Modelling And Analytics For Supply Chain Management
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Lecture 07
Supplier Selection Analytics

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Hello welcome we are into module 2 of modelling and analytics for supply chain management. In module 1, you have learnt the entire concept of supply chain and where exactly modelling and analytics lie in this entire gamut of supply chain that is where exactly we can apply modelling and analytics number 1, and number 2 what you learnt is what are the benefits that organisations can derive from modelling and analytics. If you recollect, see supply chain basically is a cost centric activity, that is there is no revenue is earned by the Department of Logistics and Supply chain.

Hence, there is tremendous focus on reducing the supply chain cost, if you reduce supply chain cost what will happen is the price of the end product will come down. And so the company concerned will gain a lot of lot of competitive advantage over its competitors in the market.

So, there is tremendous pressure on the supply chain to reduce cost. And that is exactly where all the mathematical models come into role or come into play that is where we can apply mathematical techniques and optimise the supply chain and as a result reduces cost. That is the objective of modelling and analytics in supply chain. That is what you learned in module 1.

Now, if you look at supply chain and if you just visualise the supply chain it starts with forecasting of demand. Once you have forecasted the demand then what happens is now you will start selecting suppliers because when you go to a supplier the supplier will first ask you how much do you need from us? That means how much quantity do you need from us. Now, that how much quantity you need from us, you will not be able to tell unless you have done a proper demand forecasting.

So, supply chain starts with proper demand forecasting and once you have done your proper demand forecasting then you do supplier selection. Once you are done with supplier selection then you will have to find out how to reach the raw material or the semi-finished products to the factory. So, this is transportation. So, demand forecasting number one, number two supplier selection and number three we move on to transportation modelling. Now, once the products have reached your factory, they have to be stored for some time till they are into the machine shop or the production shop.

So, then comes the warehousing decision. Where to locate the warehouse, how much space do you need, how to synchronise the supply of materials into the production system so your warehousing cost is minimal. Now, so this is your warehouse location and warehousing decision models. And then your production starts, again after production the finished products will go into various distributors and dealers then again your warehousing of the finished products come in. And then the last mile delivery.

So, this is your entire gamut of supply chain modelling. What is inbuilt-in it? Returns is inbuilt in it, so returns modelling, supply chain risk analysis, supply chain risk measurement. You are having a global supply chain today, look at Dell computers, it is manufactured in different parts of the world and reaching you in our country. So, we are looking at global supply chain, which countries was the product pass through? You have to understand the riskiness of this global supply chain. So, this is the entire gamut of modelling and supply chain.

So, as we mentioned supply chain starts with or supply chain modelling starts with demand forecasting. Now, demand forecasting as a mathematical tool or technique is widely covered in operation's research classes. So, we are not going into that, we presume that the organisation has done a fairly accurate demand forecasting. Now, once you are done with your demand forecasting, then we move on to supplier selection, this is where we are starting of today.

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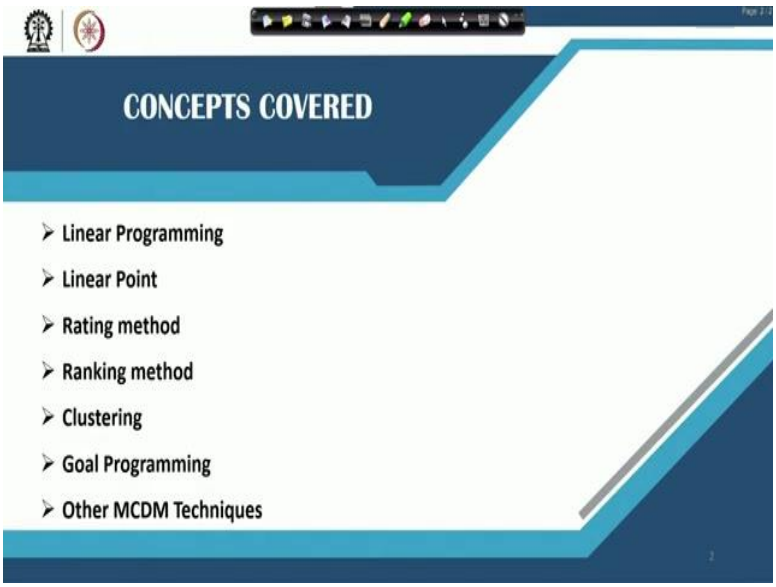

So, what we intend to cover today? We intend to cover today little bit of linear programming. Just to have a small recap of what linear programming is all about. Then, we will go into all the supplier selection methods and techniques and models. We will cover linear point, rating method, ranking method, clustering, goal programming and some other multi-criteria decision modelling techniques.

