Modelling and Analytics for Supply Chain Management
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Lecture 08
Supplier Selection Analytics (Contd.)

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Hello, welcome, in the previous lecture we have started off with supplier selection models in supply chain okay and we gave you a brief idea about why mathematical modelling in supply selection is required okay, because our objective is to have a justifiable selection model so that no supplier should grumble about why they have not being selected etc. As well as the organization should also develop some meteorology by which they select suppliers.

Now, why organization should develop a meteorology? Because organizations need to follow certain methods over a period of time, number 1, number 2, if a supplier is selected that supplier also needs to improve over time, so there should be some objective feedback given to the suppliers also. So a mathematical technique help to understand why I should select a supplier and next I should also be able to groom the supplier over a period of time, this mathematical model helps the suppliers also to understand why and where they are lacking, most particularly where they are lacking, so that they can improve, okay. Now, we move on to some suppliers selection models, okay.

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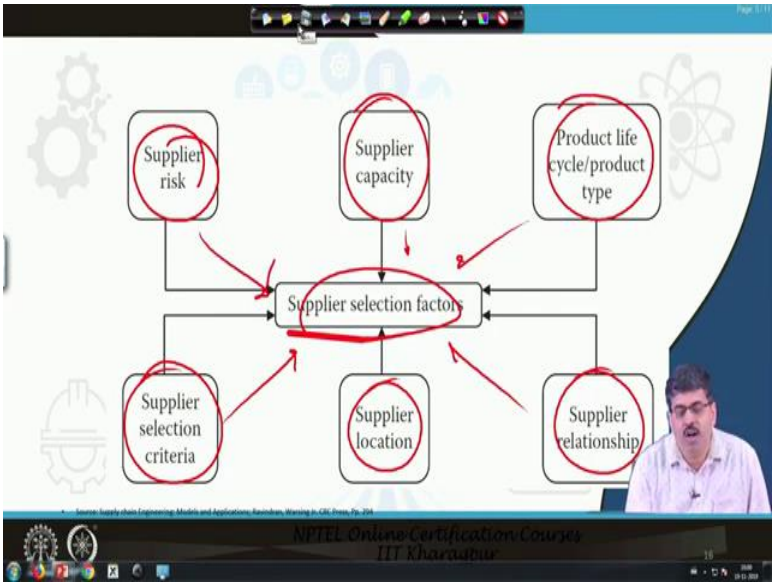

Now, if you see just a little bit of diagram of a here, supplier selection depend on many-many things of which one of the criteria is supplier risk capacity say I want to select the best supplier okay but the supplier is specialized in producing some very-very fine product, but he has a livery limited capacity. So, this is a problem, this is a constraint, I want to select a supplier from, let us say the Sunderbans regions of India but then during the rainy season the rivers will be flooded and my products will not be able to come.

Let us say I am dealing with honey, processing of honey, now honey is grown in Sunderbans regions, now but during the rainy season what will happen the rivers will might get flooded and these, the honey will not be able to reach the main land, so supplier risk is another factor, okay. Sometimes the product life cycle plays an important role in supplier selection.

If the product life cycle is very short, I might go for a supplier who is very near to my production base. Supplier relationships over time I develop a strong supplier relationship, so then I do not want to change, if the supplier is doing very well why shall I change the supplier, supplier location. As we just mention that let us say certain industries like say your milk production, milk powder production we want it to be very near to the supplier base or supplier location.

So and sometime we have a strongly written down supplier selection criteria, so all these contribute to supplier selection factors. What is our job? Our job is to mathematically come up with some models and techniques, right.

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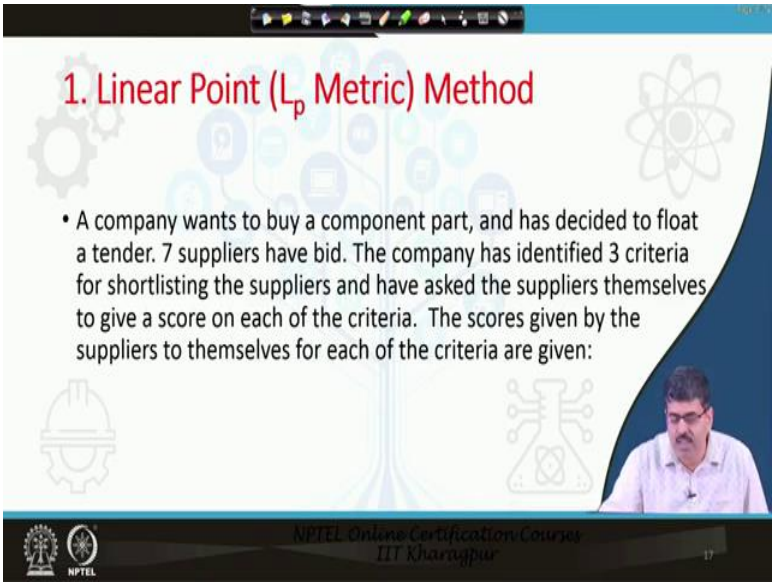

