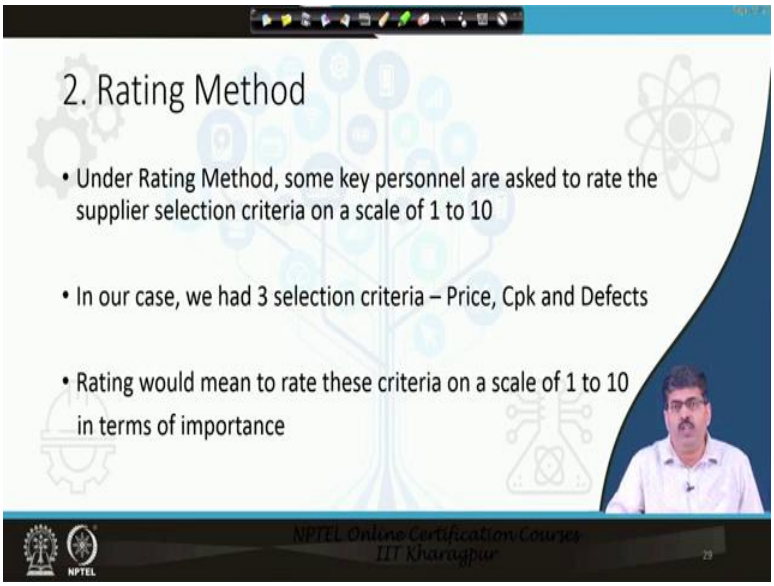

Now, two criteria can have the same rating. For example, price if somebody has given a rating of 7 and defects also has come with the same rating 7 that means both are equally important for my company, no harm, we can have this, it should not be that price is 6 and defects is 7, may not be,

price and Cpk and defects all may be equally important for my company. So, two criteria can have the same rating. And again, the criteria rating values are to be normalized.

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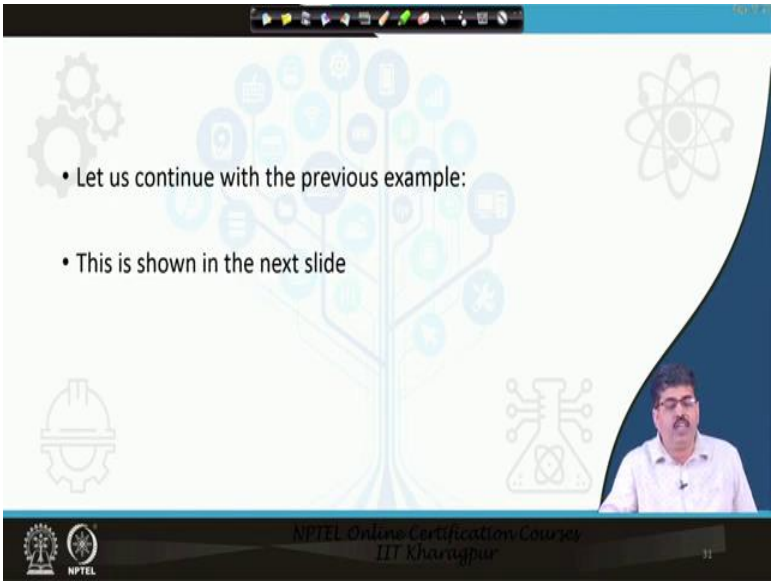

Let us continue with the previous example. This is shown in the, we will continue with the same example.

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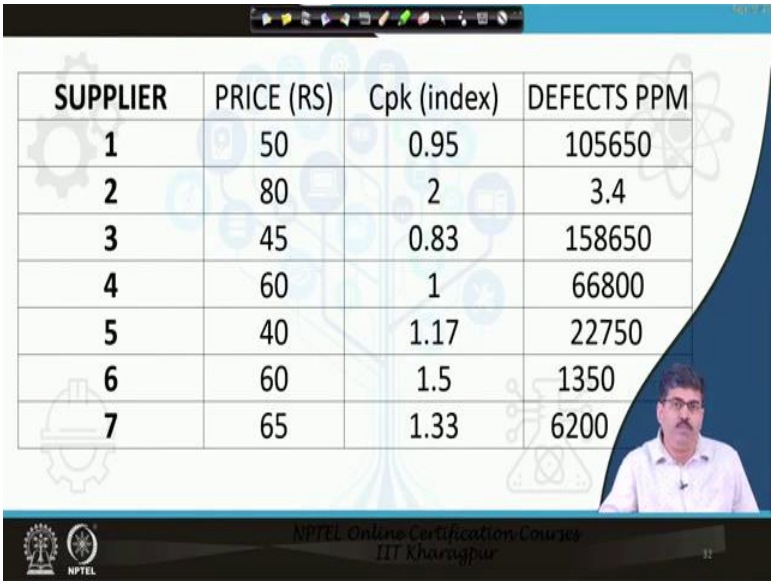

SUPPLIER	PRICE (RS)	Cpk (index)	DEFECTS PPM
1	50	0.95	105650
2	80	2	3.4
3	45	0.83	158650
4	60	1	66800
5	40	1.17	22750
6	60	1.5	1350
7	65	1.33	6200

This was the original problem that the suppliers are, 7 suppliers have coated and each supplier has given their performance, matrices.

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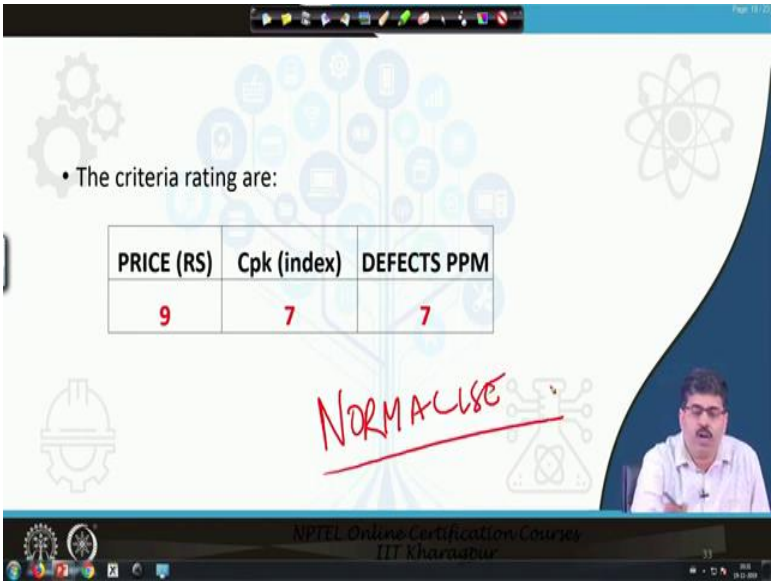

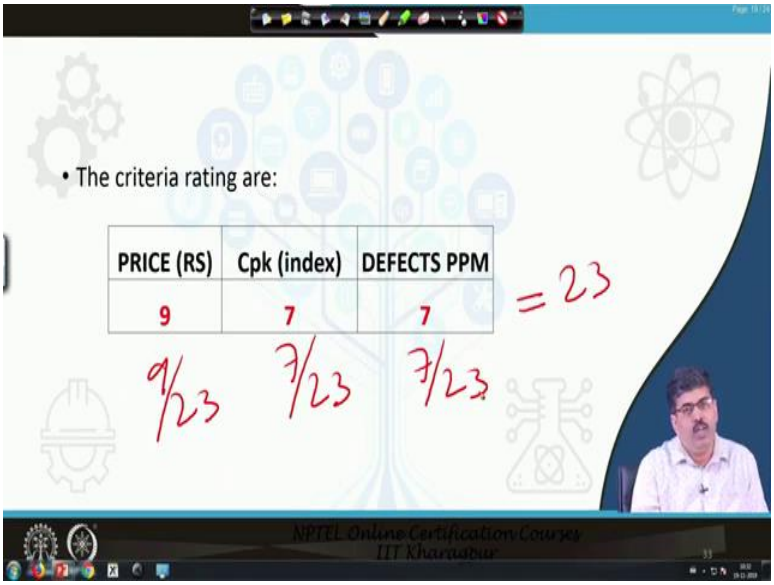

Now, the organization has come up, this price is a rating of 9 that means on a scale of 1 to 10, price is given the most important rating 9, followed by Cpk and as we mentioned defects have also been given the same rating. So, what to do now? As we mentioned the first step is the first step is normalize, the first step is normalize. So, let us normalize. How do we normalize? What is the score here? What is the score here? 14 plus 9, 23, so, what is the score for price now? 9 by 23, score for Cpk 7 by 23, score for defects 7 by 23. So, you get a normalized score.