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Now, remember we just now spoke of where the supply chain starts, so this is the diagram of the Soy supply chain. What is Soy supply chain? We all take Soya Bean or Nutrela along with our food, this is the diagram of Soy Supply Chain.

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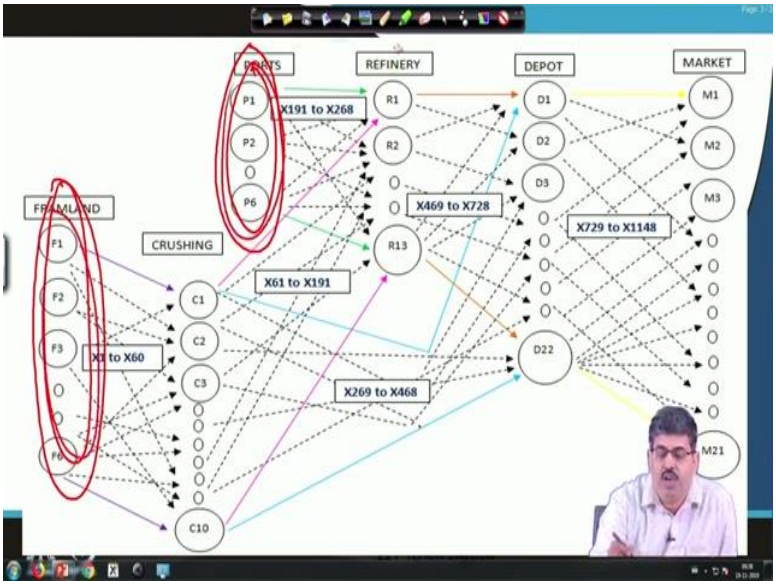

What it is it? You look at it, at the extreme left hand side there is something called farmland, what is farmland? This is where the Soy fruits are grown. Now, the Soy fruits once grown the seeds are extracted. They now move on to the next level, they now move on to the next level and this is where your this crushing these Soy foods move on from the farmland to the crushing units. At the crushing units, the soy seeds are crushed and what we get is basically the soy bean oil.

Now, why is this crushing is done? This crushing after that, it has to go to refineries. Why refinery? Because there will be lot of impurities and lot of these plant (())(6:31) etc. that will be there. So, they have to go to the refineries. Now, in our country the soy seeds or the soy fruits that are grown that is not enough to meet the demand of the nation. So, some amount of soya bean oil has to be imported, so this comes in through the ports.

So, again from the port they will go to the refinery. So, it is the refinery where the oils will be processed. What about, what about the leftovers? Through a chemical process these leftovers are now then converted into the soya bean that the Soy foods that we speak about. The most common brand name been Nutrela and all these companies. Now, once the finished products the oil and the soy fruits they go to the depots and from the depots they go into the whole seller, the distributor, then to the final retailers in the market. So, this is the entire supply chain that we are talking about.

So, once we have a proper demand forecasting, the products move from the farmland to the crushing units, from crushing units the oil is extracted, then they go to the refineries, it is

made pure and then they go to the depots and from the depots they go to the market. So, this is my supply chain. So, this is what you are supply chain diagram is all about. We have to, if we go back again we have to find out who will be my suppliers, who will be my suppliers who will supply me this raw material.

Who will be my suppliers who will supply me the raw materials, who will be my suppliers who will supply me the soy oil that is imported? So, the supplier selection who will be my suppliers of raw materials, who will be my suppliers of semi-finished goods that will reach my factory. So, the supplier selection becomes very very important.

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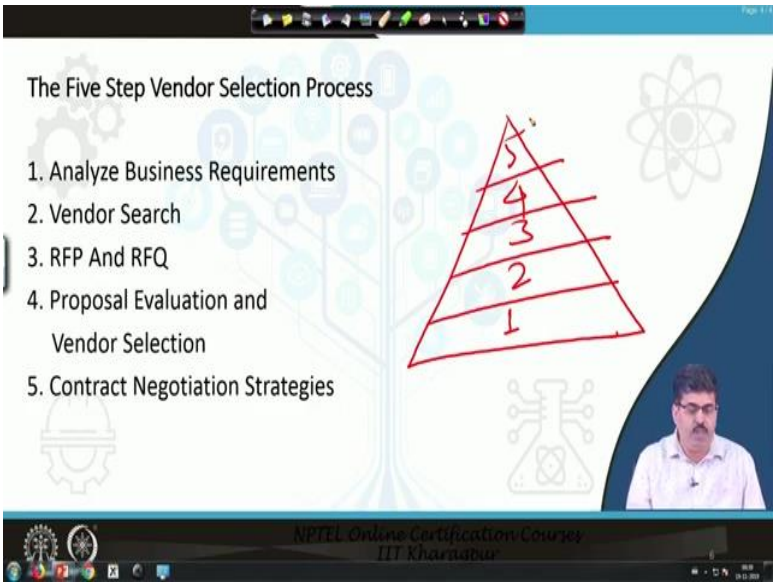

