**Modelling and Analytics for Supply Chain Management**
**Professor Anupam Ghosh**
**Vinod Gupta School of Management**
**Indian Institute of Technology, Kharagpur**
**Lecture 11**
**Supplier Selection Analytics (Contd.)**

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Welcome to module 5, week 2 for modelling and analytics for Supply Chain Management. And we are continuing with supplier selection analytics, we have covered the numeric methods and then we covered the clustering of suppliers or grouping the suppliers into different groups.

And then we came up with a question as to if you have to distribute the total orders or total purchase quantity among two to three suppliers, how will you do it? And then we showed you how you can use goal programming, more specifically lexicographic goal programming for distributing the order quantities.

Now, what is the objective? An objective of this entire modelling and analytics is to bring in the mathematical justification and in that process, optimise on your supply chain cost. On a supply chain activities, rationalising them making an agile supply chain and as we mentioned on optimising your supply chain costs. So, that was our objective. So, one thing is that we are bringing in a numeric justification to the decisions that we are taking and the second thing is in that process, we are also optimising costs.

Now, today, what we will do is, we will take you through a few more ways by which you can select suppliers. See the methods that we have discussed till now all have taken help of numbers. When you have numbers, when you have numeric values, how to select the supplier is what we have learnt.

Now today, we will tell you what to do when you have only qualitative information, qualitative, not quantitative, no numbers, when you have some sort of a descriptive information about certain suppliers. When will these situations happen? This situation will happen under two circumstances. One is when you are new in the market, you have never dealt with any supplier. So, you have no idea about which supplier is good, better, best. There is no numeric value possible because you have no past records, you are just a new entrant.

The second thing when this will happen is for a totally new product, you might not have any numeric information in the market. So, then also you will have to rely on, you will have to depend on descriptive techniques. So, this is what we plan to discuss today.

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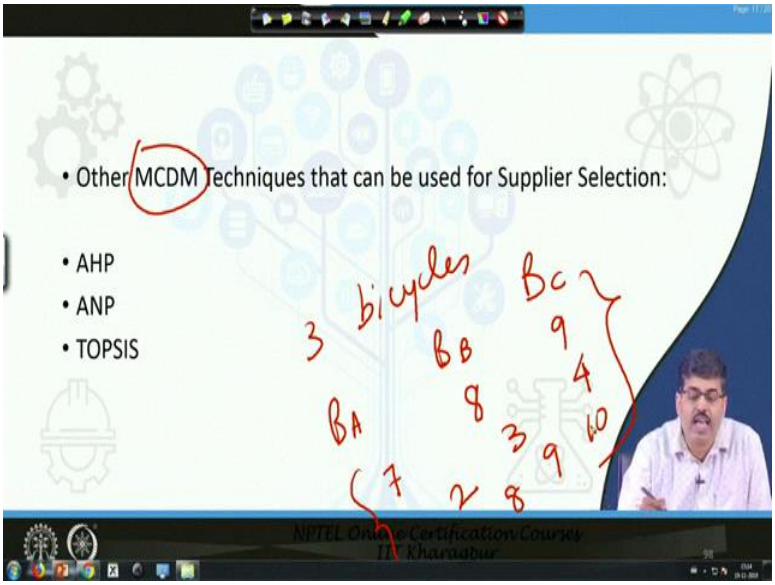


Now, there are few methods AHP which you must be knowing that is analytic hierarchy process. Now, another one which is a bit extension of AHP itself is the analytic network process or ANP it is another one, another method of multi coloured MCDM that is TOPSIS and there are yet a few more. Now, we will take up or we will just give you an illustration about AHP. AHP over the years have become very common and you can easily understand it once we give you the examples, like you see AHP, ANP, TOPSIS all are multi criteria decision making techniques MCDM.

What do you mean by MCDM? Multi criteria, just like you see we had price. We had Cpk and we had defects ppm, then we brought in price, Cpk and we brought in distance from the base and we had different criteria which we had to either maximise or minimise. So, when we have this type of a situation, we have multiple criteria that are used for decision making purpose that is what we call us multi criteria decision making models, AHP is one in such technique, analytic hierarchy process.

Now, what do you mean by analytic hierarchy process? Normally, we use AHP when we do not have exact numeric value of a variable, or when you do not have exact numeric value for a situation, clear? Suppose, you have 3 bicycles, you have 3 bicycles, bicycle A, bicycle B and bicycle C. Can you attach a numeric value to its functionality?

Let us say on a scale of 1 to 10 can you say that bicycle A is 7, bicycle B is 8 and bicycle C is 9, some may. But when the second person rides the same bicycle assuming that he is very very accustomed to ride on a very very smooth road, he will say this bicycle is 2, 3 and 4. Some will say the bicycle is 8, 9, 10. So, they will lot of ambiguity in rating, lot of ambiguity.

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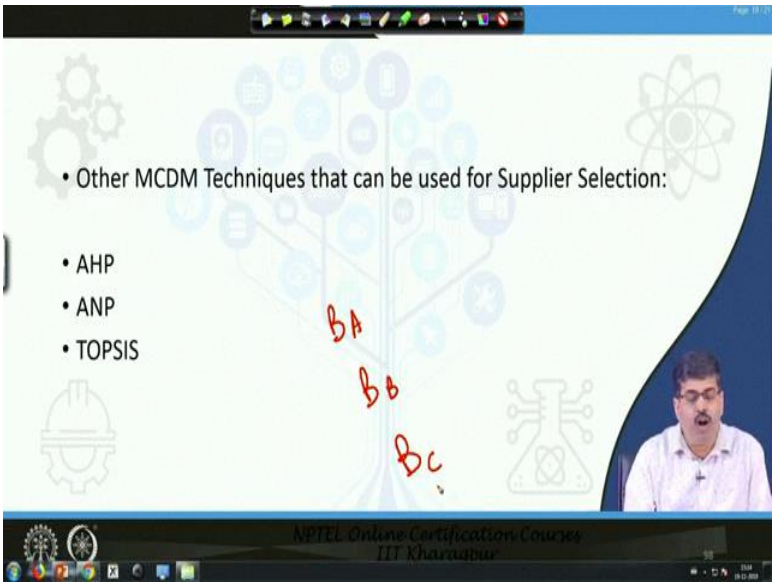


So, instead what we can say is, what we can say is, that can we say that bicycle A is better than bicycle B and is much much better than bicycle C. What are we saying and repeating? Bicycle A is better than bicycle B and is much much better than bicycle C. Bicycle A is better than bicycle B and bicycle A is much much better than bicycle C. That we can say, it is easier to make this judgement.