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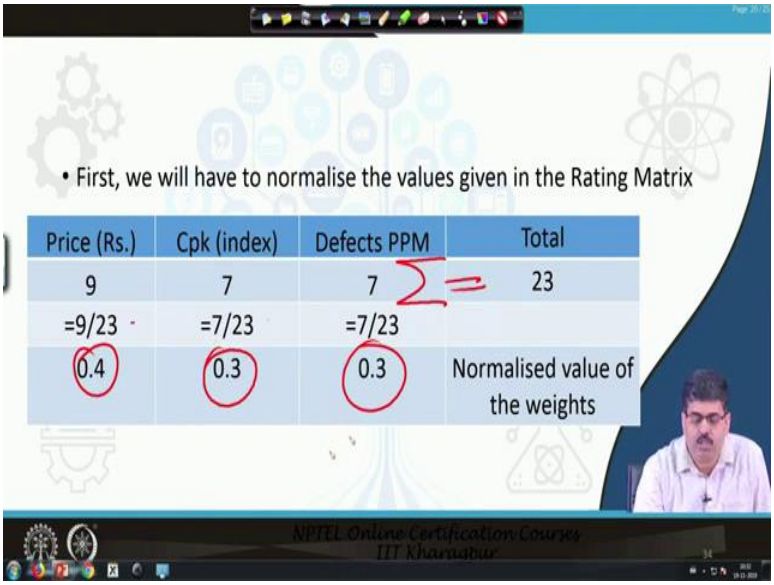

This is what we show here. So, my normalized scores are 0.4, this and this. I just showed you how to get this, agreed? Understood? You just done, total is 23 that is the summation is 23 and 9 by 23, 7.

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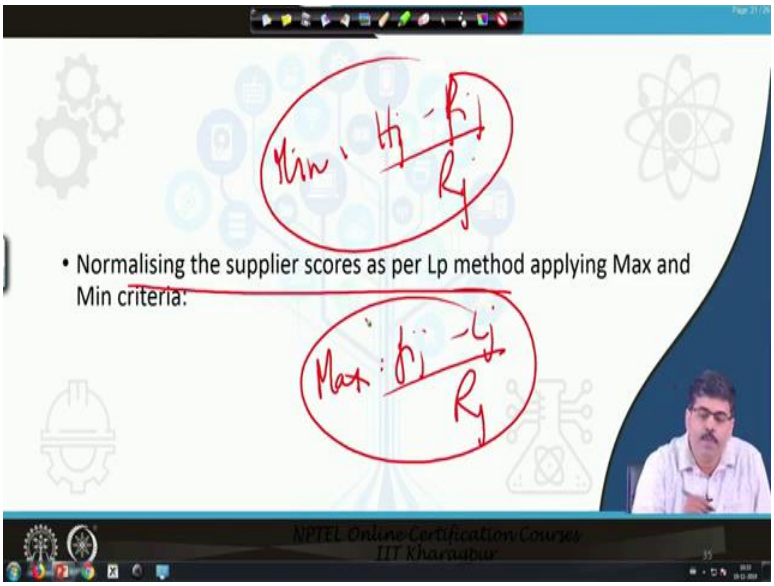

Normalize, next step, so, first we normalize the rating scale and then normalizing the supplier scores as per, normalize the rating not the scale, normalize the rating values, then normalizing the supplier scores as per Lp method applying max and min criteria. This we have already done, remember? We had used these formulas, we have used this and we have used this min formula as

Hj minus Fij by Rj, remember? So, we normalize the matrix and max was your Fij minus Lj by Rj. So, these formulas we again use to that old matrix.

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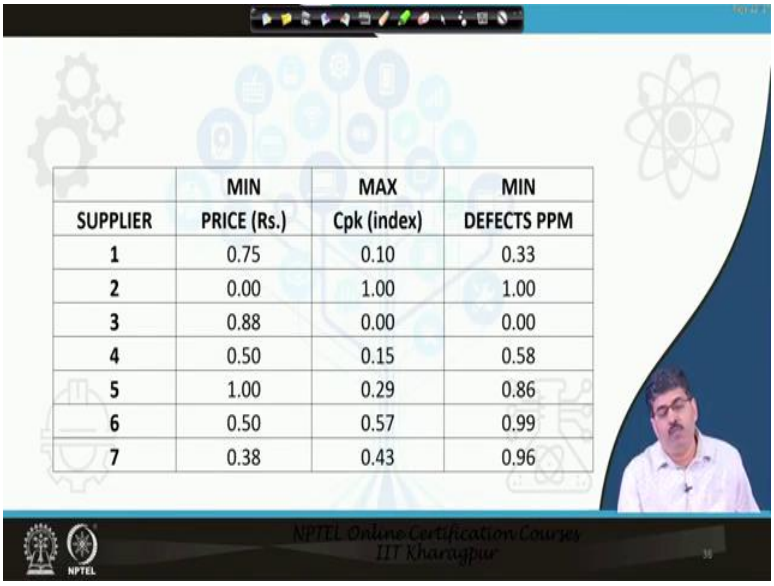

	MIN	MAX	MIN
SUPPLIER	PRICE (Rs.)	Cpk (index)	DEFECTS PPM
1	0.75	0.10	0.33
2	0.00	1.00	1.00
3	0.88	0.00	0.00
4	0.50	0.15	0.58
5	1.00	0.29	0.86
6	0.50	0.57	0.99
7	0.38	0.43	0.96

So, after normalizing we have got this matrix, remember we had done this in Lp method.

