Modelling and Analytics for Supply Chain Management
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Lecture 50
Forecasting: Multi - Period Forecasting

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Hello and welcome to Modelling and Analytics for Supply Chain Management. Today, we are into lecture 50 of week 9, that is forecasting and we will specifically deal with multi period forecasting. All along, all these weeks, we have taught you or taken you through different methods of forecasting and you can apply these methods based on different situations. Which situation you will apply, that depends on the nature of the product, the time frame, everything.

Now, all were giving you, all the methods that we taught were giving you the forecast for tomorrow that is, next day or next month or next year, depending on the data. But today, we will discuss multiperiod forecasting that is, we have the actual demand for these many months, these many years. With that, we want to forecast what is the demand for tomorrow, day after tomorrow, next day, next day, and next day. So, multi period forecasting, that is the agenda for today. Now, apart that is one agenda.

Second agenda is , we will see now, as a wrap to the forecasting, as a module, as a week, we will see what companies are doing all around the world and how companies are adopting the forecasting techniques to increase their profits. Then we will also learn or we will touch through what is forecasting error, means which model to choose, which model will give you lesser forecasting on the basis of lesser forecasting errors. So, this is our agenda for today.

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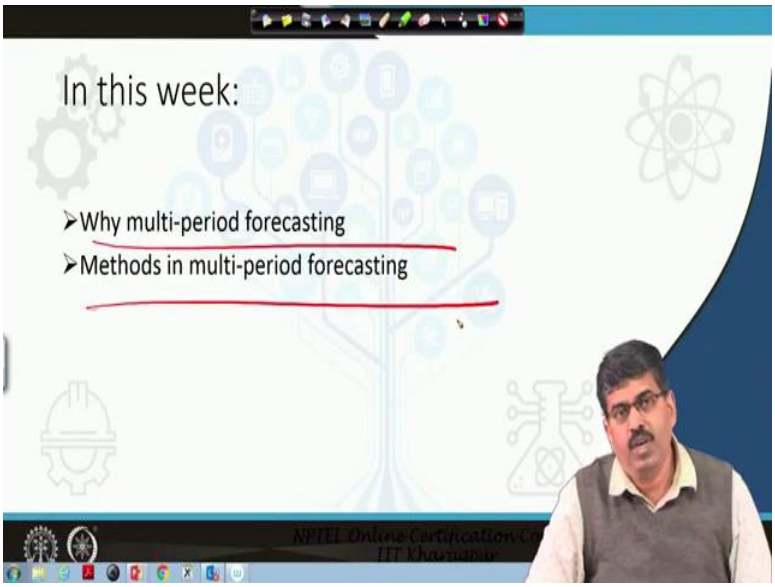

Now here, first question why multi period forecasting? As we have mentioned that forecasting for one period does not have the business in the long run, why? Assume your period is monthly, okay. So, forecasting for the next month, let us say August, September, October. You are forecasting for October based on data available from January till September. You are forecasting for October.

But, forecasting for October, when you are going there to buy raw materials, the suppliers are asking you how much raw material spread over how many months? You are not able to tell them the number because you have forecasted only for one month. So, that is why your multi period forecasting has become very important. And then, we just touch upon methods of multi period forecasting.

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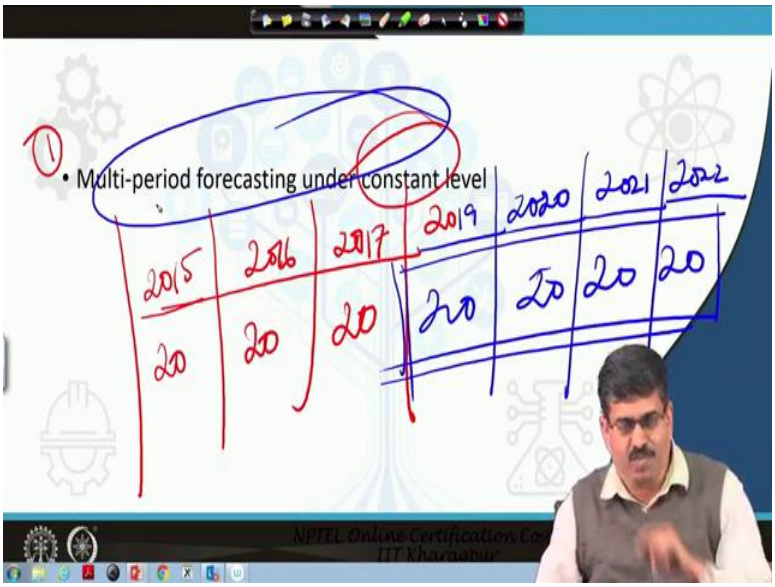