The first one that we will deal with is Lp metric method, now just a caution Lp here does not mean linear programing, Lp here means linear point okay. Now, let us see this is all very simple okay. A company wants to buy a component part and as decided to float a tender. You have to float a tender if you are a limited company or if you are a government organization. 7 suppliers are bid. The company has identified 3 criteria for shortlisting the suppliers and have asked suppliers themselves to give a score on each of the criteria.

The scores given by the suppliers to themselves for each of the criteria are given okay. So, what are we doing? The company is buying a component part, 7 suppliers a bid and the company has identified 3 criteria for shortlisting the suppliers. But you will have to have some numbers, some score for this criteria okay. I am just stopping for a second, just read the slide, just go through the problem.

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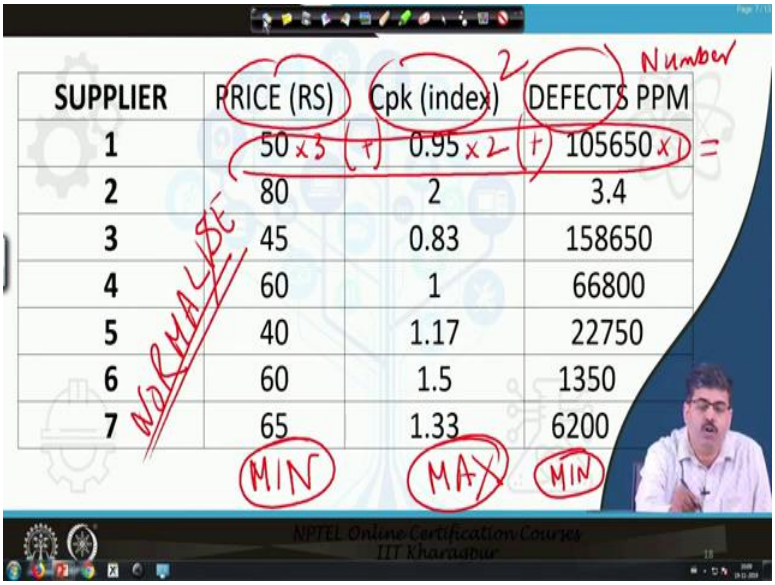

See the company has identified 3 criteria. What are the criteria? Price, measured in rupees, Cpk. What is Cpk? Cpk is let us say you want to have a defect free supply right, that is all what company is want, more the defects more the problem in my production line. So, I will want as manufacturer a very-very defect free supply. So, Cpk is an index to measure how close your processes are towards six sigma.

Six sigma means almost zero defect that is 3.4 defects per million, so Cpk is a measure as to how much close you are towards a almost a six sigma level of production okay. What should be the ideal Cpk value? Ideal Cpk value is 2 okay, as you are approaching a value of 2 means you are approaching a six sigma level of production okay.

So, this so when this particular company is looking for a supplier, they are looking at 3 criteria, one is how much is the supplier quotation? That is the price, what is the six sigma level or the Cpk level of the supplier and just parallely what are the number of defects per million that is defective parts per million PPM, defective parts per million, is out of 1 million or 10 lakhs produced, what are the number of defects that the supplier incurs or the supplier shops incurs.

So, each supplier has given their numbers okay, we have 7 supplier each supplier has given their numbers that is just as in the illustration supplier 1, supplier 1 has mention that they can cote 50 rupees as a price, they have a Cpk index of 0.95 and this is the defects that they are incurring, if they are producing 1 million products, right.

So, every supplier has given their scores okay, every supplier has given their scores. Now, how to select my suppliers? That is my question, how do I get or prioritize my suppliers? That is my job okay. Now, since we are doing it in a PTT I have given 7 suppliers and 3 criteria, if 20 suppliers or 30 supplier as a bid, as if it is a global tender, 30 suppliers a bid, three-zero 30 and we have not 3 criteria of price Cpk and defects, we have 10 criteria.