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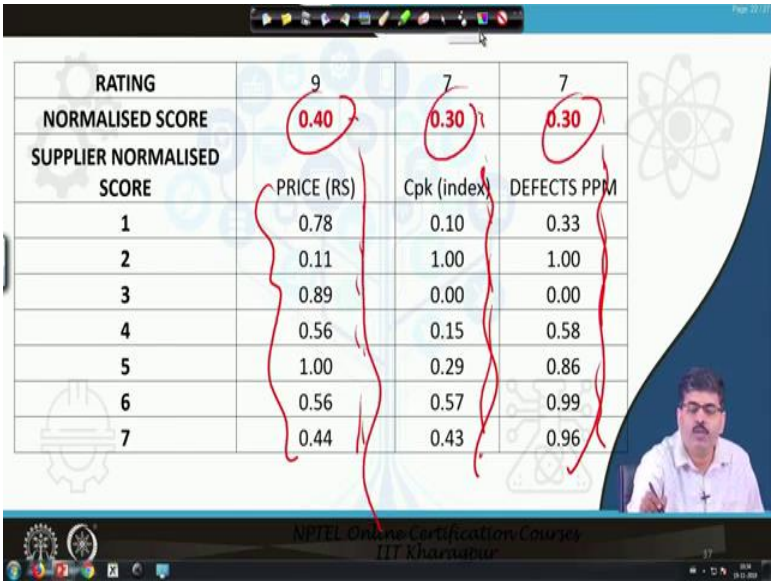
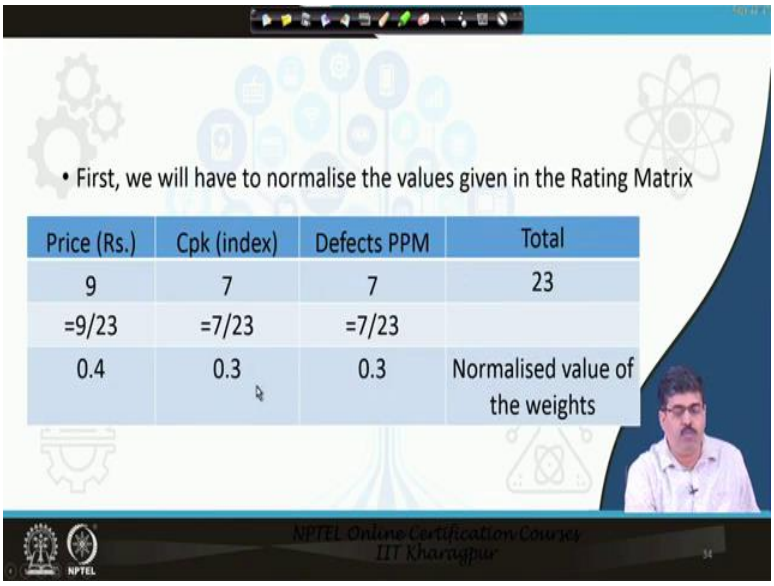


RATING	9	7	7
NORMALISED SCORE	0.40	0.30	0.30
SUPPLIER NORMALISED SCORE	PRICE (RS)	Cpk (index)	DEFECTS PPM
1	0.78	0.10	0.33
2	0.11	1.00	1.00
3	0.89	0.00	0.00
4	0.56	0.15	0.58
5	1.00	0.29	0.86
6	0.56	0.57	0.99
7	0.44	0.43	0.96



So, your normalized score, remember 9 by 23, just look at it 0.4, then 0.3, 0.3. So, this is your normalized matrix. Now, some cases these numbers will be slightly different because of some rounding off, etcetera. Now, so, what we will do now? We will now multiply the weights with these things, we will multiply the weights with these. We will multiply the weights. This was already done if you remember, this was already done. We just got the normalized values and now we will multiply.

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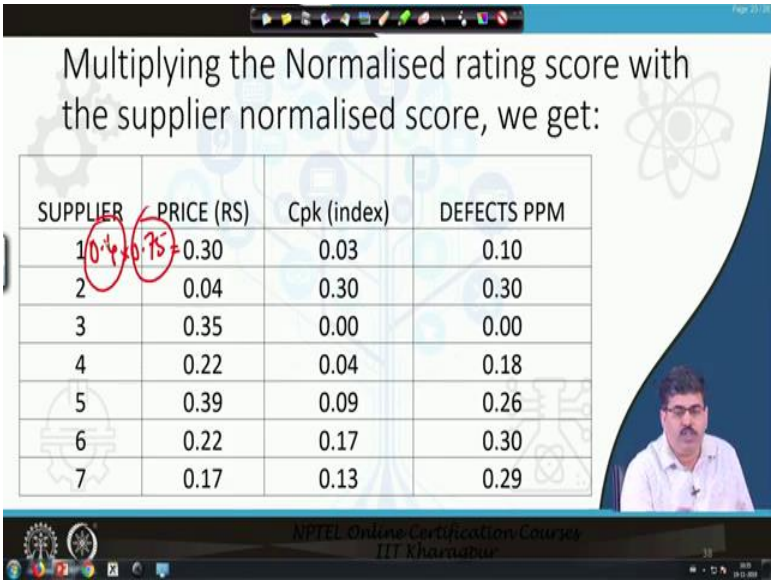

So, after multiplying the 0.4 by this, this, this, we get this value. After multiplying we get this value. So, if you remember this value was 0.4 into 0.75 is 0.3, 0.4 was my weight and 0.75 was the normalized value. So, 0.3. So, we multiply each weight with the normalized values.

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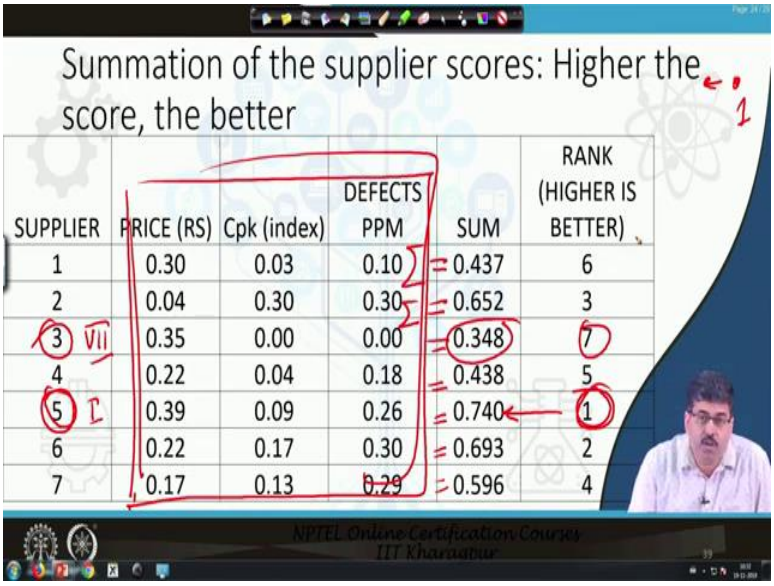

Once we have done that, once we have done that, this was the weights multiplied by the normalized value matrix. So, what we do? We do a summation, just like the Lp matrix. We learn one method properly, everything you can do. This is the summation and rank higher is the better. In Lp method, we say it lowest was the best, why? Because we are measuring how far it was away from the ideal point of 1.

Now, we have given a score, we have given an important score. So, higher is the better. So, 0.74 was the higher score, so supplier 5, supplier 5 is ranked 1. 0.34 is the lowest score that is rank seven, and supplier 3 is the lowest, so supplier 5 is ranked 1 and supplier 3 is ranked 7. So, Lp method is minimizing the distance or the lowest value, in ranking meth, in rating method it is the highest. So, we normalized summation and ranking higher is the better. I am stopping for a second, just go through it, just look at it nicely and then we will proceed.

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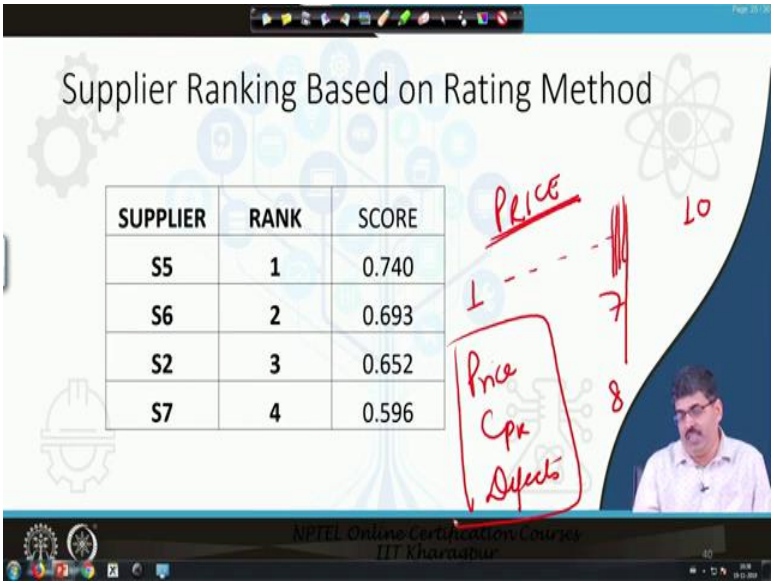

So, we are proceeding, so this is my rating 5, 6, 2, 7, rank 1, 2, 3, 4. Now, we are moving on to a situation, see here what happened, in this case we have asked people in the organization that Sir or Madam, price on a scale of 1 to 10, how important is price to you? And somebody said 7, somebody said 8, so they have been able to give a numerical value or a numeric value to the importance. But sometimes it is not possible to give a numeric value.