Now, our first model is multi period forecasting under constant level. Why am I smiling? I am smiling because multi period forecasting under constant level has nothing. What do you mean by it has nothing? Let us say this is year 2015, 2016, 2017. Let us take three data points. I should have taken 18, 19, 20, but then, okay let us stick.

With that you are forecasting, let me use a different colour, with that you are forecasting for 2019, 2020, 2021, 2022. Now, what is your demand? Demand is under constant level. So, your demand is, let us say, 20, 20, 20.So, what is your forecast now? It is constant level, so constant level demand is 20, 20, 20, 20. So, this is what is a very simple one are multi period forecasting under constant level. As simple as it is. That is why I was smiling.

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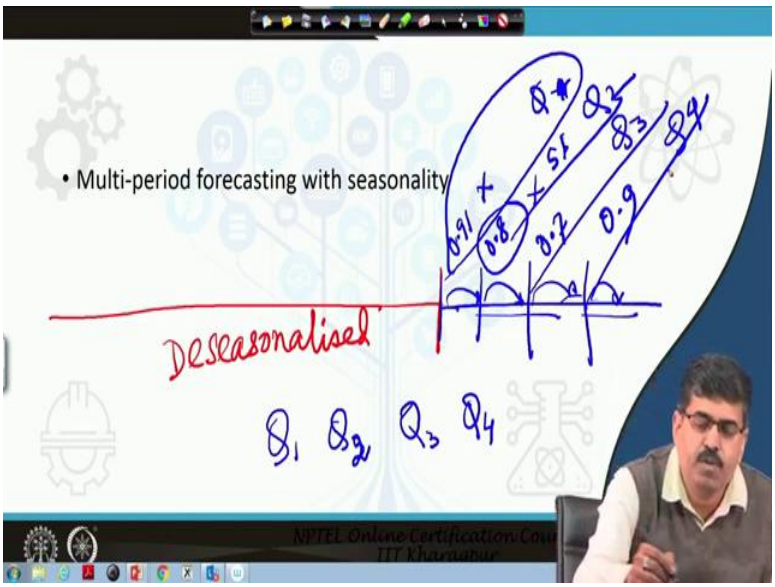

Now, what is the next model? Next model; multi period forecasting with seasonality. Looks very difficult? No, it is not difficult. Multi period forecasting with seasonality. You already have the trend, the deseasonalised one. What are your planning to do? With that, what will you do?

With that, you will forecast next few years. With the deseasonalised data, you can forecast. Which method? Constant level. What are you changing then? You already have, remember, we already had calculated the seasonality indexes for quarter 1, quarter 2, quarter 3, quarter 4. So, whatever is your forecast, let us say, your seasonality index was 0.91, 0.8, 0.7, 0.9.

So, whatever you are getting in that constant level forecast, multiply this by 0.91. So, that gives you a forecast for the next quarter, quarter 1. Whatever you are getting here, multiply it by the seasonality index, this gives you the forecast for quarter 2. Whatever you are getting here that gives you the forecast for quarter 3 and whatever you are getting here that gives you the forecast for quarter 4.

So, only your seasonality index is changing. Your constant level, that is the deseasonalised data is not changing, that is same. The top up, the multiplicating factor that is changing. So, accordingly you can do a multi period forecasting. How will you do it? You will only take the seasonality index and multiply with that, nothing else. That is your multi period forecasting with seasonality.