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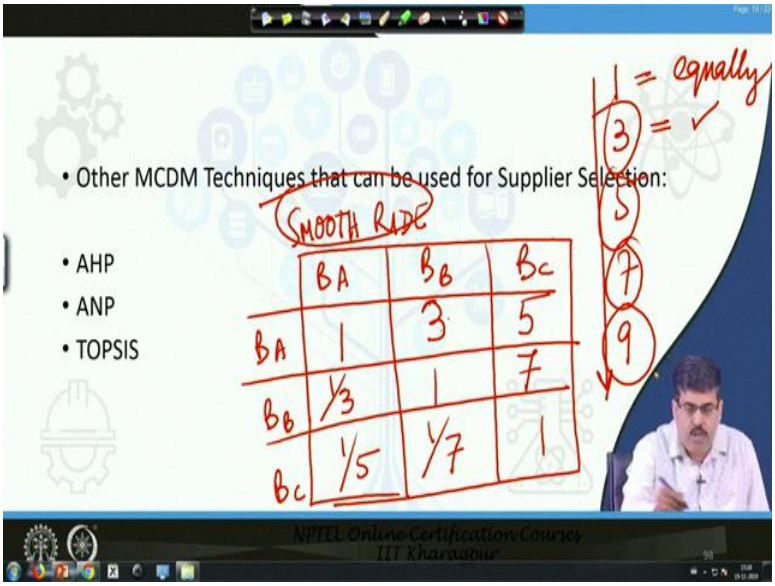


So, when we plot this in a metrics when it brought this on a piece of this thing what is the criteria? Smoothness, smooth ride. So, bicycle A, bicycle B, bicycle C. Bicycle A, bicycle B, bicycle C. Now, when I am comparing bicycle. This is the metrics that we can get for smoot ride, when I am comparing bicycle A with bicycle A what is the score? Understood? Now, what are we saying? Bicycle A is better than bicycle B. So, when we say they are same like bicycle A and bicycle A both the same. It is 1, 1 means equal, equally important. 3 slightly better. 5 much better. 7 very much better. 9 is extremely better. So, it goes in this manner 1, 3, 5, 7, 9. 9 is extremely better.

Now, so by, now if you say bicycle A look at this, look at the row and we are moving from the row to the column. We are moving from this row and we are coming to this column. We are saying bicycle A is better than bicycle B. So, bicycle A is better, what is the better score? 3. Bicycle A is better than bicycle B. We are moving from row to column. Bicycle A is better than bicycle B.

So, bicycle B is one third better than bicycle A. Bicycle A is three times better, better three times. 3 is the score. So, bicycle B is the reverse, it is one third than bicycle A. So, we should move always row wise. Bicycle A three times better than bicycle B. So, bicycle B is one third times that a bicycle A. The bicycle A is much better than bicycle C.

So, what score do we give? 5. So, then conversely bicycle C and bicycle A one fifth. Now, bicycle B and bicycle C. Bicycle B is very very much better than bicycle C. So, 7, what is the converse score? 1 7. So, this is some sort of an AHP metrics for one criteria that is smooth

ride. Then we will have to normalise them, again we will have to normalise and then move about again an average rating, average scoring etc, etc, has been done.

So, I just gave you a rough idea about what an AHP metrics looks like and how do we rate them. When are we using this? We are using this when as I say, this supplier is much better than the other supplier. This supplier is extremely better than the other supplier. So, some sort of a descriptive one we are trying to convert into some sort of a numeric value. Then the question comes in, why are we directly not giving a scale rating? No, because we are doing some sort of a comparison with two, three parties. We are doing some sort of a comparison with two, three parties. That is the reason why this type of metrics is required.

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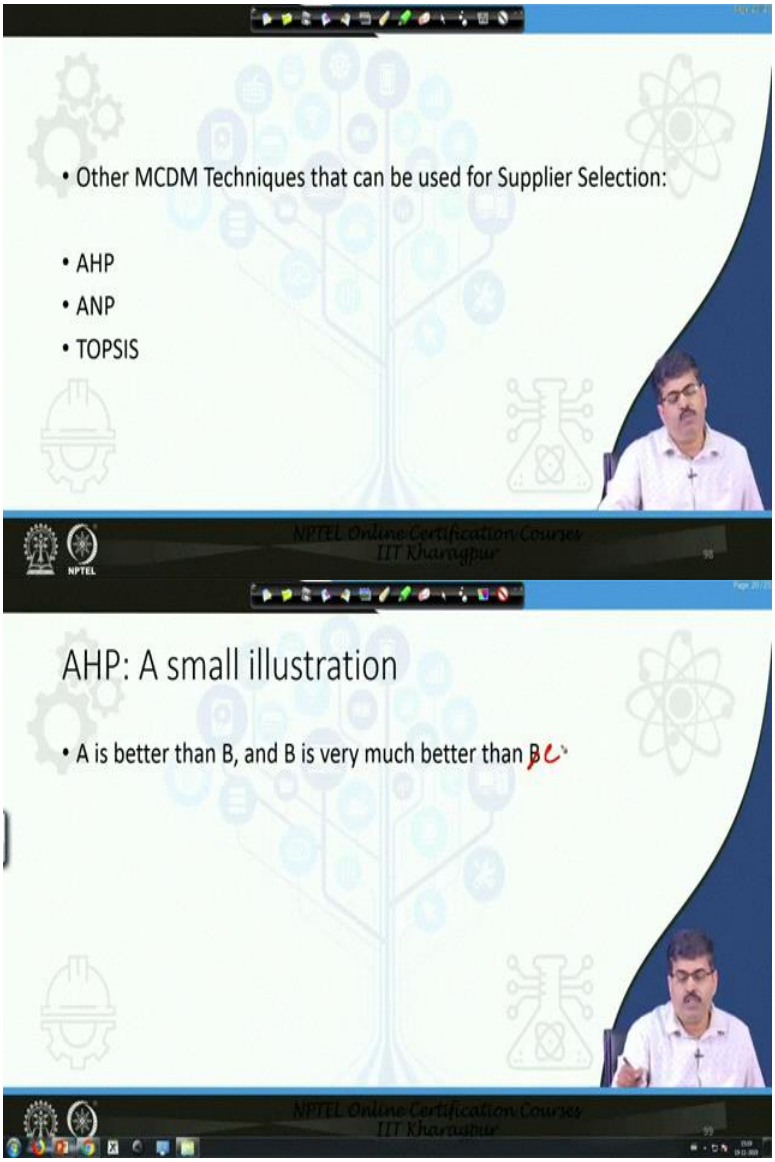

Similarly, for ANP is an expanded version of AHP, TOPSIS also follows some sort of a similar rating. Yeah, this is what I was speaking about, A is better than B. B is very much better than, B is very much better than C it should be. The B is very much better than C.