What we can only say is that well price is more important than Cpk and Cpk is more important than defects for my organization, price is more important, Cpk is second most important and defects is the third most important. So, they are able to not rate it, but to some extent prioritize or rank it.

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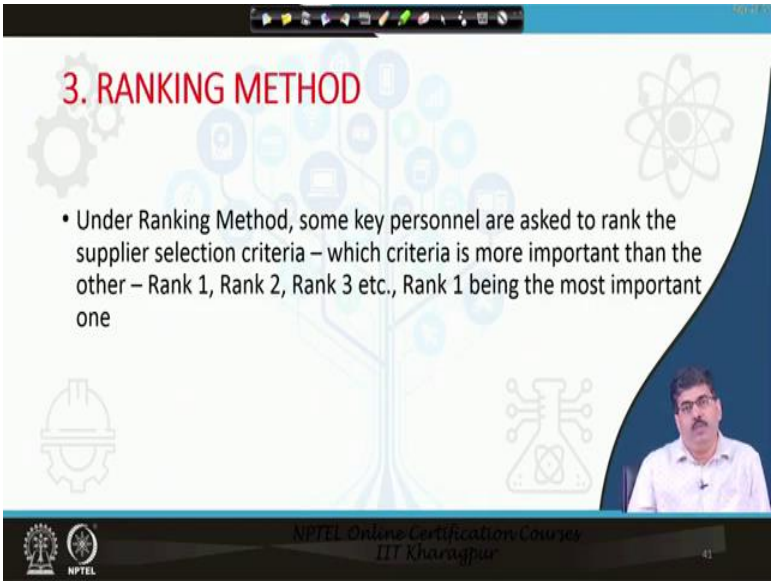

This, when such a situation is there, this we call as the ranking method. Under ranking method, some key personnel are asked to rank the supplier selection criteria, which criteria is more important than the other? Rank one, rank two, rank three, rank one being the most important one, as we said price may be the most important, followed by Cpk and defects.

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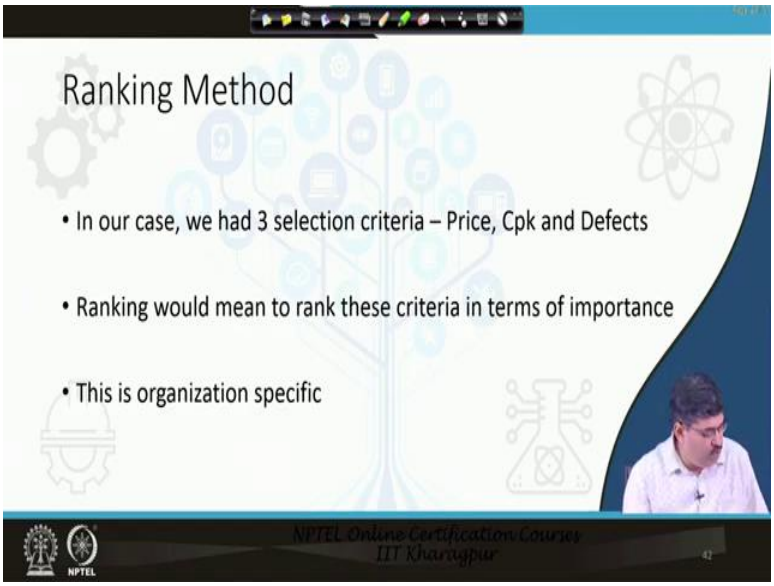

In our case, we had three selection criteria. Raking would mean rank these criteria in terms of importance. This is organization specific, definitely it has to vary from organization to organization.

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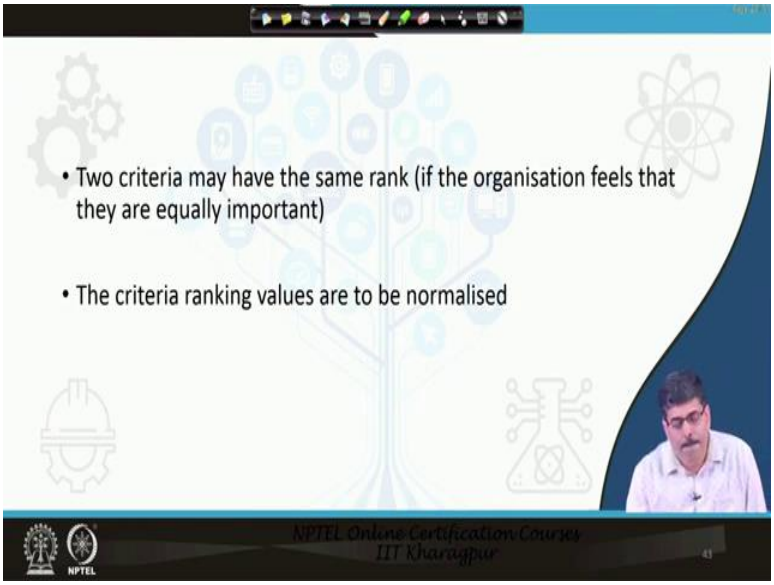

Now, two criteria may have the same rank, if the organization feels they are equally important and then like the rating method the criteria ranking values are also to be normalized.

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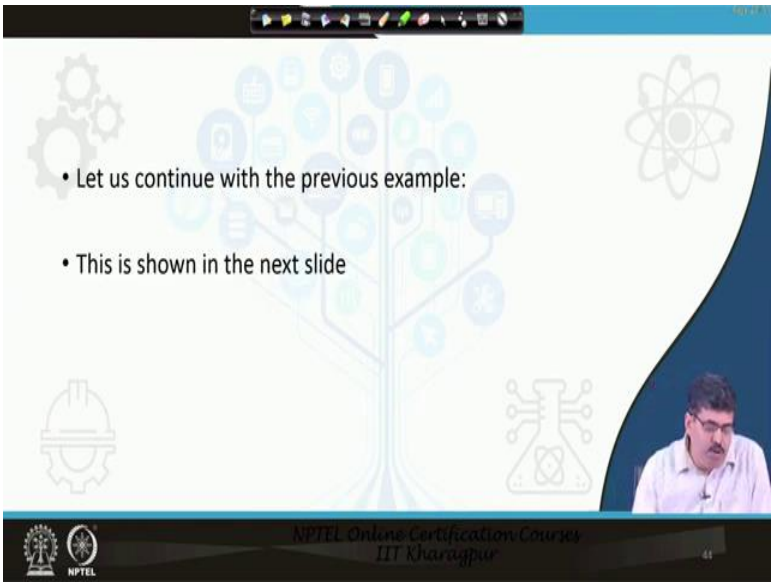

Let us continue with the previous example.