Now, so we have to keep the, so that is what we were all talking about. Firms have to keep cost to minimum to remain competitive and that leads to focus on material procurement cost and this warrants effective supplier selection.

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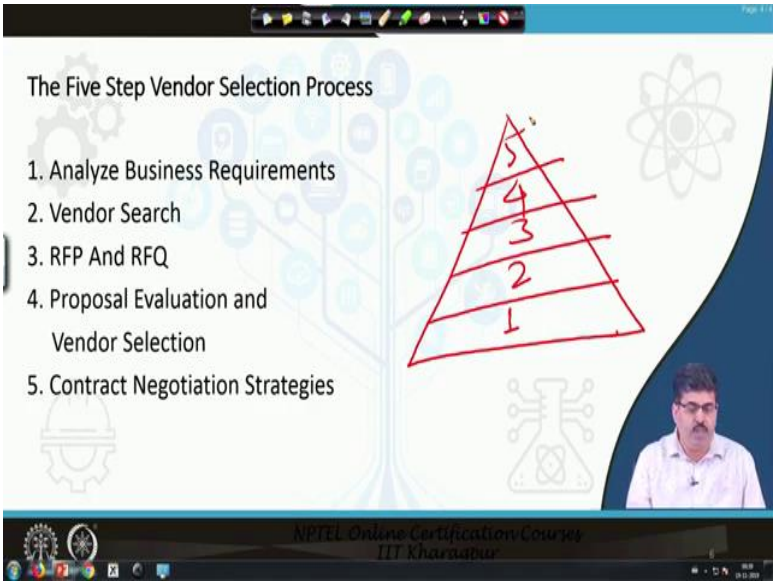

Now, we all know this, the 5 step vendor selection process. We have to understand what my organisation needs? What is my requirement? This what is my requirement looks very simple but the (mome) we will do an exercise and we will see why it is a very very important thing as a first step to supplier selection, we have to understand what are my requirements. Based on the requirements we will do our search for who will supply me. This is called as a vendor search.

Then we go into RFP and RFQ, what is that? That is a request for proposal and request for quotation. And then we evaluate these proposals and then we go to contract negotiation. So, if you see this entire thing can now be looked into as vendor selection pyramid. First, we go and first we look at to what is my requirement. Then we search according to venders, who are my venders who can supply me the materials. Then we ask a proposal from them. Then we evaluate the proposals and then we negotiate and do a contract. So, this is also called as a vendor selection pyramid.

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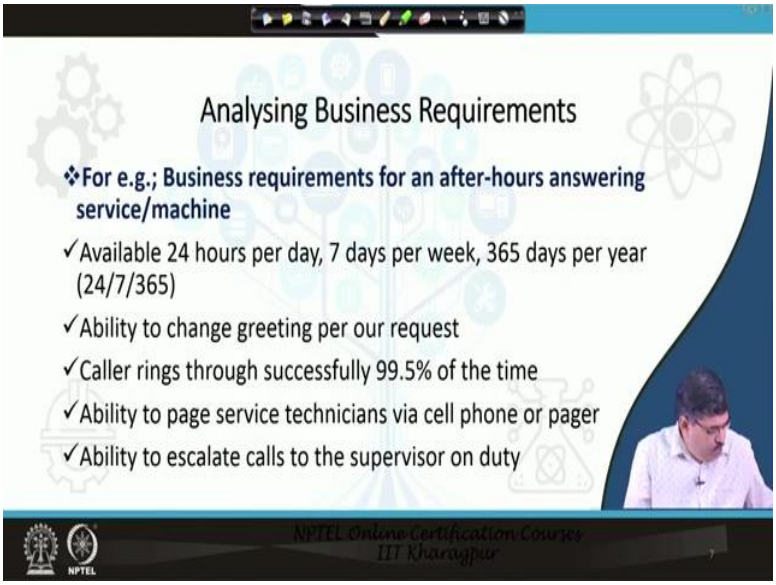