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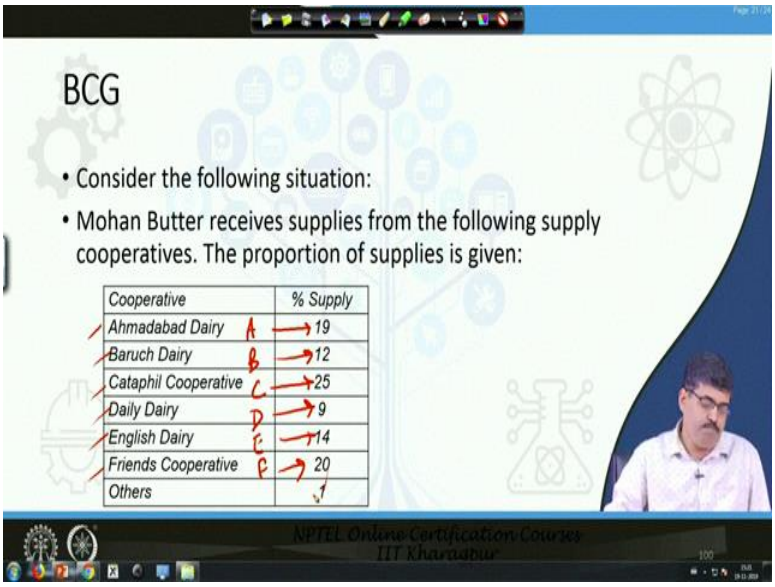


Now, this is another one that I want to talk about. This is when you have all qualitative information, no numbers, but still you want to give a meaningful numeric analysis for selecting suppliers, for giving them discounts, for bringing them under some promotions, etc, etc. Promotion means a job promotion. Promotion means some promotional benefits, promotional techniques, promotional facili, business promotion. So, this is a method that we use when we have only descriptives and multiple pairs, another method.

Now, what do we do? Mohan Butter is a company who is manufacturing and selling butter. Now, we know that nowadays it is all outsourced. So, Mohan butter is basically coordinating its operations, is going under Mohan Butter's brand name. What is Mohan Butter doing? It is procuring butter and dairy products from, it is procuring butter and dairy products from Ahmedabad, Baruch, Cataphil, D, E. So, if you see it is procuring butter from A, B, C, D, E and F as a supplier.

Now, this supplier supply 19 percent of Mohan Butter's requirements. 12 percent, 25, this, this, this. So, this is the supplier's market share so long as, so far as Mohan Butter is concerned. Understood? I am just stopping for 2 seconds. So, what is it in a nutshell? Mohan Butter is receiving butter supply from suppliers, there are six suppliers A, B, C, D, E, F as you are noticing and this is the percentage of supply that they are given to Mohan Butters.

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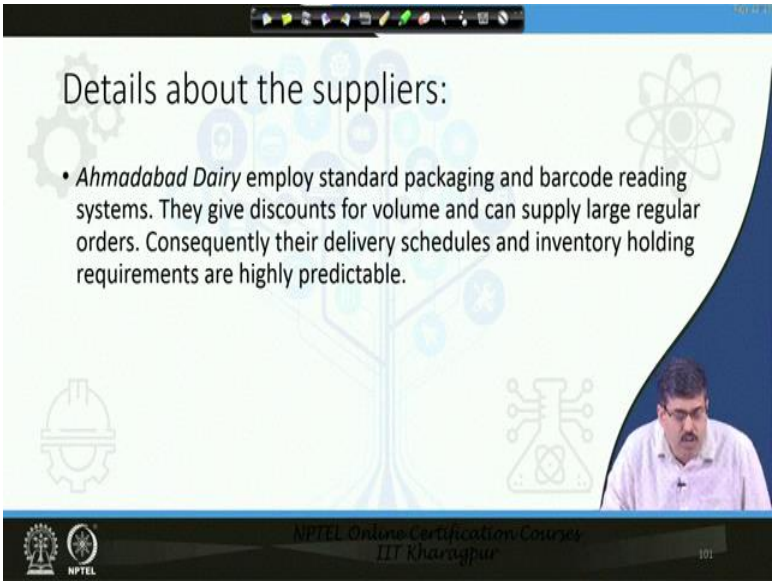


Now, what about these suppliers? This is the description of the suppliers. Ahmedabad dairy employs standard packaging and barcode reading systems. They give discounts for volume and can supply large regular orders. Consequently their delivery schedules and inventory holding requirements are highly predictable. This is some information that when you reach Mohan Butters that is the original company. This is some information that their purchasing team tells you.

What is your job? Your job is to prioritise an A, B, C. A, B, C, D, E, F and then if required, bring them under some supplier management scheme or something like that. So, you need some information about them. This is what Mohan Butter office provides you in on, they have only this much of information of Ahmedabad dairy. They employ standard packaging, barcode reading systems, they give discounts, etc, etc.

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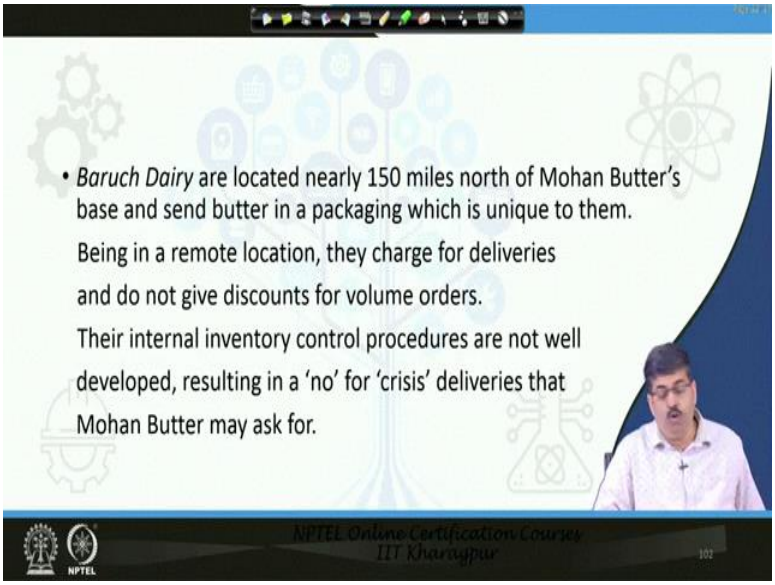


This is the information that you gather form B that is Baruch dairy from Mohan Butters office. Baruch which is located 150 miles away and sends butter in a packaging which is unique to them. Being in a remote location they charge for deliveries and do not give discounts. Their internal inventory control procedures are not well developed resulting in a no for crisis deliveries that Mohan Butter may ask for. That means if Mohan Butter is asking for sudden increase in delivery, Baruch will say no.

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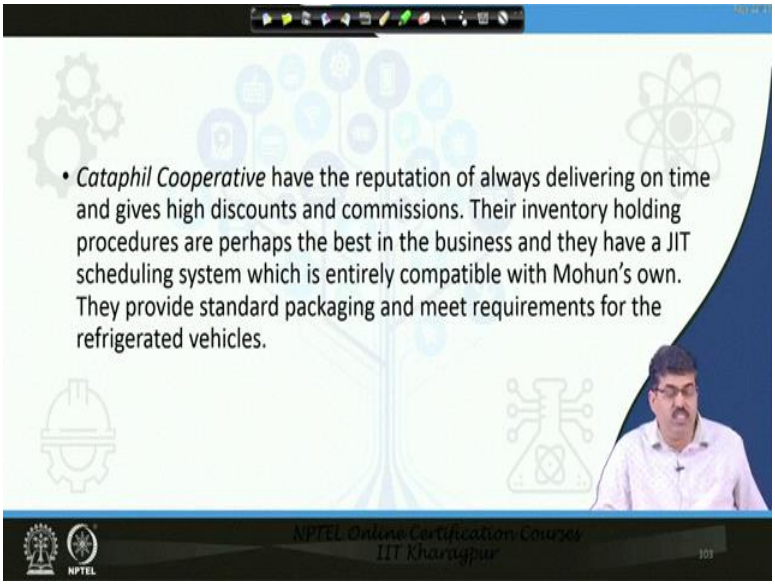


These are just some descriptions. Cataphils has the reputation of always delivering on time and gives high discounts and commissions, their inventory holding procedures are best in the industry, etc, etc.