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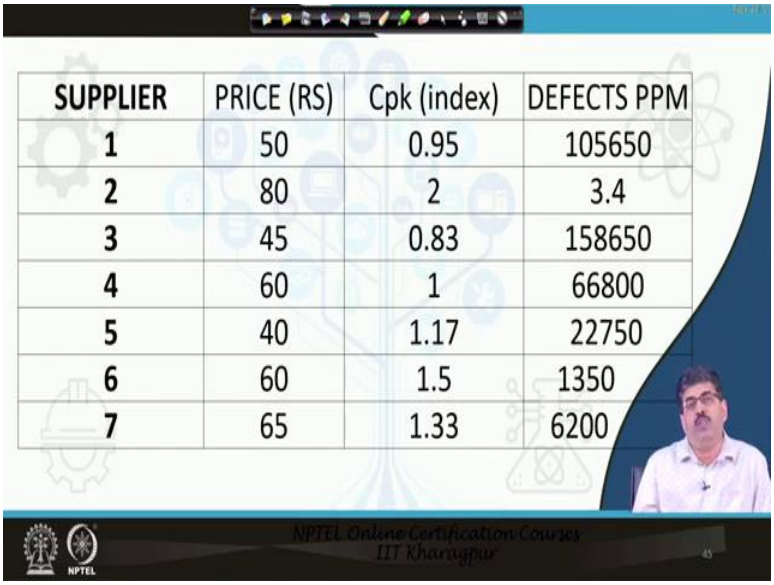

This was our, this was our original matrix with which we started the supplier selection modeling.

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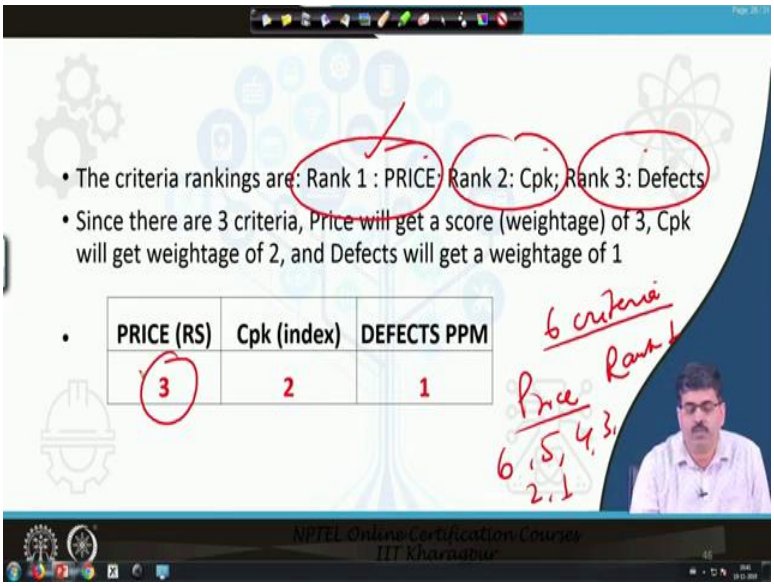

Now, we had said that price, now see here, this is something that you need to understand, the rank 1 we say price is rank 1 that means price is most important to me, Cpk is second most important and defects is third most important. So, price is rank 1, when you have 3 criteria, then what should be its score? Its score should be now 3, followed by 2 and 1, defects now, assume there were 6 criteria, 1, 2, 3, 4, 5, 6, price was the most important, price was rank 1, so, what will be the score of price?

The score of price will be now 6, next one will be 5, next one will be 4, 3, 2, 1, so this is the way it goes. So, the most important one gets the highest score. What is the maximum score possible? The total number of criteria, I am stopping here for a second, you look at it, rank 1 is price, there are 3 criteria, 1, 2, 3, so price score is 3, ok, got it?

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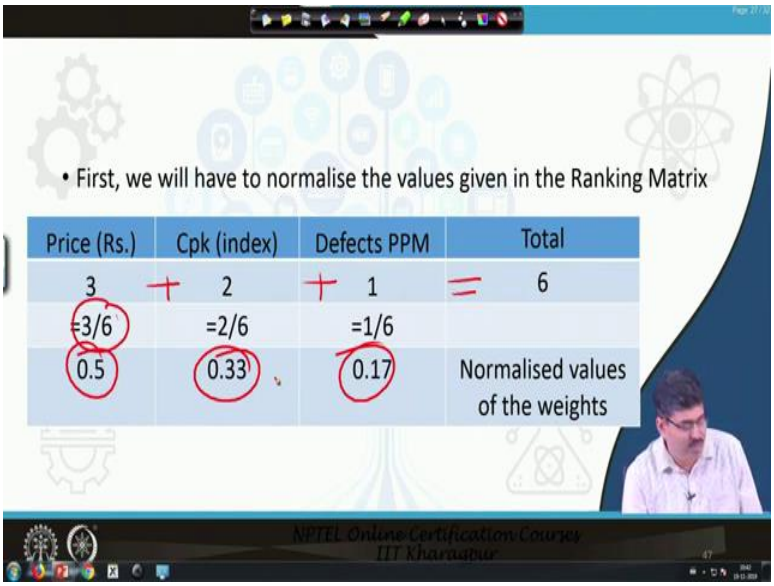

Now, then we will have to again normalize, let us again go, 3 plus 2 plus 1 is equal to 6, so 3 by 6, 0.5 is price is normalized score, 0.33 Cpk and 0.17, any confusion up to this point? Just have a look, it is very simple actually, we sometimes forget to make things simple, that is why we sometimes fear mathematics, so do not, but do not worry, it is very simple.

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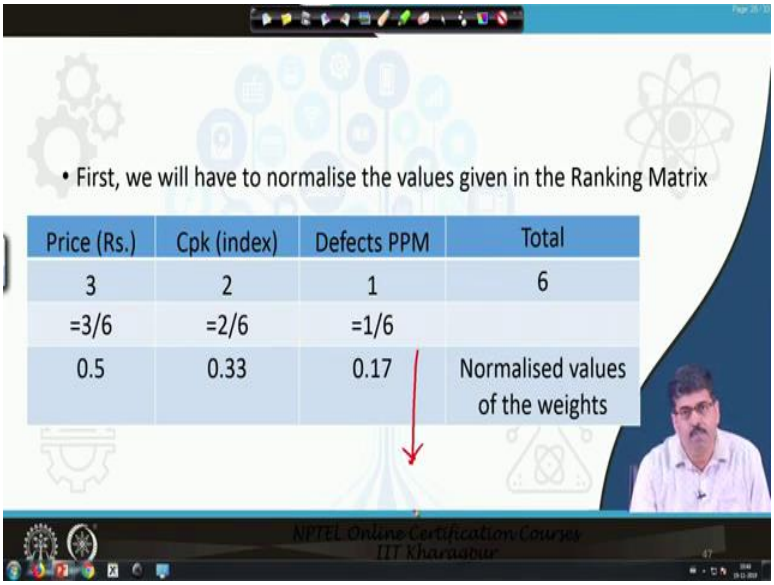

See, one thing I must tell you here that why are we doing it in a simple manner? There are two, who is your, when you are doing this analytics part of it, who is your audience? One is your audience is your subordinate staff who will not understand the complex mathematics if you give it to him or her and say this is the criteria by which I have selected a supplier and your audience is the other stakeholders.

The top management who will understand, but then some stakeholders may not find it easy to understand, other stakeholders, so, you will have to keep things very very simple, that is why, that is what I meant by saying when I mentioned that we sometimes make it complex, it is we cannot make it complex, when in organization you have to deal with your juniors, sometimes at the factory level you cannot make it complex.