As we were saying, in this in the previous slide analyse business requirement. Now, see you know we all use credit cards etc. and we call up on an automated voice speaks it up. Now, we want to buy a machine. So, what is my business requirement? Look at the criteria. Available 24 hours per day, 7 days per week, 365 days per year. Ability to change greeting as per request. Caller rings through successfully 99.5 percent of the time. Ability to page services, so you see these are some of the business requirements. So, once you are clear about your business requirements. Then you can do a very good vendor search witches point number 2. So, first we will have to be very clear on what exactly we need accordingly we will search for vendors.

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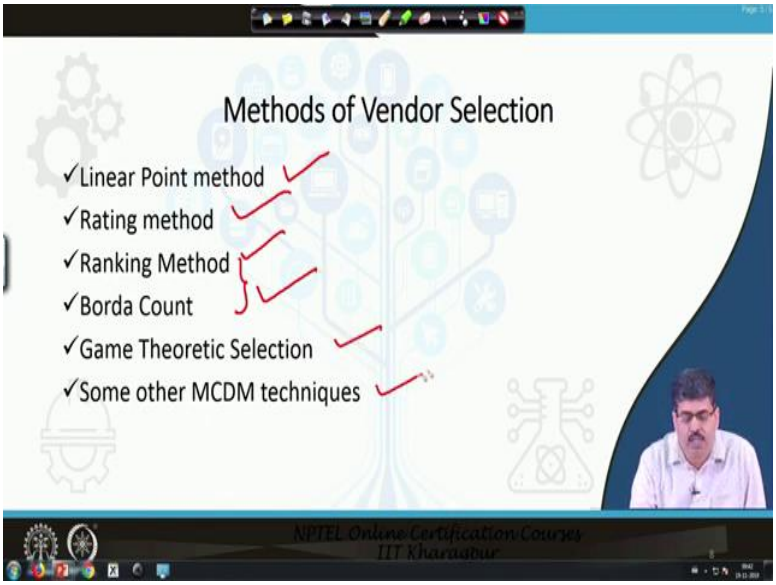

Now, so this vendor search, sometimes it is for every product we do not get too many vendors also. If it is very very unique product, we will get only one or two vendors, then we have no choice. But then, for products or for semi-finished products or for raw materials for which we have a pretty decent number of suppliers available then we will have to apply some mathematical techniques to select vendors. Why mathematical techniques? Because take a simple situation that we have floated a tender and 5 companies have shown interest that we want to supply your company let us say chairs, we want to supply your company some chairs. Or let us say raw material for a manufacturing unit.

So, these 5 suppliers they have expressed interest. And you as the purchase manager have selected one supplier, immediately what will happen? The other 4 will start complaining, why have you not selected me? What is it good in supplier number 1 that you have selected the supplier number 1 and not us? And lot of letters will come in, lot of complaints will come in, so, there should be some justification and if that justification is mathematical then we are very very safe.

And we are very very just also in selecting the suppliers and then we are doing an objective analysis and objective justification to supplier selection. So, what are the methods of supplier selection? The first one is linear point method, you will learn all of these. Second one is rating method, third one ranking, now this ranking and Borda sometimes are put together Borda Count. Game theoretic selections and some other MCDM techniques.

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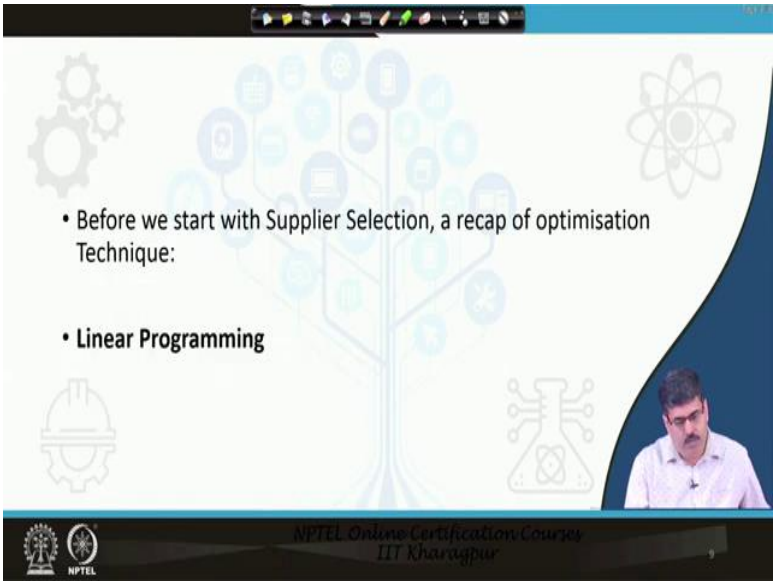