So, this will be a 30 suppliers that is 30 rows and 10 criteria, that is 10 columns. So, it will be a 300 matrix okay right, 30 by 10, 300 cell matrix, no problems. The methodology remains the same, just remember this, the methodology remains the same, just to fit it in a PPT format or in a side format we have taken a 7 by 3 matrix, even if it was a 30 by 10 matrix the methodology remains the same okay.

So, do not get vary with a big-big-big excel sheet or a big-big-big list of numbers, methodology is same okay. Now, what is our job? Our job is to prioritize these suppliers based on the best supplier, the second best, the third best etc-etc-etc okay. Now, how to do this? Think over it for 2-3 seconds, I am just stopping here, how to do this? And try to note it down on a piece of paper in front of you, how you are planning to do this?

Okay, now you see the first thing that should come into your mind, as an analyst is that price Cpk and defects, see this is the most simple way what at the drop of a hat what will you say, we will give weights to each of this price is most important, Cpk is second most important defects is third most important and the weights we will give as 3, 2, 1 and we will just multiply.

So, 50 into 3 plus 0.95 into 2 and then 105650 into this is 3 okay. So, this is what we will say, so what we will do is 50 into 3, 0.95 into 2 this into 1 and then we will keep on adding and we will get an additive score, right. This is what we will say, at the drop of a hat, this is what will come into our mind, not only your mind, it will come into my mind also okay.

But, are we doing the correct thing? What is the unit of price? Rupees, what is the unit of Cpk? It is index with the maximum value 2. What is defects? It is a number, right. So can we really compare (())(10:16) that is the questions. So, first thing is just by giving a weight and multiplying might not give a good selection or a good result.

Second thing that should come into your mind is, as a company who is selecting the supplier, I am repeating, as a company as an organization who is selecting the supplier, what is your

objective for price? For price you want to select a supplier who has a lowest price, so your objective for price is minimization. Again as a company, which supplier do you want to select? You want to select a supplier whose Cpk value, six sigma value just a notation wise, just an indicator wise, whose six sigma value is very high.

So, for a Cpk you want to select a supplier who has a max and look at the defects. As a supplier whom do you want to select? You want to select sorry as a manufacture you want to select a supplier whose defects is minimization right. Now, you tell can we really just put some weight and multiply, no, then we will be wrong, right so there should be some other way of doing this, right.

So, the again I am stopping for 2 seconds, you look at the slides and just see whether you have understood it or not. Okay now, so what we will do? We will first then have to, we will first then have to, we will first then have to normalize, we will have to normalize this data, right we will have to normalize this data.

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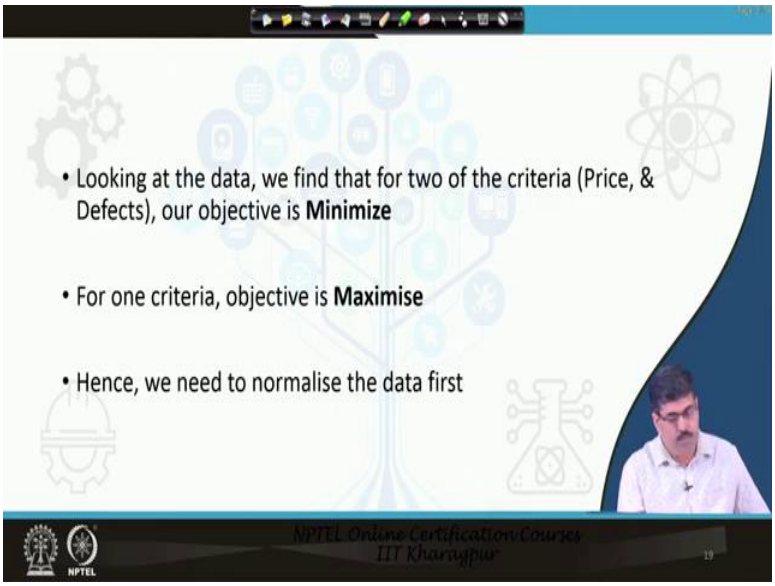

As, we have just mention looking at the data we find that for two of the criteria our objective is minimize and for one it is maximize and we need to normalize the data first.