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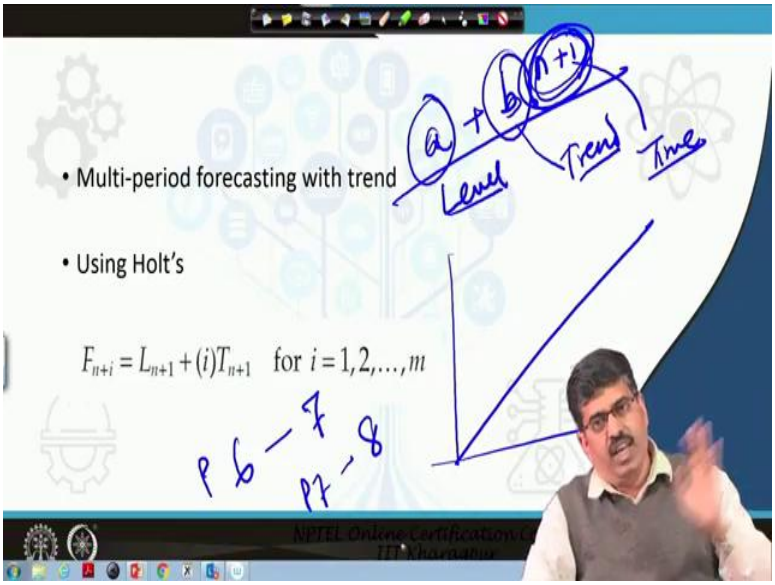

Multi period forecasting with trend. Is it any rocket science? No. What was the trend telling me? Trend was telling me a plus b into n plus 1. That a was the level. Level, trend, time. So,

multi period forecasting with trend is nothing. Wherever the trend takes you, you go there, okay. This b is constant, a is constant. So that n plus 1 will always keep on changing. So today, if your period is 6, what will n plus 1 becomes? 7. You are in period 7, what does n plus 1 becomes? 8. So, this n plus 1 keeps on changing, b into n plus 1. b remains constant, a remains constant, so just multiply by the time period. That takes care of it.

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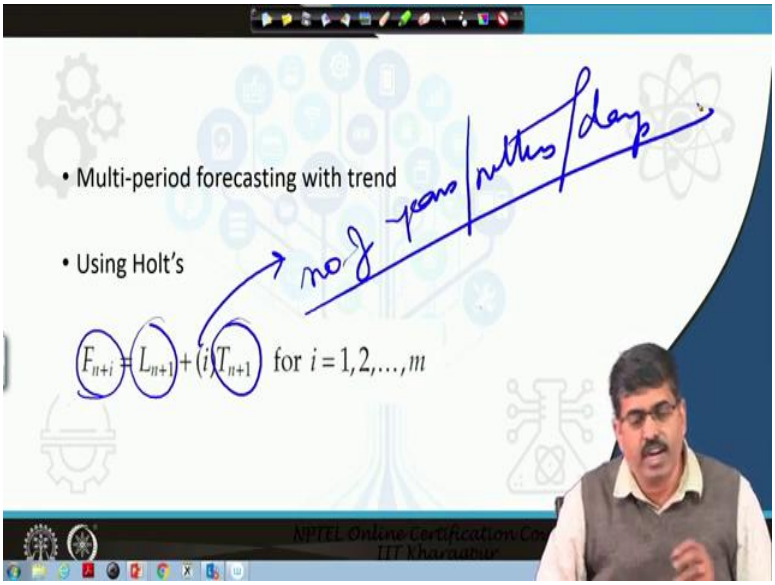

Holt's method, same thing. Forecast, level, trend. What is that i? The number of years, months, days. That i is the number of years, months and days. That is Holt's methods.

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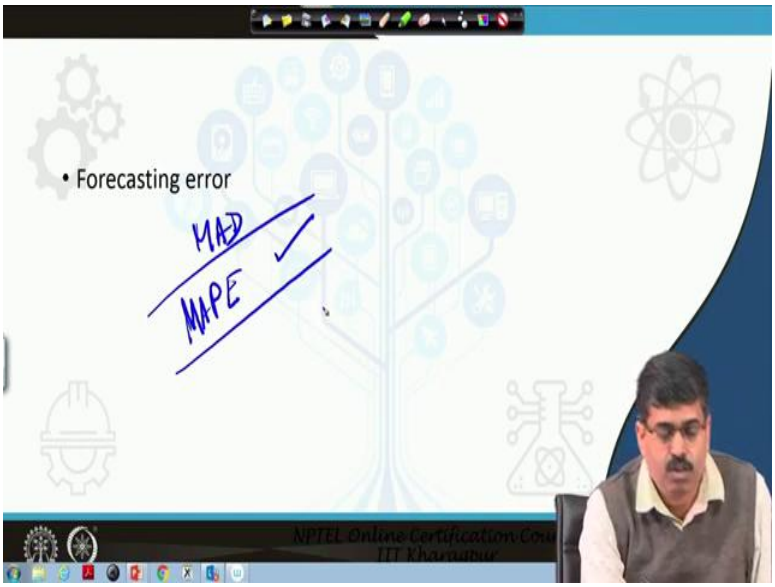