Now, we are in to supplier selection modelling. This was a brief recap or a brief introduction about why mathematical modelling is required for supplier selection. Before we go into supplier selection, little bit of revision is required for linear programming. I hope all of you have an idea about what linear programming is all about. Linear programming is an optimisation technique, it has given lot of constraints how do you optimise different situations.

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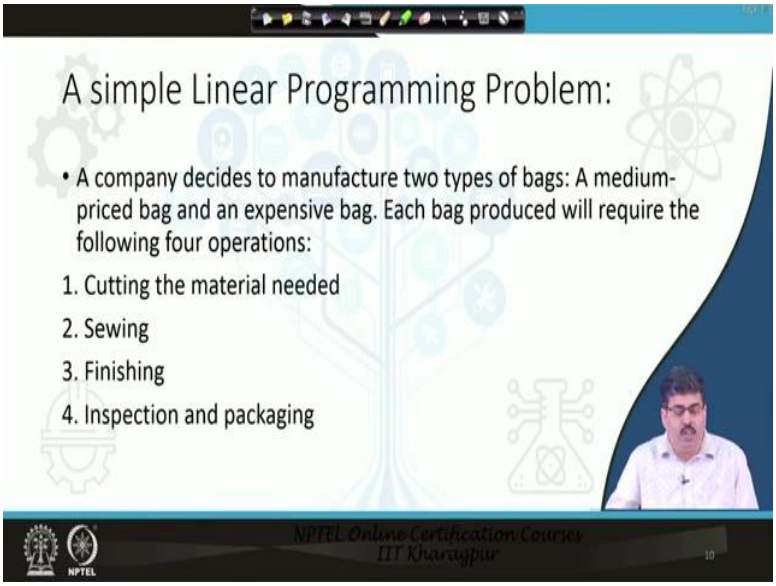

Let us take a simple linear programming problem. A company decides to manufacture two types of bags of medium priced bag and an expensive bag. Each back produced will require the following four operations. Cutting the material, sewing, finishing, inspection and

packaging. So, you see what have you learned from this? Let us have a look. You look at the problem, you go through the problem, I am stopping for a second. Just go through the problem.

So, we have two types of bags which we are manufacturing, a medium priced bag and an expensive bag. Each bag will go through the same four processes okay.

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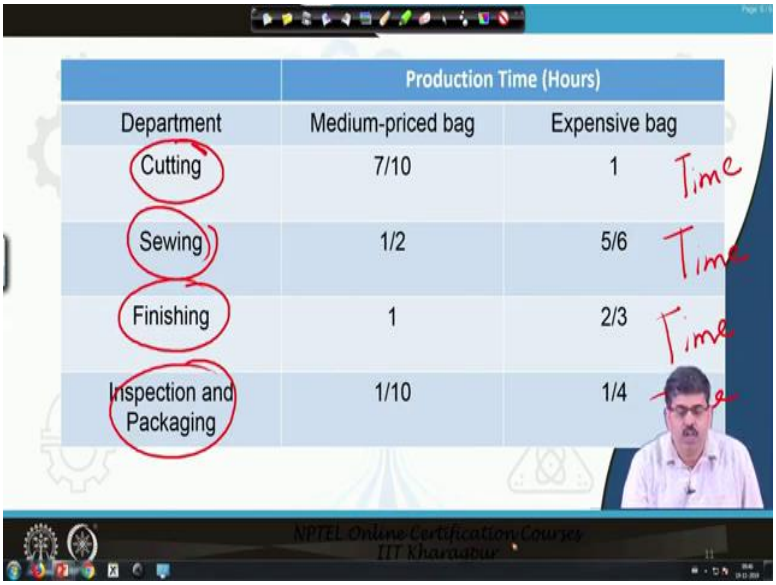

Now, in the processes for medium priced bag, for cutting the bags 7 10th of an hour is required, for expensive bag 1 hour is required. Definitely expensive bag requires lot more monitoring. Sewing, half an hour is required for a medium priced bag and 5 6th of an hour is required for the expensive bag. Similar way finishing, inspection and packaging. So, this is the time required to process one bag for each of these centres. Time required for processing one bag for each of these centres.