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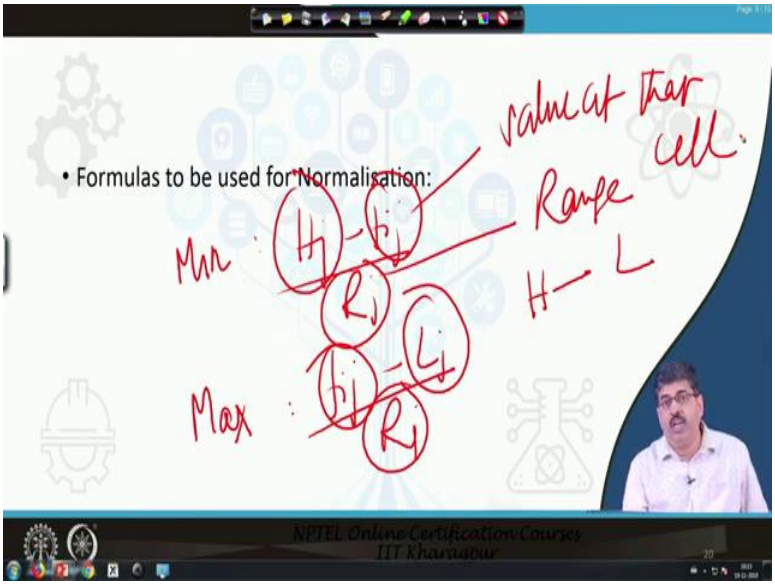

How will you normalize? Formula to be used for normalization. So, what we did was if the formula is minimization then what is it? Hj minus fij by Rj, do not be very panic about these numbers, if the objective is maximization then it is fij minus Lj by Rj okay. What are these? Do not worry, H means highest value, L means lowest value, what is R? R means basically the range, what is range? Range is highest minus lowest right. Then what is fij? That is remaining, fij means value at that cell, value at that cell okay. Now, do not no need to copy it you already have it in the next side.

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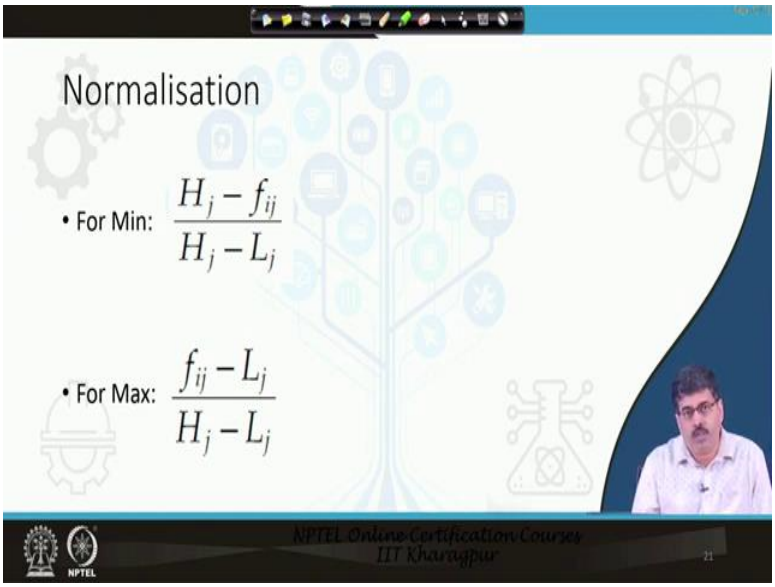

This is my formula. This we just wrote down okay.

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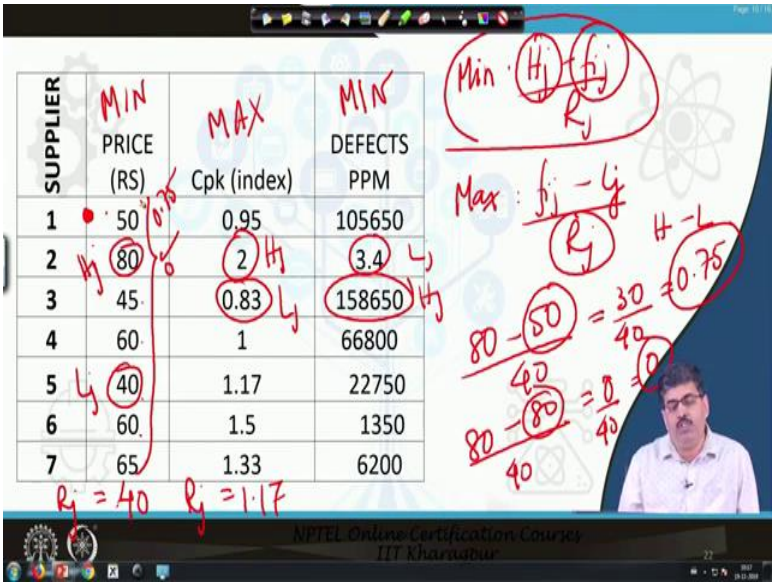

How to do this? Let us see. What did we say? For this was the original problem that was given to us, then what was the criteria now? Let us do it. What was the criteria? The criteria price criteria as an organization I want to minimize, Cpk what do you want to do? I want to maximize and defects per million, defect per million what do you want to do max or min? Minimization, right, okay.