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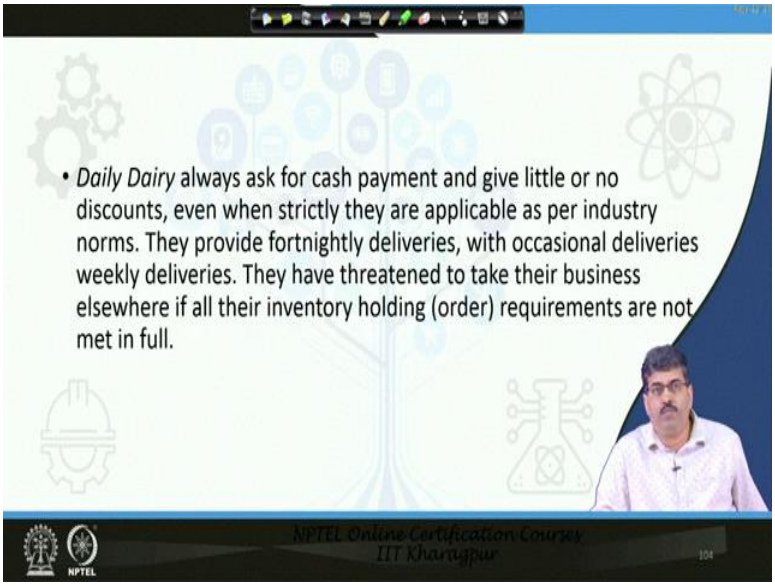


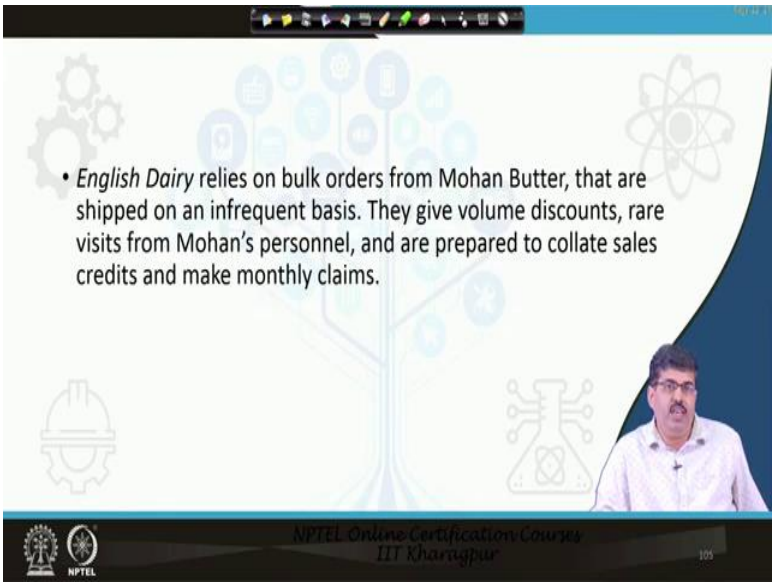


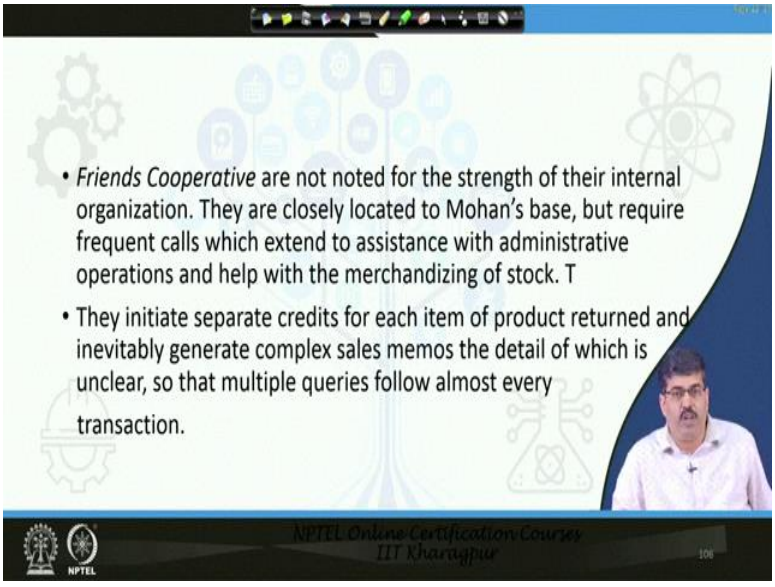

Same for Daily Dairy, English Dairy and Friends Cooperatives. So A, B, C, D, E, F for each of these six suppliers, you have certain descriptive information. What is your job? Convert these descriptive information into some numerics, so that tomorrow if somebody ask you then you will be able to give a numeric justification as to how you have categorised your suppliers.

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How to prepare this matrix that is the question.

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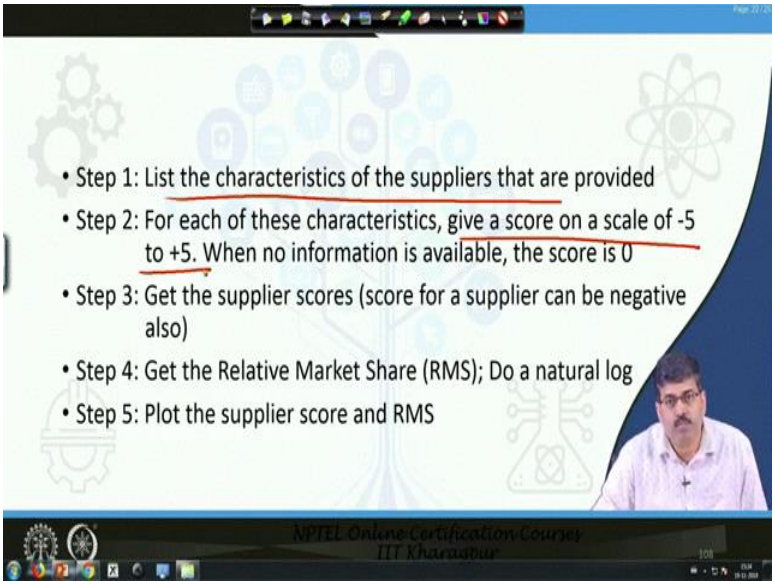


Step 1, list the characteristics of the suppliers that are provided. For each of these characteristics give a score on a scale of minus 5 to plus 5. When no information is available,

the score is 0. Get the supplier scores, get the relative market share, plot the supplier scores and relative market share. We will do this. Let us take step 2. Lists the characteristics of the supplier and for each of these characteristics give a score on a scale of minus 5 to plus 5. Let us see what is happening.