Now, this cutting is done in a separate cutting shop, this cutting of this bags is done in a separate cutting shop. Now, this cutting shop will not run indefinitely, sewing is also done in a separate production shop, finishing is also done and inspection all are done in separate production shops. And they will not run indefinitely. So, each one its cutting shop will have a time constraint. The sewing shop will also have a time constraint. And this finishing shop will also have a time constraint. And this inspection shop will also have a time constraint. What are the constraints let us see now?

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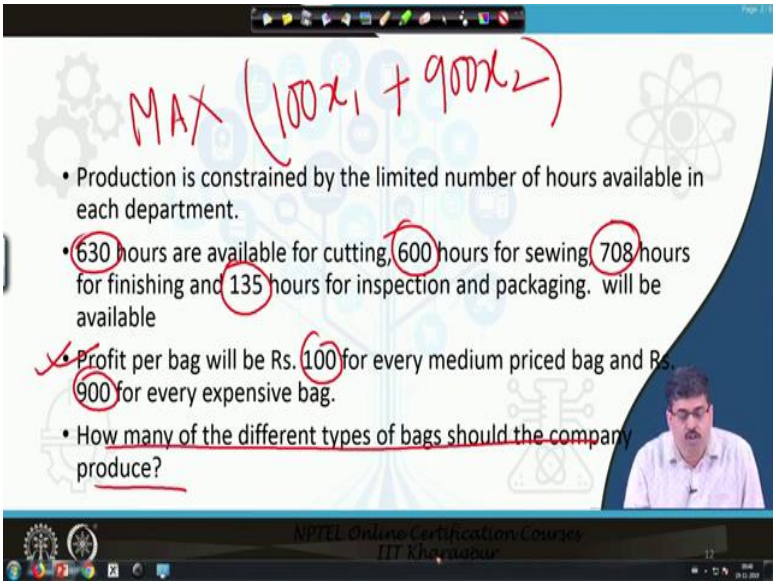

630 hours are available for cutting, 600 hours for sewing, 708 hours for finishing and 135 hours for inspection. And the profit will be 100 for medium priced bag and 900 for every expensive bag. So, how to, so just a second again I am pausing for 2, 3 seconds just have a look. So, how many of the different types of bags should the company produce? That is the question, and that is basically which every business wants to know. How many of the different types of bags should the company produce?

Now, we do not know how many they should produce, so medium priced bags, how many they will produce we do not know. So, let us keep it that X1, the expensive bags, how many they will produce we do not know so, let us keep that as X2. So, X1 medium bags are produced and X2 quantity of high-priced bags or expensive bags are produced. What do you want to do? What is our objective? Our objective is to maximise my profit. So, what is the profit per bag? See here, profit per bag is 100 for every medium priced bag, so, what is the profit? 100 X1 and 900 for every expensive bag, so 900 X2.

So, what is my total profit possible? 100 X1 plus 900 X2, what do you want to do? What is my objective? My objective is to maximise this, my objective is to maximise 100 X1 plus 900 X2. What are the constraints? 630 hours cutting, 600 hours sewing, 708 hours finishing, 135 hours for inspection. So, now how should we write it? Let us go back.

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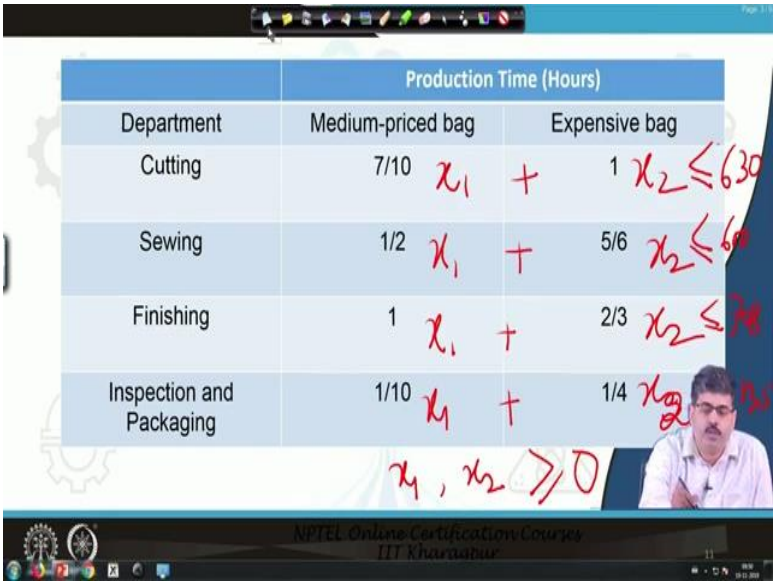