Now, remember the formula what we mentioned for minimization criteria it should be Hj minus fij by Rj right and for maximization criteria it will be fij minus Lj by Rj. Now, what is Rj we mentioned? This is the range that is highest minus lowest, take this column, what is the highest value? 80. What is the lowest value? 40. So, what is my range now? My range is highest minus lowest that is 80 minus 40 that is 40 okay.

Again, for the second one, Rj what is the highest, that is the highest minus lowest? What is the highest value? 2. What is the lowest value? What is the lowest value? That is 0.83. So, 2 minus 0.83 is 1.17 okay, so this is my range. So in this way you can calculate the range right. Now, Hi that is going to Hij as we mention this is already my Hj, this is my Lj, this is my Hj, this is my Lj, similarly for this problem, for this column this is my Hj and this is my Lj. So, we have got it right. What is remaining is fij.

What is my job? We want to normalize this data, what is my job? We want to normalize this data. Let us take the first one, let us take this particular cell, this particular cell right, 50, what is the objective? Min, this is the formula minimization ight, Hj, what is the highest value? 80

minus fij is 50, okay fij is 50, 50, what is the range? 40, we have just got 40 here okay, so 30 divided by 40 that is equal to 0.75, okay, done?

So, this is basically the normalized score for this particular cell, this is the normalize score for this particular cell. For the next one what will it be? 80 highest value, for this particular cell 80 highest value minus, what is the cell value? Cell value is 80, 80 minus 80 by 40, so it will be, so 0 is the normalized value here okay. So, this, what is fij? fij is basically the cell value okay, the cell value right, I am stopping here for 2-3 seconds just have a look whether you have understood it or not okay, now we will proceed.

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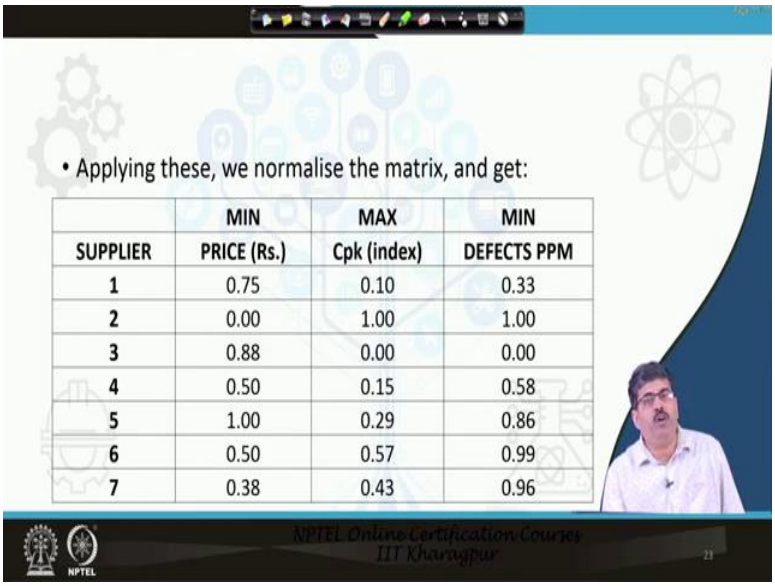

	MIN	MAX	MIN
SUPPLIER	PRICE (Rs.)	Cpk (index)	DEFECTS PPM
1	0.75	0.10	0.33
2	0.00	1.00	1.00
3	0.88	0.00	0.00
4	0.50	0.15	0.58
5	1.00	0.29	0.86
6	0.50	0.57	0.99
7	0.38	0.43	0.96

As, we just mentioned applying this we normalize the matrix and get this. Now, how will you do this? Just very simple, go to excel and just type in the numbers, type in the formulas the way we have mention and just you will get the score okay. The beauty is type the formula in excel just type in one cell, drag it down and you get it done okay.

Now, as we mention let us go back again this is the 7-supplier model, we have used it only 7 suppliers and 3 criteria just to fit it in one access, one slide, but let the suppliers be three-zero 30 let it be one-zero-zero 100 no problems, let the criteria instead of 3 be 10, 15, 20 it is just a numerical exercise okay. We can keep on increasing it, it is absolutely no worry or no harm okay. Now, once we have normalize this okay.