Even if something is complex, you will have to make it simple and make them understand, so, try to keep it simple that is what my objective of telling this is, telling the entire thing about, when we mentioned, when we say that we sometimes make it complex, the point that I am trying to say is that we cannot make it complex, we will have to keep it simple because my audience is my organization staff at different levels.

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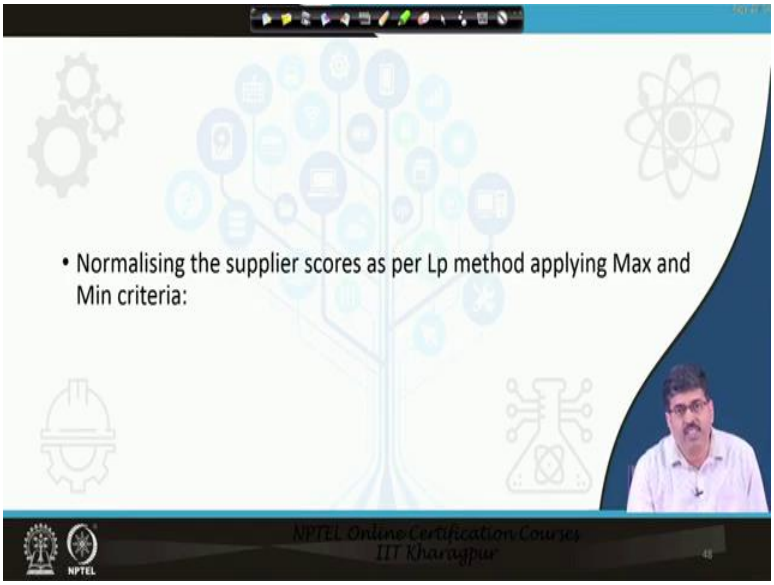

So, we normalize it and then we move on, normalize the supplier scores as per Lp method applying max and min as we have already mentioned in the previous problem.

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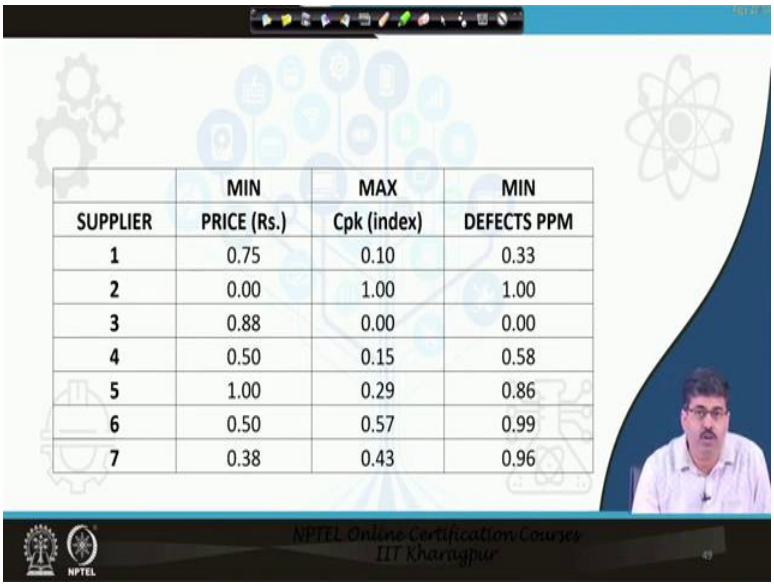

SUPPLIER	MIN PRICE (Rs.)	MAX Cpk (index)	MIN DEFECTS PPM
1	0.75	0.10	0.33
2	0.00	1.00	1.00
3	0.88	0.00	0.00
4	0.50	0.15	0.58
5	1.00	0.29	0.86
6	0.50	0.57	0.99
7	0.38	0.43	0.96

And this was the score, this I hope you remember this, this is the normalized score that we got earlier, that we have obtained the earlier.

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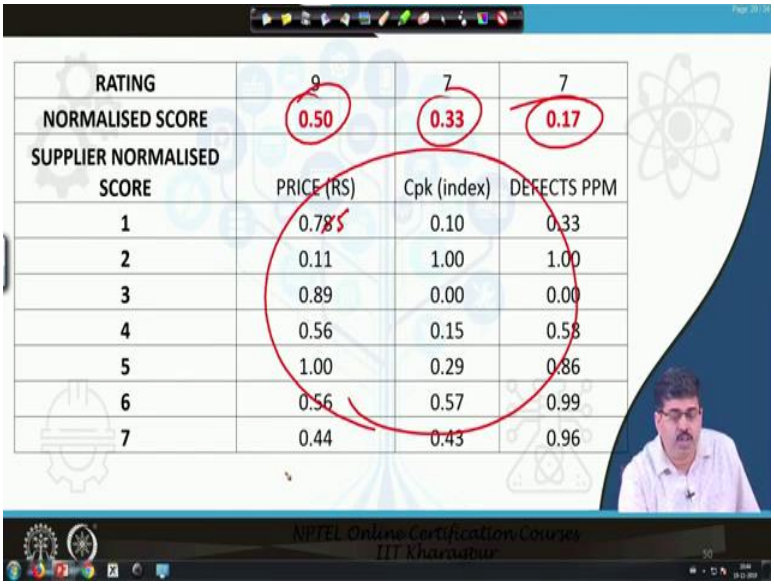

This was again the normalized score of this as we got from the 3, 2, 1 ranking. This is the normalized matrix as I mentioned there are some points like this is some points as we move ahead will look, some will be slightly different because we are converting them into some whole numbers.

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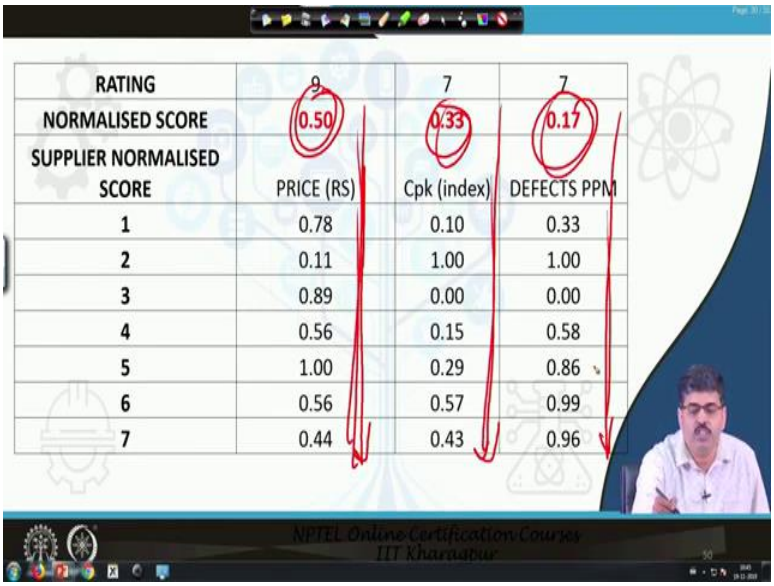

As we mentioned, multiply this with all, multiply this with all the values here, multiply this with all the values here. Once we have multiplied, multiply this with all the values, multiply this with all the values, multiply this with all the values.