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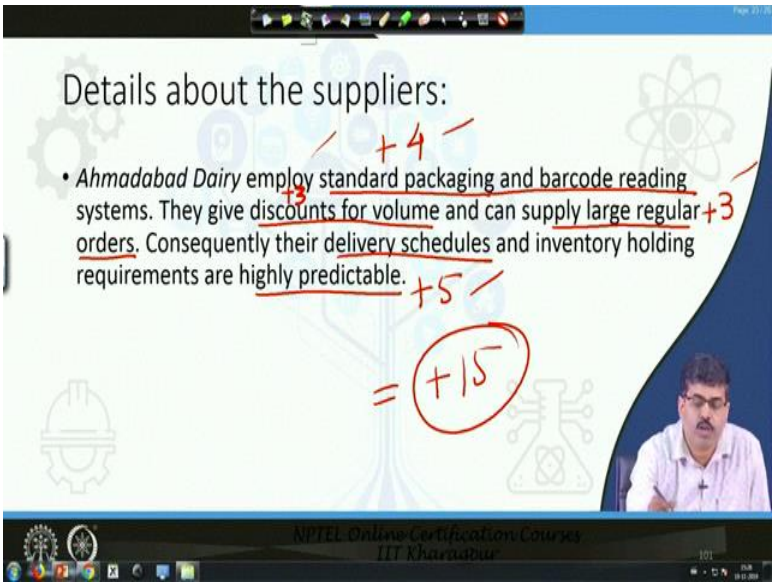


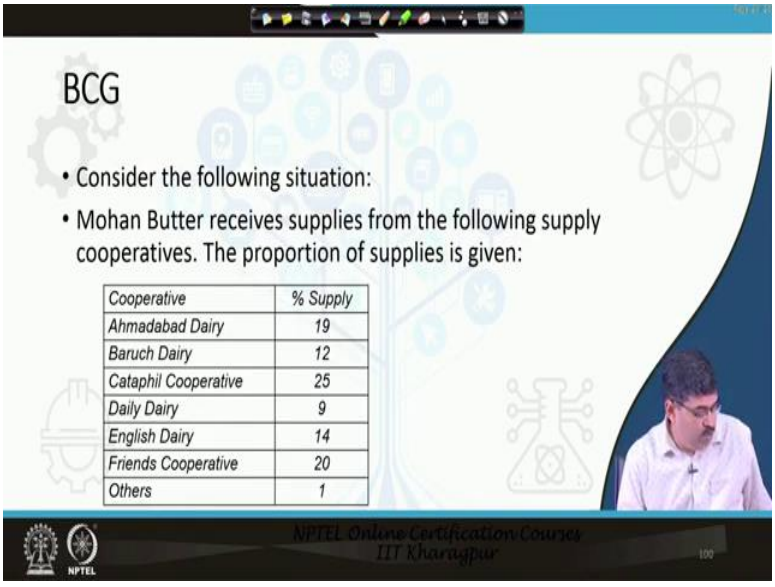


Let us go to Ahmedabad dairy. Who are you? You are, who are you? You are Mohan Butter. What are you doing? Trying to evaluate the suppliers. So, from whose standpoint or whose angle will you look at? You will look at from the angle of or from the standpoint of Mohan Butters. So, let us start, Ahmedabad dairy employ standard packaging, standard packaging, is it beneficial for you or not?

Who are you? Mohan Butters. So, Mohan Butters it is beneficial, because standard packaging then you need not change the packaging, you need not put an extra packaging to send it PAN India. So, standard packaging is beneficial for you plus, How much plus? Plus 5 or plus 3. What is your scale? Minus 5 to plus 5. So, how much plus? So, standard packaging, maybe you can give a 4.

Now, the question is, somebody else will give a plus 3, somebody else will give a plus 5. So, who is correct, who is incorrect, who is wrong what, what, what? Answer is very simple that ambiguity will remain. But, if you have given a score of plus 5 and another person in the same department has given for the same thing as minus 5. Then there is something basically wrong.

One of you have not understood, either you or your colleague, how to rate this. So, that plus 4 can be plus 5, can be minus 5, no problems. So, sorry plus 4 can be plus 5 or plus 3, but not, plus 4 cannot be minus 4 for your friend that much a wide gap will not be there, got it?

So, Ahmedabad dairy employ standard packaging, plus four, packaging and barcode reading systems. They give discounts for volume. So, view that is Mohan Butter, if you are giving large orders to Ahmedabad dairy, they will give you discounts, they give discount, how much? Let us say plus 3, so it is a plus no problems plus 3. Plus 3 and can supply large regular orders.

So, you can supply large regular orders, it is beneficial for you because if you want suddenly bulk orders, they can supply. Say, again let us give a plus 3 or plus 4. Their delivery schedules are inventory holding are highly predictable. Delivery schedules are highly predictable.

Now, when somebody delivery schedules are highly predictable. It is always beneficial, because then you know how to plan things. You need to plan a space, you need to plan a vehicle, loading, unloading section. So, when your delivery schedules are highly predictable, that is very beneficial for Mohan, Mohan butter. So, what is Ahmedabad dairy score? 4 plus 3, 7 plus 3, 10, plus 5 is equal to plus 15 is Ahmedabad dairy's score. Understood?

Can your score be minus? Yes, if all our negative, means every factor it is not beneficial for your company, then the score will be minus. So, you can definitely you can have a minus score, minus 5 or a minus 6, anything you can have. So, it is not, it is not something which you should be worried about. So, you can have a minus score.

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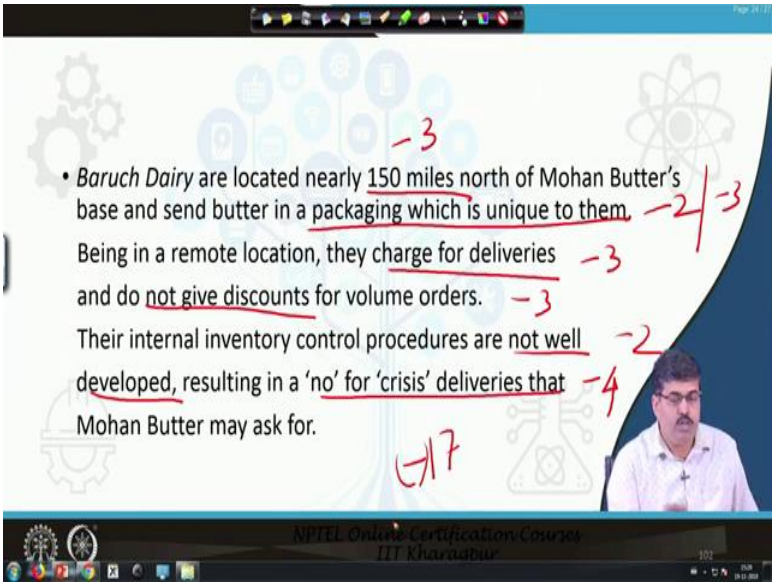


Let us go to Baruch, what will happen? Let us see, B located 150 miles away, negative minus 3, far away. So, there will be problems in delivery and sends butter in a packaging which is unique to them. That means I will have to again repack. Who am I? Mohan Butters. So, it is again a minus 2 or minus 3 also whatever you choose.