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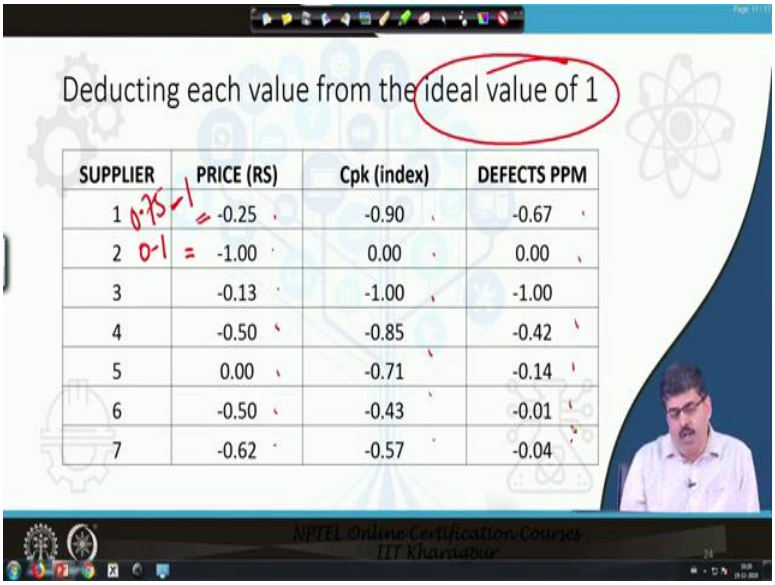

Now, now we introduce something, we introduce a concept called ideal value, ideal value of 1 okay. What is ideal value we will come a bit later, what we need to do is, we need to deduct each of the normalized scores from ideal value. So what was this score here? If you remember this score was 0.75, so what we do? 0.75 minus 1 and this is what we get right, 0 point minus 0.25, remember the second score it was 80 minus 80 divided by 40 okay, so my score was 0, 0 minus 1 that is equal to minus 1 okay.

So for every value deducted from minus 1 and this is the new matrix, for every value deducted from minus 1 and this is my new matrix. Is it understood? I am stopping for a second, this is the, so this is the second step right.

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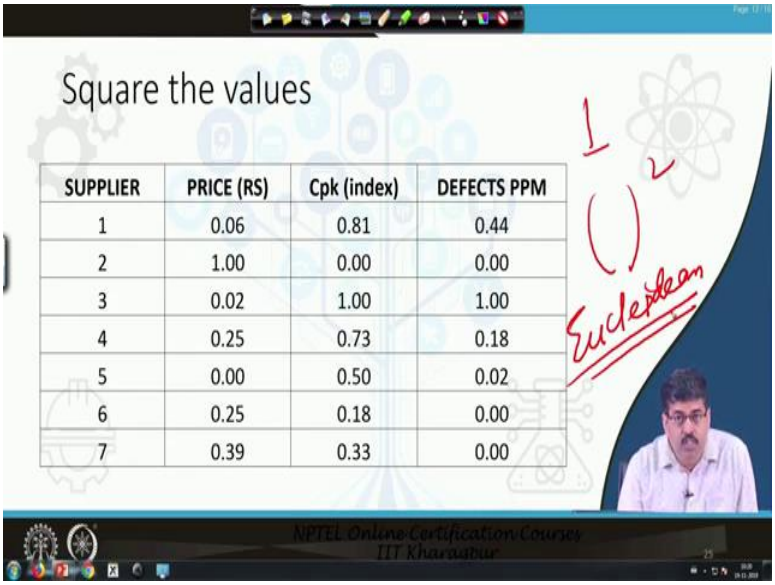

Next is very simple, square the values. Why square? So, now you see we have taken 1, we have taken 1, we are squaring the values, so what are we moving towards? Slowly we are moving towards something called Euclidean distance right, if you do not know what is Euclidean distance do not fear nothing to worry, basically just remember we are squaring the values okay, we are squaring the values.

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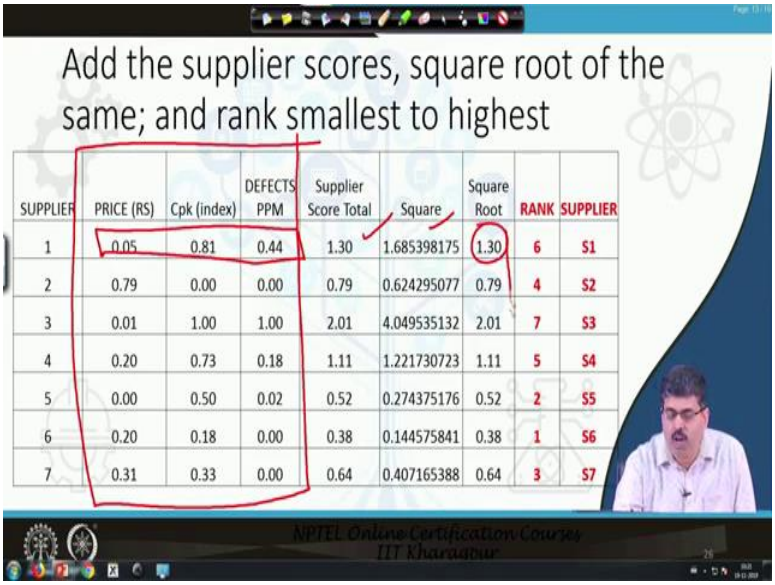