Now, next, so that is brief about multi period forecasting. Next, what will we see? Next, we will see what we call as forecasting error. We already have done forecasting error for mean

absolute deviation. There is another one called ‘mean absolute percentage error’. Nowadays, many companies are using these MAPE; mean absolute percentage error, because they have found out that it is much more accurate than the other methods.

But we cannot say that because it is still, time is still not matured to tell such a thing because there are other versions to it also but up till now, MAPE is, again mean absolute percentage error, it looks very very true scientifically. It has given very good results. That is your forecasting error.

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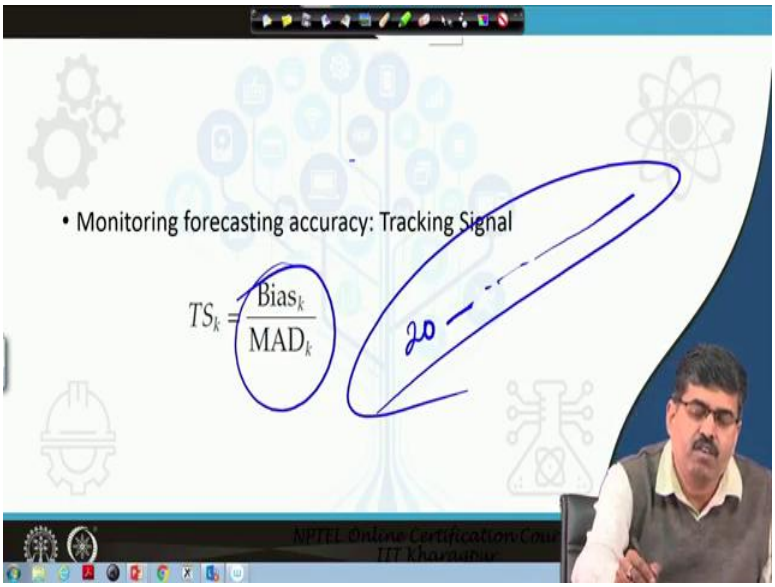

How do I know what is the forecasting accuracy? It is called as tracking signal. What is tracking signal? Tracking signal is your bias divided by mean absolute deviation. What is bias? Bias is your first period forecast, let say first period forecast minus all the subsequent forecasts. That is your tracking signal.

You will learn more about it once you look into the reference books that have been given at the end of the text but this is tracking signal monitoring accuracy, tracking signal.

So now, if you see, you have pretty much learned about all the forecasting models that are relevant to supply chain. Even, which one to use, which tracking signal to use, etc., etc. Question is, what is this application? This is what we will tell you now. These are some stories that tell us how forecasting has been very very helpful to organizations.

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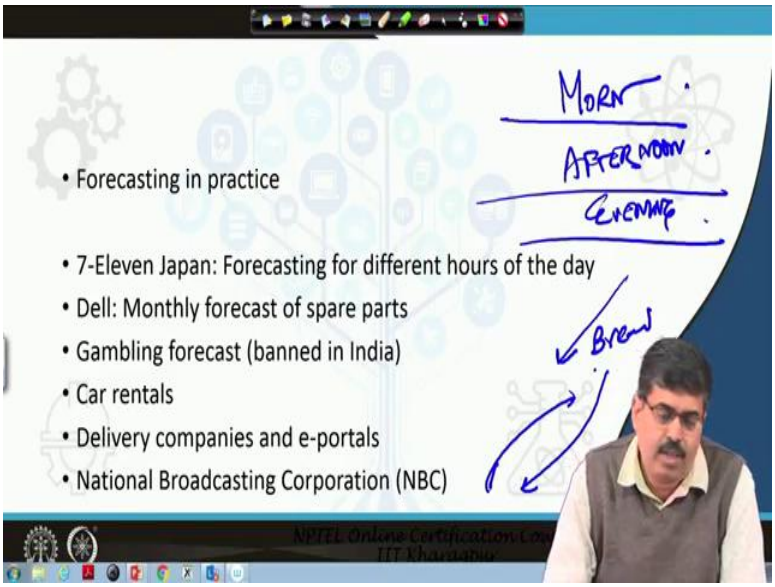