Being in a remote location they charge for deliveries, others are giving free deliveries, they are charging, minus 3, do not give discounts, minus 3, their internal inventory procedures are not well developed minus 2, resulting in a no for crisis deliveries that Mohan Butter may ask for. So, no crisis delivery minus 4, so all minuses, 3 minus 2, 5, 8, 11, 13, 14, minus 17 is the score for Baruch. So, are you getting the point, how to do this?

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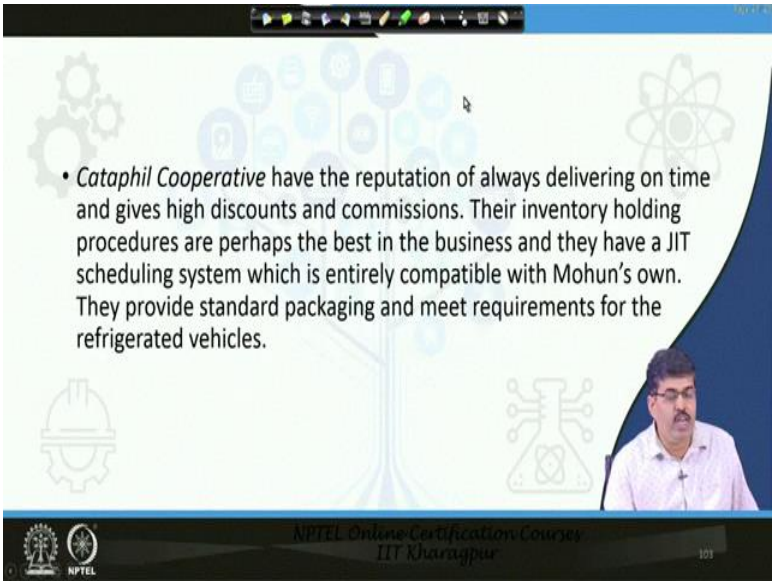

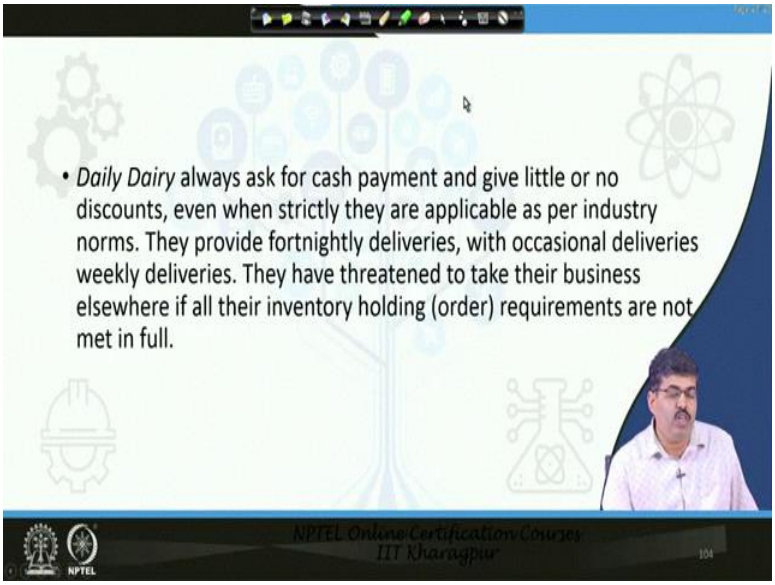


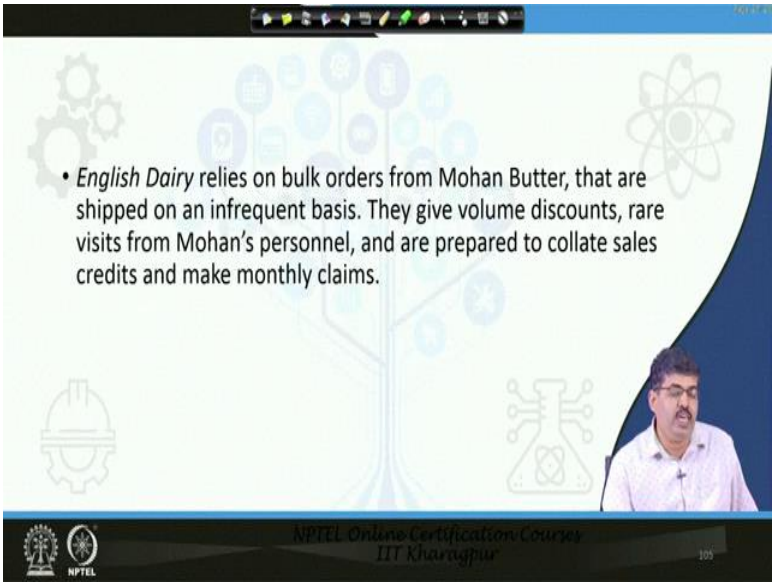


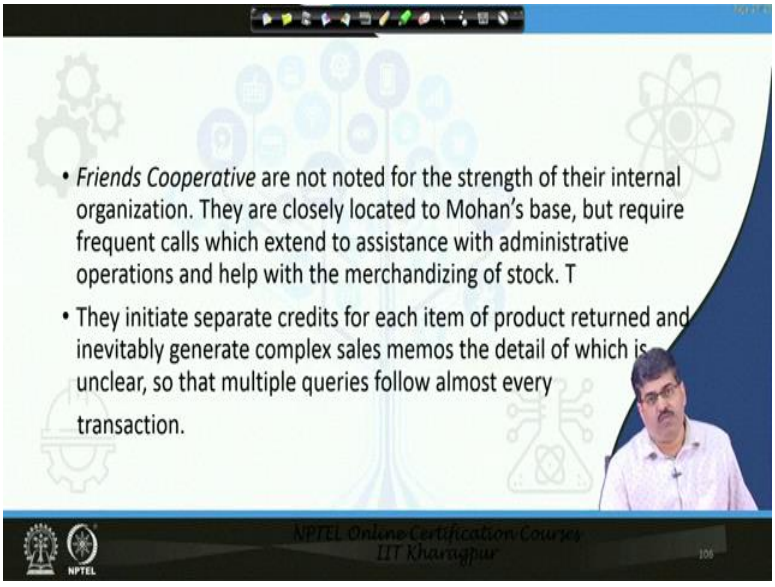


So, in this way you do for C, D, E and F, get the scores. Get the scores.