Once you have squared the values, what we now do is, so this is my, this is the matrix for squaring the values, we have got this, after squaring the values. Add them up, add this score,

add this score okay, supplier score total, square them, square root them and once we have square rooted them you rank smallest to highest okay.

So, what is the smallest score? 0.38, so then let us again repeat, we got the values of the suppliers, we got the values of the suppliers, got the total score, got the total score of this, square it, square root it and then the lowest value of the square root is my supplier ranking 1. The highest value of the square root 2.01 is the last rank supplier, highest value is the last rank supplier okay. Now, what does this mean? And why did we come up with this?

See 1, you remember ideal score of 1 we mentioned, no suppliers is in the ideal score of 1, every supplier is a bit far away from this ideal point, some are little far, some are medium, I would say distance away and some are very far away, from this ideal point. Now, which supplier will you want to choice? You will want to choice a supplier who is very close to that ideal point and so I will select the supplier who is only 0.38, agreed?

Who is only 0.38 away from the ideal point, so he is my best supplier and I will not select a supplier who is very far away that is 2.01 right, who is 2.01 got it. So, I will select a supplier who is very close to the ideal point. So, that is why we take the lowest score okay, that is why we take the lowest score as the best supplier. Is it okay? Have you understood this concept? 0.38 is very close to 1 were as 2.01 is a bit far away that is why select the one that is closest, okay.

Now, is it understood? I am stopping for a second just go through it once and then we will see what can be done, I am removing this 1.30 because it might create confusion.

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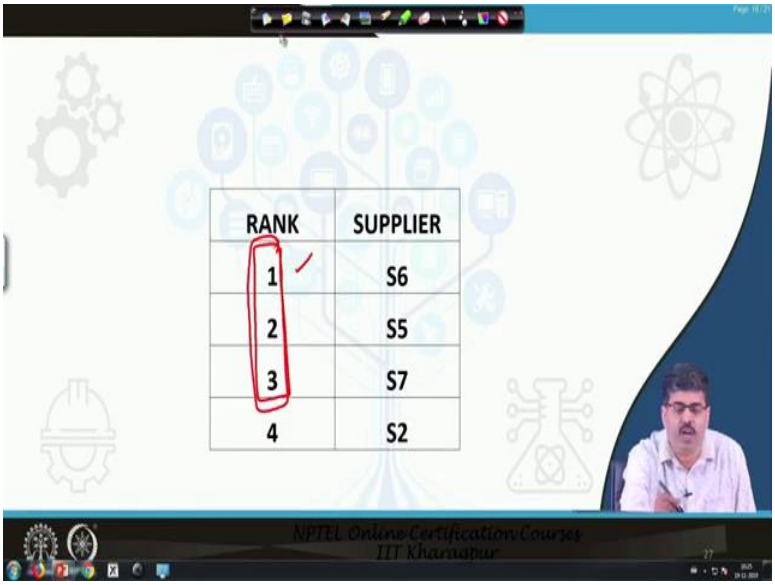