The first one is 7-Eleven Japan. Now, 7-eleven Japan, as you all know, it is like a, it is not like but it is a departmental store, a huge one in Japan, something similar to our Walmart's. 7-eleven, at one point in time found that the sales are not picking up. As you say, the regression line is same trend, same beta is equal to 0.8.

So, 7-eleven tried to understand what is wrong. What are we teaching? We are teaching forecasting in practice. So, 7-eleven looked at how or when the customers came. This is where data analysis come in, data modelling comes in. 7-eleven was studying when the customers have come in the store. So, they were looking at the bill timings and then they found out that the bill timing can be broken into three slots; morning, afternoon and evening.

These are the three slots in which they have broken up. Now, they did the customer mapping and the customer characteristic mapping for each of these; morning, afternoon, evening. And what they found out was, morning customers, the characteristic was, there were men, women very few, but they quickly run into the store, look for what? Look for bread, butter, jam, marmalade whatever, eggs, milk, maybe some other health drink and they would run out. Time spend, only this much, average time spend.

Afternoon customers, they purchase a bit home items, costly items, maybe tea, coffee. Some of these items, the daily necessities, packed food. So, they were the afternoon customers. How much time of the day? More time. Evening customers, again, more time but not as much time as the afternoon customers and they were not rushing.

So what did 7-eleven do? That served as a very good indicator of what they were doing. 7-eleven had those movable racks with wheels at the bottom so they put all the necessary products in one of those wheeled racks. The medium necessary; and the last ones in the behind which takes some leisurely shopping.

So, the ones that where important necessary item, this particular shelf or shelves were brought in front in the morning because there were wheels, there were tracking type of a thing, so they were just brought in front in the morning, in front. So, the men would come in, quickly come in, grab, go away. They do not spend time in the system.

The other racks that were having goods like the daily household goods, they were second. So, during afternoon, this rack will come in front and the bread, butter, jam will go extremely behind. So, the afternoon, the leisure items came in front. And in the evening, a mixture. They looked at the purchase bills, in the evening, the mixture items, mixtures of necessities and luxury or daily use or rushing items, mixture of these were put in front for the family to shop.

Now, it was not only the husband or the wife, it was the family. So, they would spend time but not that much of time. So, these items were brought into front. So, what did we do? You forecasted how the behaviour, how the buying pattern would change during the day? So, your forecast was not monthly; your forecast was not yearly. It was during the day, hourly forecast. And as a result what happened? 7-eleven became very popular, they were popular, but the 7-eleven came to be known as a very very good organization that take cares of the customers.

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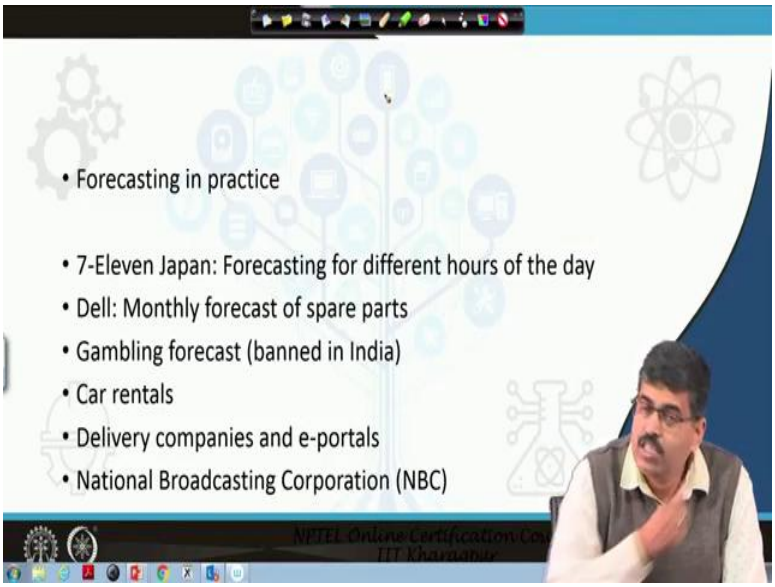

The next example is Dell. Your monthly forecast of spare parts. As we mentioned, forecast spare parts is very very difficult thing to get. We mentioned it in the previous lecture. So, they had to do a monthly forecast of spare parts and then keep it, because computer without spare parts is not acceptable.