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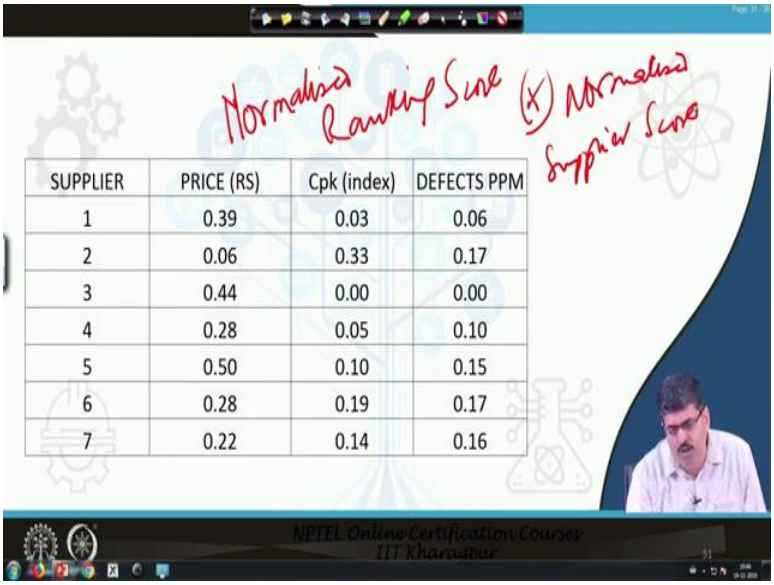

Once you have multiplied, this is your new matrix. So, multiply the ranking score with the normalized score, multiply the, I am repeating multiply the ranking score with the normalized score and this is your new matrix. I am writing it down again, multiply the normalized ranking score with the normalized supplier score, normalized ranking score with the normalized supplier score, just like the previous one, it is no rocket science, nothing different or nothing new.

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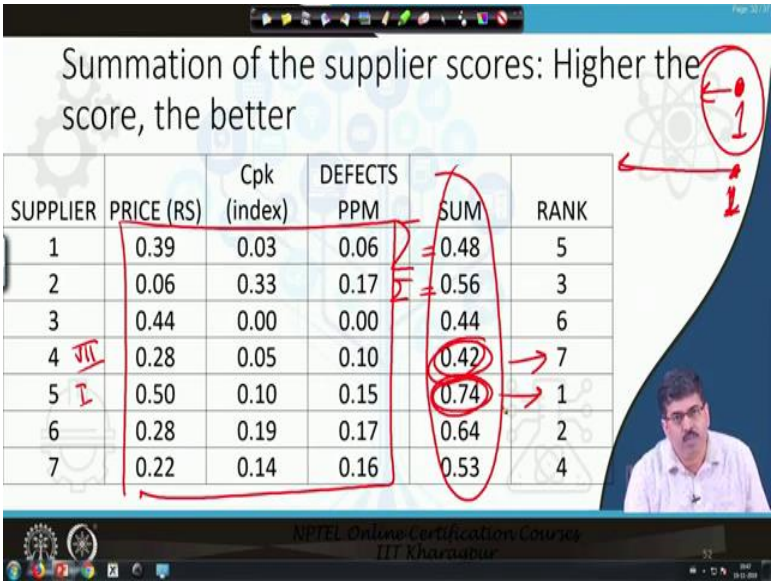

And then, this is the normalized matrix that you have obtained from the previous slide, summation it, summation of the rows and this is the summation scores that you have got,

summation of the rows. And, which one should be the highest? Since, we have already given some weight, the one with the, one with the highest score gets the rank 1 and the one with the lowest score gets the rank 7.

So, this is rank 1 and this is rank 7, got it? So, the highest score is rank 1. Remember, linear point the first one with which we started the lowest score was the best, why? Because we were measuring the distance away it was from the ideal point. So, the one which was the closest from the ideal point was the best supplier. Here we are giving importance. So, the one with the highest importance is the best supplier that is why it is changing, it is reversed.

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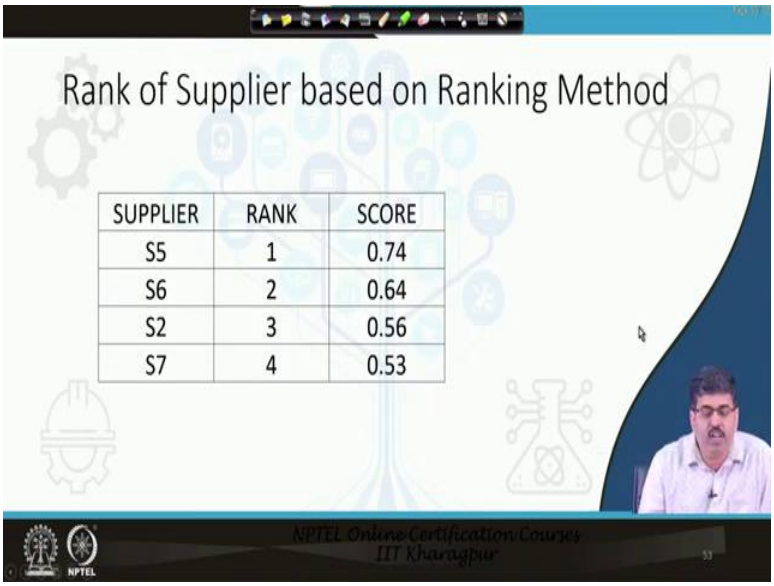

So, this is my final score S5, S6, S2, S7, rank 1, 2, 3, 4.

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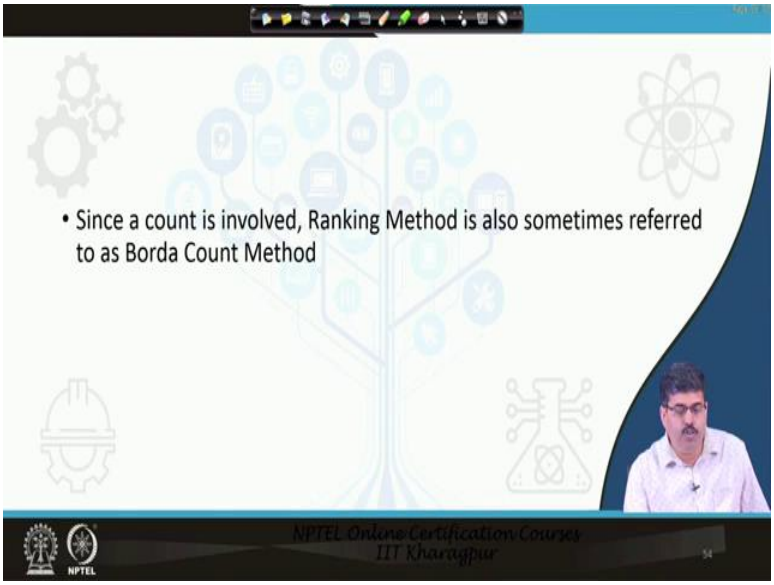

Now, let us do a, now this is just just it is, since a count is involved, ranking method is also sometimes referred to as Borda count method.

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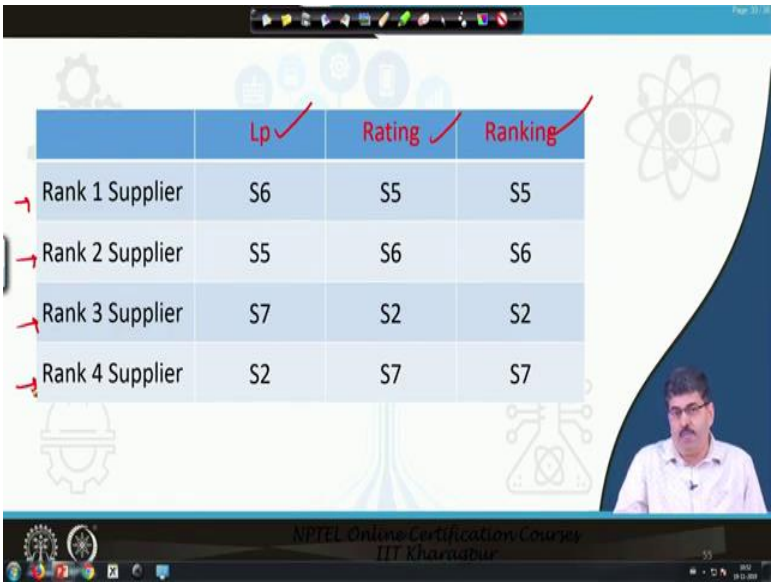

Now, this is, this is a matrix, we have done Lp method, we have done rating method and we have done ranking method. This is and this is rank 1 supplier, rank 2, rank 3 and rank 4 suppliers. Now, let us see what results did we get. Lp, linear point we got supplier 6 as the best supplier. Supplier 5 second best, supplier 7 and supplier 2. So, 6, 5, 7 and 2, whereas rating we got 5, 6, 2, 7, same for ranking, it might have differed also, what we are trying to say is different methods

are giving me different prioritizations that is what I am trying to say. So, if I use of Lp method, I will select supplier 6, 5 and 7, if I am using rating 5, 6 and 2.