What was the problem? 7 by 10 hours for medium priced bag and 1 hour for expensive bags. How many, how many medium priced bags are we manufacturing? X1, and how many expensive bags? X2, how many medium priced bags? And what is the cutting hours that are available to me? 630 cutting hours. So, total cutting hours cannot exceed 630. 630 is the maximum time available for my cutting shop so 7 10th X1 plus 1 X2 is less than equal to 630.

For sewing how much time is available? 600, so again it should be less than equal to 600. Similarly, 708 and similarly 135. So, these are my constraints. And what can be the values of X1 and X2? Can they be minus? No, so, X1, X2 can either be greater than or equal to 0. So, is it clear? Just have a look at it, I am waiting for 2 seconds. Okay I am proceeding.

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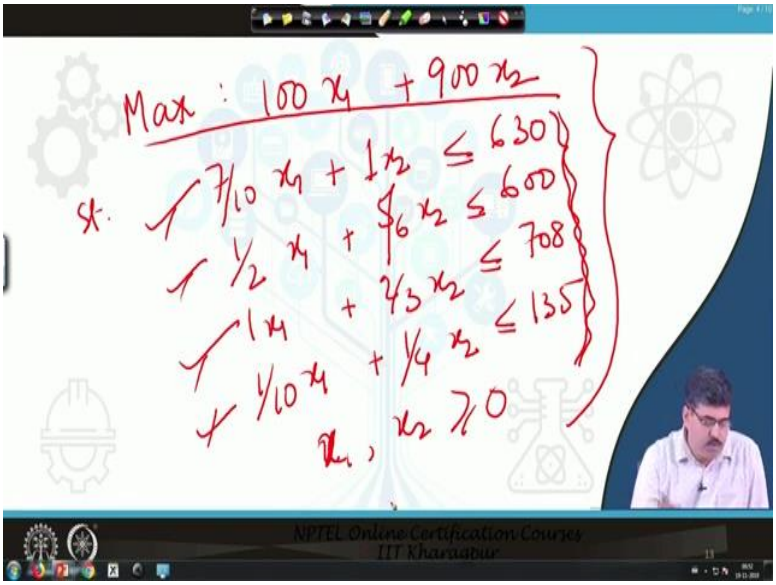

So, what will be the new model look like, what was my objective? My objective was to, my objective was to maximise, objective was to maximise 100 was the profit from medium price bags and 900 was the profit from the expensive bags. What were the constraints? 7 10th X1 plus 1 X2 and maximum time that was available to me was 630. So, this is my linear programming formulation now, is it okay? You want to maximise the profit and these, we want to maximise the profit and these are the constraints that are there in doing this.

What are constraints? These are basically the limiting factors that are limiting my profit-making capacity. If my production hours, if my hours available here on this side, if my hours available here on this side was more than I could have produced more. Since, hours available is limited so my profit capacity or production capacity is also limited. So, what is optimisation technique? Optimisation technique basically helps you to optimise given these constraints. So, if you look, is it okay now?

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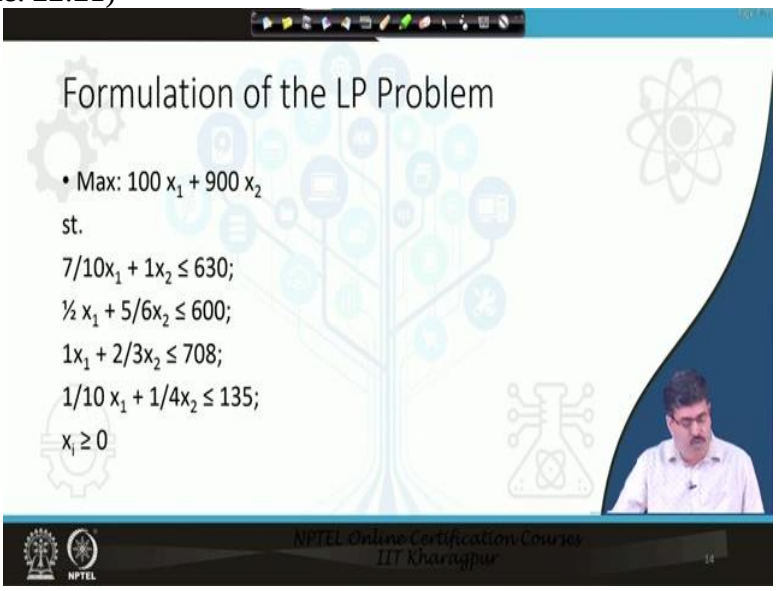