The third example that we have is gambling forecast. There is a disclaimer that it is banned in India. You cannot do it, but then, and there are few companies who were having their data base management for these types of businesses but they are located outside India. What are they doing?

Based on the customer's gambling history, they are forecasting how many customers will visit your particular outlet. How many will actual gamble? How many will win? How much they will win? So, what is your profit? So, that also becomes the part of your business forecasting.

Third one, sorry the fourth one, car rentals. Car rental is also something which requires al lot of forecasting. It a very very dicey one. Dicey in the sense, that it is very very undulating just like seasonality. Morning, more cars. Afternoon that much requirement is not there. Evening, once the office hours are over, much much more cars.

So, what does your Olas and your Ubers do? They have surge pricing. But the surge pricing is not the answer, how to manage is the answer. You buy enough cars, you put enough cars in the franchise more with Ola and Uber so that, people earn money, Ola and Uber also earns money. Because, during the peak hour, if they are saying that the vehicle will be available

only after 20 minutes, the customer will not wait. He will take a bus or a train and go to his office.

So, this car rental forecasting, how many customers will exactly take your services? Be it Ola-Uber, be it the fixed car rental. There some companies give you cars on rent. You can move around the day, come back, deposit the car, and go away. So, car rentals, how many cars will be rented? For how many hours? What is the revenue? So, these types of forecast can also be done.

Next example, the fifth one, delivery companies and e-portals. I think today, they have to a great great amount of forecasting. Let us take Amazon a gearing example because I know all of you buy from there. Now, Amazon, it has to forecast how much will be the sale. Money? It has to forecast how much will be the sale in quantity? And the daily, not only daily but hourly forecast it has to do because based on that your vehicle planning will be done. So, delivery companies, e-portals are in a great issue now because they have to forecast demand this much accurately.

Now, (ano) National Broadcasting Corporation, NBC. NBC have a different kind of forecasting problem. What are they doing? They are, they advertise, NBC is a radio, right. So they have advertising slots. They want to know how many advertisements will actually come, that also has to be forecasted.

Because how much money are you generating from them, because on the basis of that subtraction, you will decide the salary of your employees because the salaries of your employee are depended on how much revenue you are earning from advertising companies. So, National Broadcasting Corporation, having a forecast of how much advertisement they will get.

Now, there is, now also, let us take another example of this forecasting in practice, your restaurants. Restaurants need great, great, great deal of forecasting because they also, if there is wastage of food it is their loss. If there is unsold food, it is health, it is environmental hazards, anything but if, there is more demand, then how much they are cooking that day; it is really a great loss for them.

So, forecasting is very very much important, proper. Unfortunately, in India, we do not do that much of forecasting for the medium priced and less priced products. Why you know? Because we in India, because of the population and because of money in the hands of the

people, decent amount of spendable money, anything that we produce, and it sells off. That is one thing that we have to be, that is why the application of forecasting is bit limited and limited only to the big corporates houses who use it as a scientific method of forecasting.

I think I have shared with you. I do not remember if I have shared with you in earlier slides but then, you see, forecasting is so much in practice. Coke and Pepsi, they are forecasting how much they will sale per day in the summer months, because accordingly they will have to bottle, they will have to send it to the small small outlets spread in innumerable areas around the city and if does not sell, if it does not give them, it is a loss sale.

But then, Coke and Pepsi, so they have a very very accurate method of forecasting which is being in practice for many years and it is doing pretty well. But then, in all the forecasting we will go hay where if today outside, instead of the hot scorching sun, just for today, it is cloudy. Cloudy means, people will not feel that much thirsty and so they will not go and buy a Coke and Pepsi. So, forecasting goes wrong.