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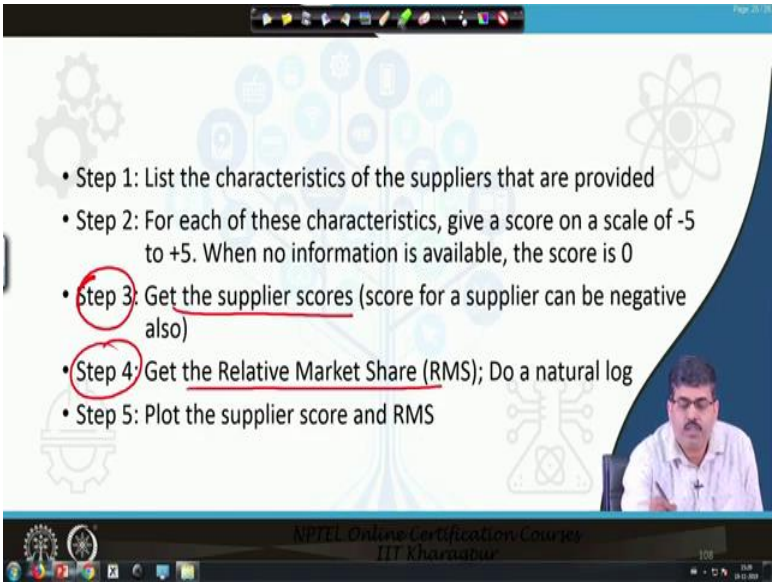


This is what we had just done, get the suppliers scores. Now, next step is what? Get the relative market share. What is the relative market share?

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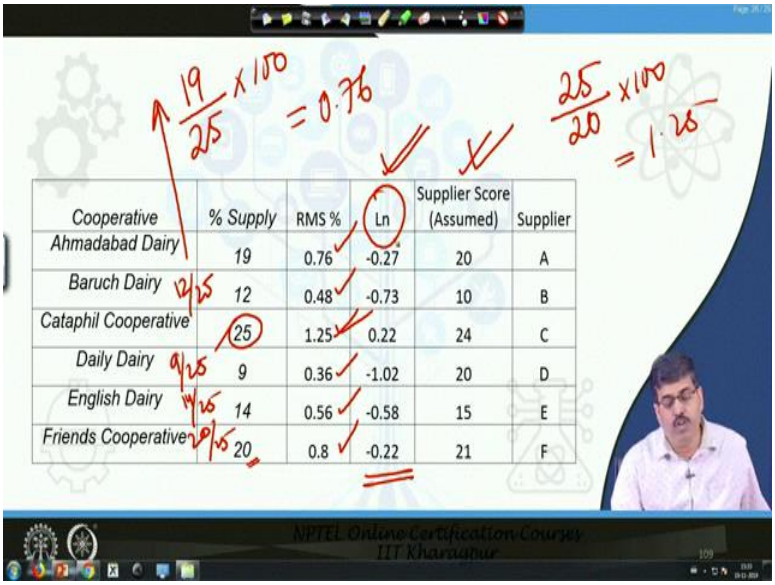


Relative market share is something like this, this was the original metrics 19 percent was Ahmedabad's market share right. Relative market share is your share with respect to the best player in the market. So, Ahmedabad dairy the market share will be 19 percent is share, best players market share is 25 percent into 100, this gives us 0.76 that is your relative market share for Ahmedabad dairy.

Same for Baruch, 12 divided by 25 into 100 that will give you 0.48. What about C? It is the best player. So its own market share 25 divided by the best player 25 by 25 into 100 that should be 1. But we are getting 1.25. So, let us keep this aside, we will do this later on. Daily diary 9 by 25 best player, relative market share, 14 by 25. 20 by 25, so this I am just writing 12 by 25 into 100.

Then, so we have got it, What about Cataphil? What about Cataphil? Its market share is 25. Rule is when you are the best player whom should you look at how or where the second player is? Is the second player directly breathing behind you? So C's market share is 25 divided by the next best player is 20. 25 by 20 into 100 that will give you 1.25. Now, then we do a natural log of all these and this is the natural log balance. Natural log of the relative market share, natural log or the relative market share and then we get this log values.

Now, this is one that we calculate from market share percentage that was already given to you at the beginning of the problem the market share of the suppliers. And we have just calculated the supplier scores, how? Remember, we get plus 5, minus 3, plus 4, plus 3, plus minus 3. And then for Ahmedabad we got a score, for Baruch we got a minus score, for Cataphil we got another score. So, basically we got some supplier scores.

This I have just given arbitrarily just to demonstrate, but you will have to get the actual score based on plus 5, minus 5, plus 3, minus 2, minus 5, plus 3 all these ratings you get a total average score. These and we have given the short form of supplies A, B, C, D, E, F. So, we will now work with these two values, the supplier score and the natural log.

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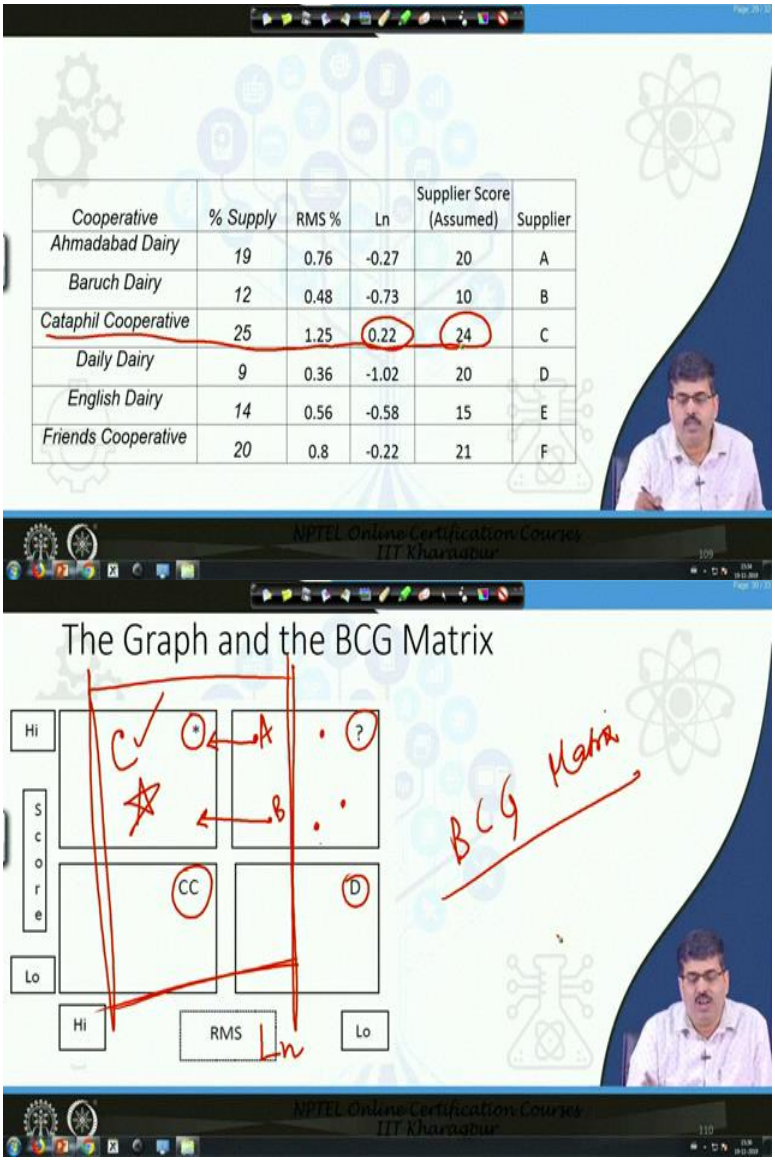


What will we do? Let us see, we will do a graph as simple as that. What do we do? Relative market share, what is this? The natural log, and high, low and this is the score for the suppliers high, low. If you go back, if you go back let us take C. Let us take C, natural log values 0.22 and supplier score is 24. Natural log value high that is 1.25 and supplier score is also on the higher side 24. So, where is C? Here, for all the others, you will get them somewhere around here. This in management is called as the BCG metrics.