So, now if you look at it, we have formulated the LP problem for you. And this is the problem. Is it okay? Now, why did we run this linear programming problem? We will require linear programming on a regular basis in modelling and analytics. So, this linear programming problem was just a recap of how to use mathematical techniques and because we will, as I mention we will regularly require this type of a problem formulation.

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Now, we will end this particular slot with this topic of linear programming. Now, what did we learn? Just a brief recap.

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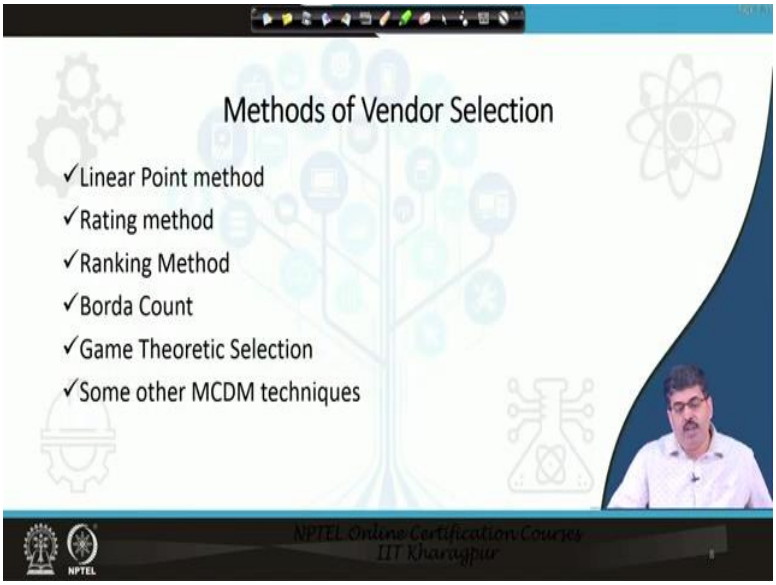

We learned what exactly a supply chain is all about. We learned what exactly a supply chain is all about.

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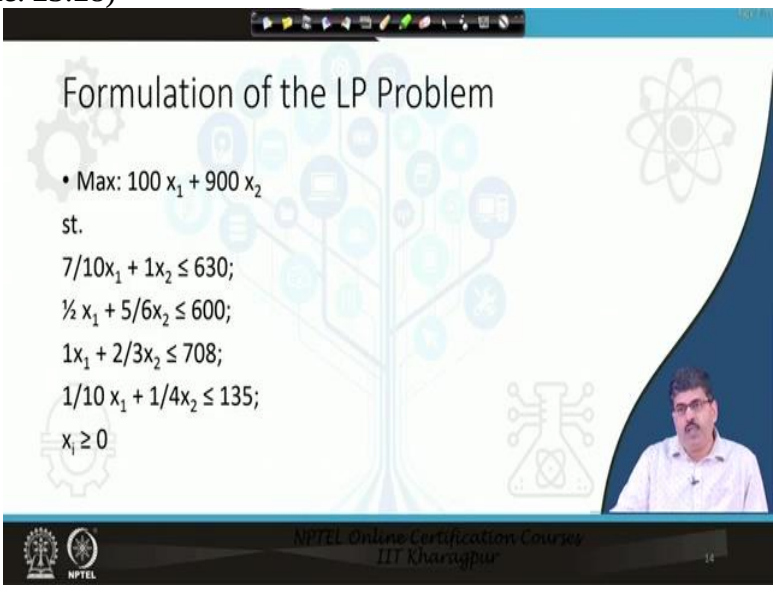

We showed you some diagrams. And we showed you where exactly modelling and analytics lies, what is the role of modelling and analytics. Then we mentioned that forecasting is the one with which we start off. But forecasting is a technique that is extensively used in operations research, so, we are not covering it and we are straightaway starting off with supplier selection models.

Why mathematical modelling is required in supply selection models? That we explained and then we moved onto a simple linear programming problem to show optimisation techniques

and why did we do that? Because we will regularly require optimisation techniques for decision making in supply chain.

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Now, supplier selection models is one which we will start off with in the next lecture session. Thank you.