So, forecasting also depends on your temperature. So, I am giving you different dimensions forecasting. Even temperature is required to arrive at a proper forecasting technique. Now, so, what I want to say is that this forecasting, you have to know, you have to model it properly and you have to use the proper method for the proper product. It is just not I know ten methods and I will keep on forecasting.

There should be a proper method for a particular method product. Particular method for a particular product. Let me rephrase it. You have to first understand the characteristics of the product and then you will have to forecast. So, you see what we have, let me now just tell you what we have done.

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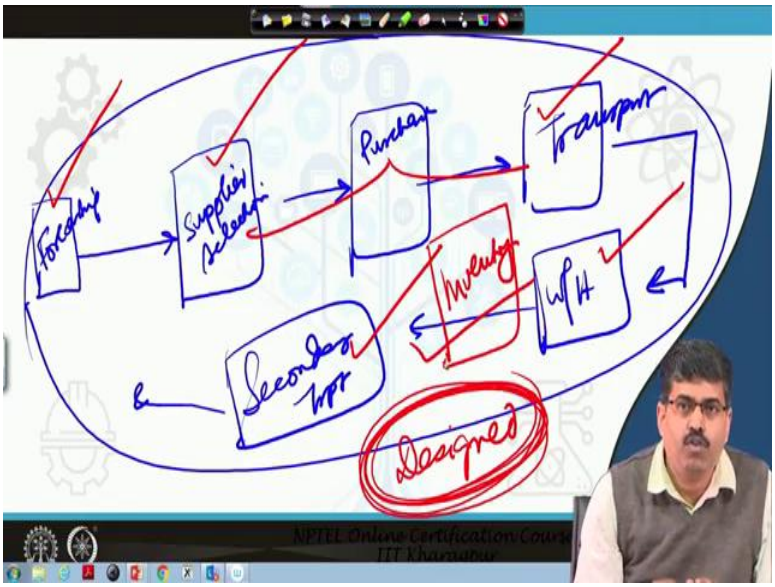

See, my supply chain started with forecasting. Once the forecast was done, then the supplier selection. Once the supplier selections are done, then the purchase. Once the purchase is done, then the transport. Once the transport is done then the warehousing. And once the warehouse is done then the secondary transport and then this entire thing has to be designed. So, if you see, we have so long, up till now, we have done forecasting, supplier selection modelling. Purchase is a part of integrated with supplier selection. We have done transportation modelling. We have done warehousing modelling and we, after this warehousing, a great and the most important thing, inventory.

We have done inventory modelling. Secondary transportation is anyway included in transportation. So with this, we will go, so this is the overall framework, which we have completed up to now. With this, we will go for supply chain designing or the modelling of supply chain networks. So, this is pretty much the overall framework of supply chain modelling and we have completed up to this point as of this week.

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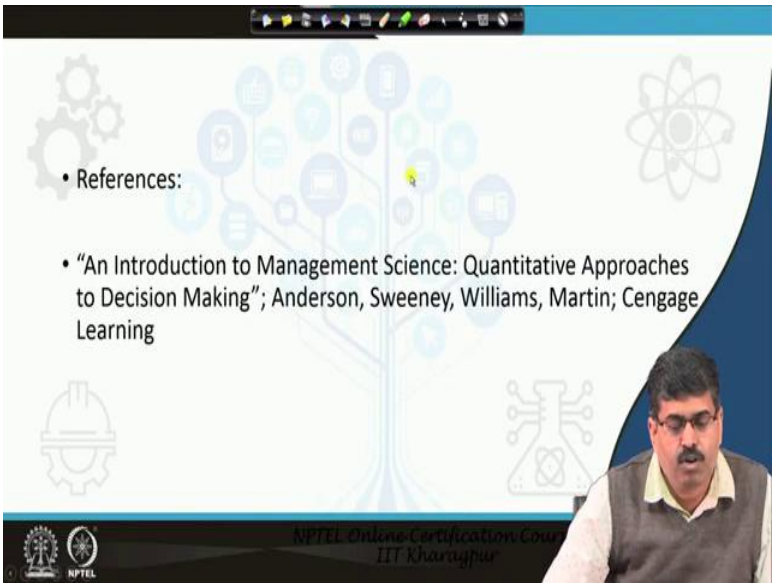

So, these are the references that you can take for this. I am giving you this reference because it is the easy one I have come across. So, thank you for today. Thank you.