In BCG metrics, this is a star, this is a question mark, this is a dog, and this is a cash cow. So, your supplier C that is Cataphil that he is the star, that is he is the best supplier. For all others, the next best supplier is the one which is closest to the star. The next best supplier is the one which is again the next closest to the star. In this way if you can rank C, then this one, then

this, then this supplier, then this supplier, then this supplier. So, this way you can prioritise. So, if you were to give some loyalty programme to some supplier, which one would you give to? You will give it to supplier C.

If you were (())(26:56) some supplier by giving them some technology or something like that, you will give it to this supplier assume this is A. Assume I said this is A, assume this is B. So, you will have to give, so if you are giving some technology upgradation training, etc might be you give it to A and B.

So, this is again another justification when you have very little information, when you have very little information about the suppliers, when your office is not able to tell you or your nature of businesses such that your entire supply base is coming in from the unorganised sector, it is very difficult to collect information. So, there you can convert the simple descriptives into some sort of a numeric description and come up with a logical understanding of supplier ratings.

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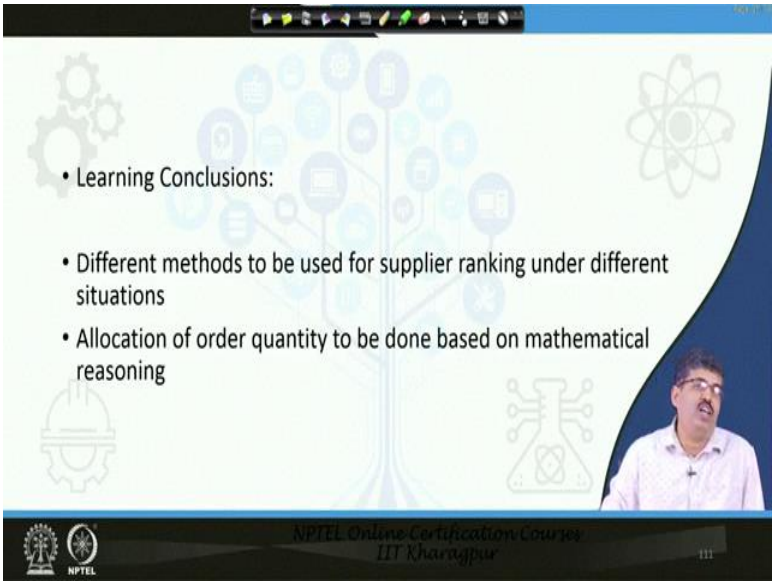


So, what did we learn? Basically, we have learned the different methods to be used for supplier ranking under different situations. And we also have learned allocation of order quantity to be done based on mathematical reasoning, it is not arbitrary. And basically, we took you through, when you have full market information, all numeric data is available. And then we took into, took you through all the descriptive information that you have in the market and how to convert the descriptive market information into numeric market information.

So, basically your entire supplier selection, if you look at we have looked at supplier selection from all angles, from the numeric angle, when you have equal weights, from the rating angle, from ranking angle, how to distribute the products, clustering of suppliers, and then also now when you only have descriptive information, and you can convert that information into a BCG like metrics and you can model your supplier selection.

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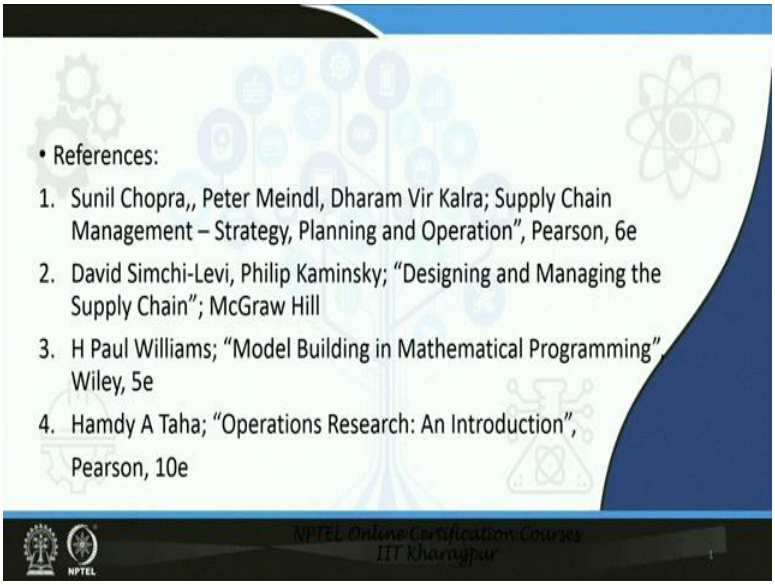


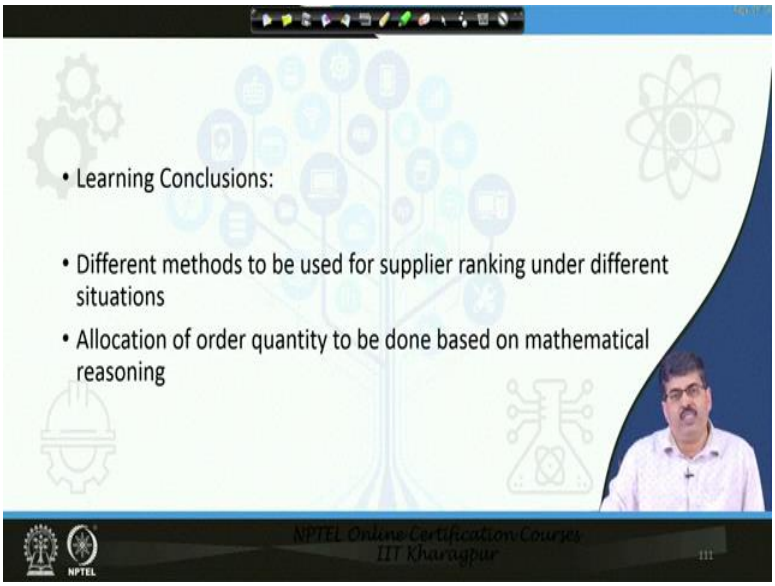


With this. We end your module 2 that is or your week 2 sorry, or your week 2 lecture on supplier selection. With this basically we conclude your supplier selection modelling and analytics. Thank you.