So, now the office will kill me. They will say what have you learnt and what are you telling us that we are selecting suppliers when we are using different methods. So, did we commit something wrong? Have we done some error on our part? The answer is no. We have not done any error. When did we use Lp method? We used Lp method, when every information was available to us. When did we use rating method? When we were not sure on whether price is important, CP is important or some other defects are important.

So, we said, rate it on a scale of 1 to 10, so we are giving some weights and the third one, when we were again, we were not able to say, we were saying, criteria 1 is more important than criteria 2, criteria 2 is more important than criteria 3. So, we were ranking them. So, market situations are such that sometimes we are not able to give a clear cut numerical value to certain things. When we are able to rate them, we will rate them and we will get some priorities.

When we are not able to rate them, it is a new method, it is a new technique, new product, new suppliers, new organization. So, we are not able to rate them. We have never done business with them, when are we able to rate them? We are able to rate a supplier or some criteria when we are already in business for many years, but we are starting the business now so we do not know, we have no idea, so then we will rank them.

So, rating and ranking are used under different situations. Sometimes all the criteria are equally important or we have no idea about the business. It is a new product, totally new to the world. Then we do not know which criteria is more important. So, all criteria are given equal weights. So, your choice of method will depend on what exactly you want to achieve and whether you ever thorough sound knowledge about the market.

Who will give you this information about the market? You are an analyst, you will not getting information about the market. So, who will give you information? This information will be given to you by the marketing team, by the purchasing team, by the supply chain team who will give you information about the market.

So, in a nutshell what we want to say is, no method is incorrect, but we will have to apply these methods based on situations, in a situation where you have to prioritize, then you cannot use Lp method. In a situation where you do not, where you cannot put a numeric value to a criteria and you can say I am better than him, he is better than her, something like that, ranking, then you have to use ranking method, you cannot use Lp method.

So, you will have to first decide on what your organization wants to achieve, what type of information is available in the market, what is the internal requirement of the organization and then based on that you will have to decide on which method you can apply. We are telling you that look these are the methods numeric methods or models that are available.

Which one you will choose that depends on what type of organization, what type of market, totally new product or not, existing product, incremental edition, how long are you doing business? Based on all these things, you will decide on which method you can apply. Now, so this is just a, this is something that you need to remember, this is what I was asking you, this is what I was asking you.

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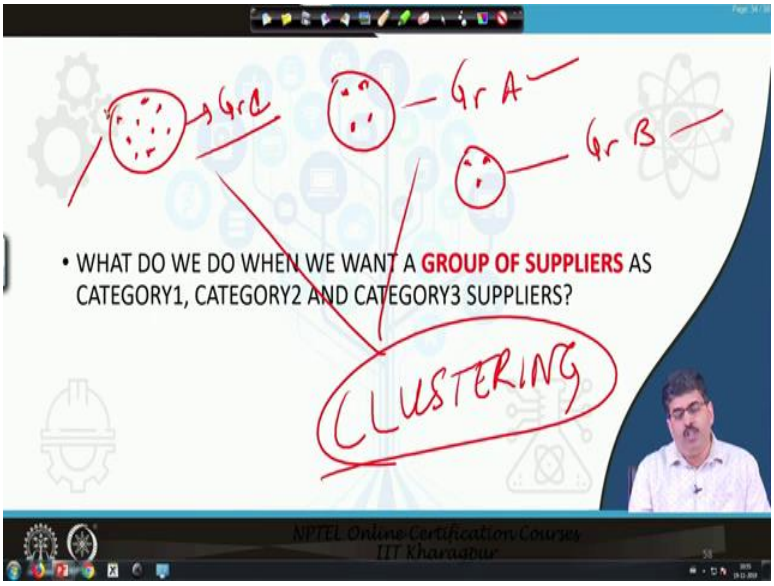

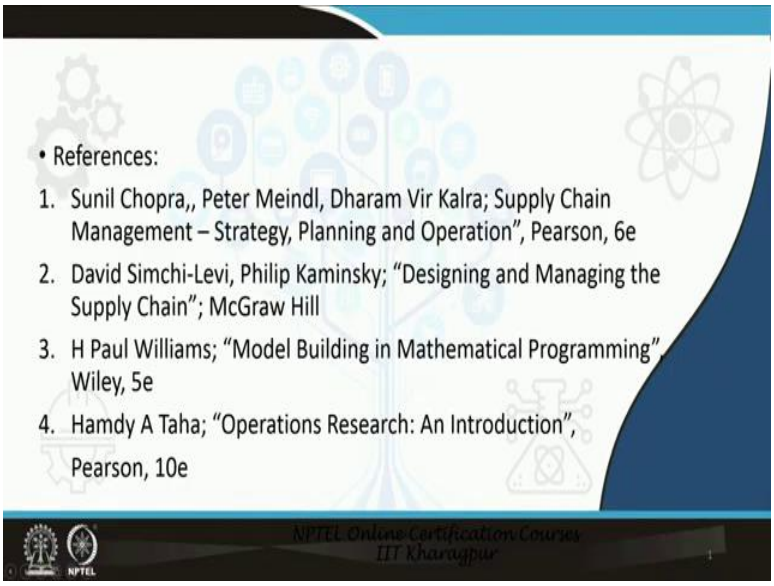

Now, what we will, another question that comes in our mind is, like say we have a product which is very generic or my organization deals with certain products which are generic products, which are available in the market. So, then what happens is that I, for every, every time I need that product, I will not do the same mathematical exercise, rather what I will do?

Suppose there are 20 suppliers and then what I do is, I group the suppliers into group 1, group 2, group 3, I do not want to do repeat the same exercise, time, time and again. I group the suppliers into group 1, group 2, group 3, or group A, group B, group C. So, what I do? And assume that group A is the better suppliers, group B is the second and group 3 is the last among the list.

Now, what I do? The costly items, I ask any group A supplier to supply me. The medium priced items I ask any group sup, any member of group B suppliers to supply me and the daily use items in my office I ask any group C supplier to supply me. So, then I do not need to do any ranking. So, I will prepare a list, I will prepare a list, what I will do is, I will prepare a list that supplier 1, 2, 3, 4 are in group A.

Any costly item, I will buy from any supplier, no questions asked, because already I have prepared this group. These 3 suppliers are in group B, medium priced item I can buy from any of these 3 suppliers, no questions asked because I already grouped them. These are the suppliers who are in group C all the pens, pencils and papers in my office I will buy from them, no question asked because I have already grouped them I can buy from any one of them.

So, basically what you are doing? We are basically clustering my suppliers into groups. Group A, group B, group C. Group A may be the best, group B middle, group C may be the least important. So, this is another exercise that we need to do. So, this we will pick up in the next module. Thank you.