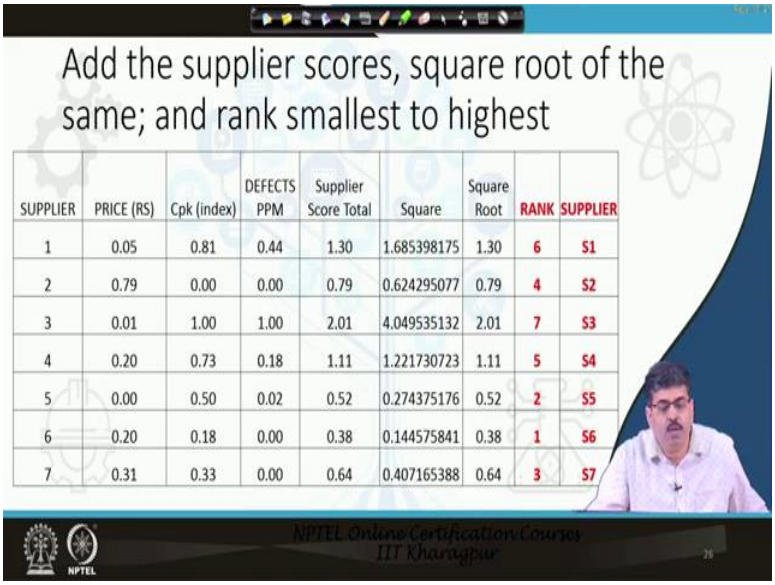

So, this is my supplier rank, supplier 6 is ranked 1, supplier 5, supplier 7 and supplier 2, this is come from this pervious matrix right, okay, now why did we take 4 suppliers? Say ideal for any product that you are buying for your organization you should have at least 3 suppliers, at least 3 suppliers okay.

We just took 4 just to show you, because we are just doing some analysis. Ideally we should have at least 3, minimum 2 because we if by chance the first rank supplier cannot supply, some unforeseen breakdown of operations it is factory then your organization will land into trouble okay that is why we select 3 suppliers okay.

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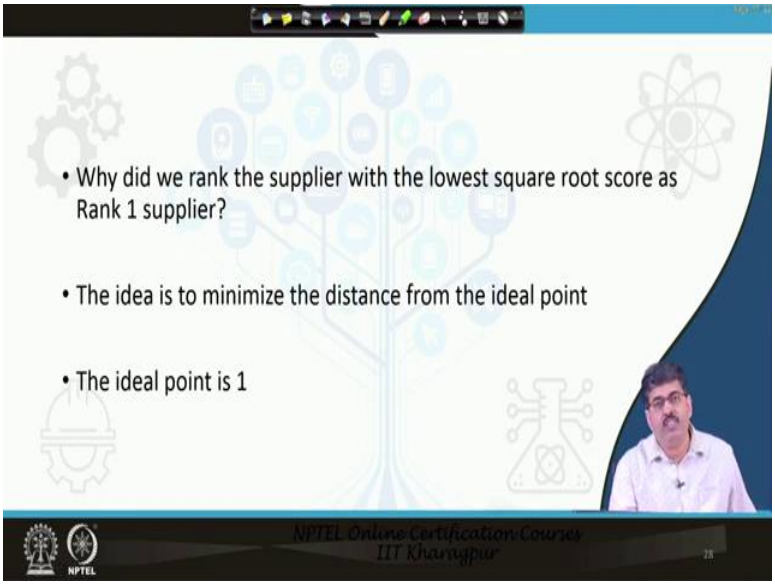

Now, we have just mentioned what ideas to minimize the distance from the ideal point this is we just mention in the table okay.

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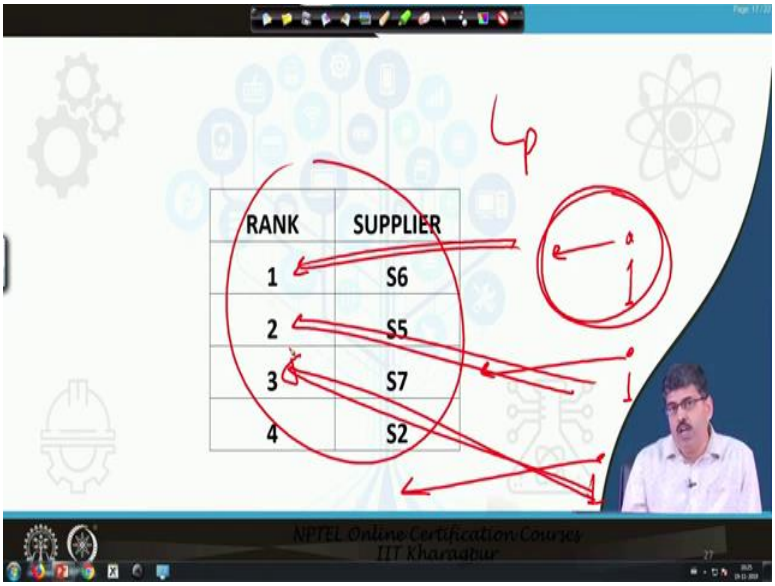

So this one, so if you see this is what this method of linear point basically tells you how far you are away from the ideal point okay and will select the supplier who is the closest to the ideal point, this is my supplier 1, this is my supplier 1, okay, this is my supplier 2 and this is my supplier 3.

So, this is the way we go through using a liner point method, okay clear, I hope you have understood, this is the first method for supplier selection analytically, okay, we will go to the next method in the subsequent lecture. Thank you.