Modelling and Analytics for Supply Chain Management
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Lecture 47
Forecasting: Seasonality in Forecasting

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Hello and welcome to Modelling and Analytics for Supply Chain Management. We are into week 9; lecture 47 that is forecasting seasonality and its impact on supply chain. Now, in the previous two weeks, we have learned about forecasting and its importance in supply chain. We learned that, see forecasting is very very important for two reasons, one is if my actual demand is 100 and my forecast was 120 that means 20 units, I could not sell. T

hat is fine. 20 units is lying in stock. I am paying for the warehouse rent, etc. but take the other way round, that is my demand is 100 and I had forecasted 80 units. So, 20 units could have been sold which have not sold. What does that mean? It means that 20 customers have gone to my competitor and multiply it by the number of times and the number of units, the customer purchases a product of my brand. So, all gets affected.

So, if I do under forecasting, that is I forecasted less than what is the actually demand, then there is a huge impact on the reputation, and the goodwill and the brand name of my organization. So, that is why, forecasting today has become very very important in supply chain. This we have discussed in the previous class.

There is another reason why forecast has become important in supply chain. See, if we cannot forecast correctly, we cannot plan the supply chain. We cannot plan how much warehouse

space we will require. We cannot plan how many transport vehicles we will require. We cannot plan what is the frequency of delivery of the consignments.

So, unless we get a clear picture of what is the approximate demand in the market, the supply chain cannot gear up to meet up the demand and the time frame of the demand. So, that is why, forecasting, which was earlier a production oriented activity has today become a primary or the first point or the starting point of any supply chain activity. So, that is why forecasting is important.

Now, in the previous two models, in the previous two weeks, what we did was we said that forecasting, this normally, we see there is a constant level of demand and some minor zigzags, minor errors happen. That is because of noise, the minor deviations will happen. You do not eat the same quantity of food every day. Someday you eat more, some days you eat less. But your overall level is same. So, that is what is, that is what is constant level forecasting.

Now, in the constant level forecasting, we have learned simple average method and weighted average method. Today, we will learn something called seasonality in forecasting. Now, certain products show some seasonality. This is where we ended in the previous week. Certain products show seasonality. What do you mean by that? See, winter garment, jackets, shawls, pullovers, all are examples of seasonal demand.

Similarly, cotton, very soft cotton, very suitable to the human body, is normally a summer fabric. In summer, people love to wear cotton in India because of the weather conditions. So, there is an element of seasonality. Similarly, marriage season. Marriage season, all he demand for the Sherwanis and the kurtas will come up for a designer wear type of a product. So, that is also another example of a seasonality. So, how to forecast a seasonal demand?

Now, this is a very very important and dicey thing. Why? Because, say it is a winter season. Now, winter season is only one quarter of a year. So, three months we will get winter. But, what is happening? This coming winter, you will forecast how much is the demand, based on the previous winter. Based on the previous winter, you will forecast the coming winter's demand.

Now, in between what has happened? 9 months have elapsed. So, the taste and preferences might have changed, the weather conditions might have changed a bit, economic conditions might have changed. So, so many things are there. So, seasonal forecasting, seasonality,

forecasting seasonality is always a challenge for marketers. So, today, our topic is how to forecast demand when the demand shows some seasonality. So, that was our first point, what is seasonality?

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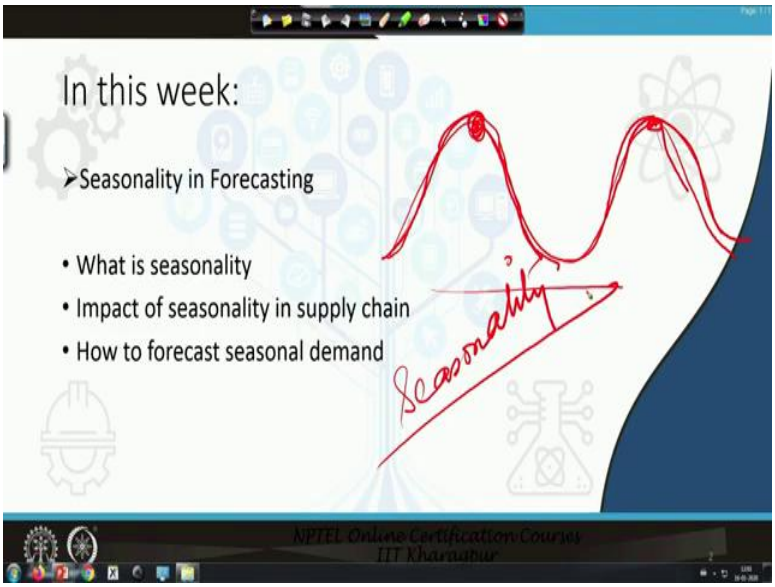

Now, we will come to the next point, that is, impact of seasonality in supply chain. Now see, impact of seasonality is like your, say your products are being demanded in winter. Let us say your oranges. Oranges are grown extensively in the Himachal Pradesh belt. Now, that is grown and demanded all in winter.

Now, the problem is if you are dedicating a fleet of vehicles for Himachal Pradesh during winter, what will happen to those vehicles for other 9, 10 months, the summer months and the rainy season? What will happen? Those vehicles will remain ideal or we might have to look into some other businesses which are active in winter, in the rainy season and some other businesses, which are active during the summer months.

So then, the vehicle planning gets evened out. But that is one impact of seasonality in supply chain, my vehicle planning becomes a challenging affair. It is a great challenge. How do I get huge number of vehicles required to transport orange for those 2, 3 months from Himachal to all over the country? How do I get that number of vehicles? I cannot have a dedicated fleet of vehicles. What will I do with them for the balance 9 months? That dedicated fleet of vehicles will lie ideal or I will have to find some alternative ways.

Similarly, we are still with the second point that is impact of seasonality. Similarly, see, when this particular season in Orissa when the ‘beedi’ leaves are ripe to be taken and then the

‘beedis’ are tied and bound and then brought into the market. So, these beedi leaves; the ‘sal’ leaves, basically, that grow in the Orissa market, sorry, that grow in the Orissa garden; Orissa plantations and the forests, they are auctioned.

Now, once are they auctioned, the time of plucking the leaves for the beedi, when that time comes, you require huge number of trucks. You require huge number of trucks to transport these beedi leaves from Orissa forests to all over the country. And then the tobacco will be put in and then they will be tied and then they will go into the market for final production.

So, you require so many number of vehicles and it is actually that in Orissa, during that time period, you will not find trucks for any other purpose, even if you require. All trucks have gone to the government forestlands to take the leaves back to the market. Question is what will happen after the beedi leaves are taken away? What will the trucks do if you have a dedicated transporter?

If you are a general transporter, you are standing somewhere in the market and you will get some consignment and you will take them. But if you are a dedicated transporter, what happens to your trucks after the beedi leaves are gone? So, this is something that supply chain has to take care of. So, that is the impact of seasonality in supply chain.

Now, the next point is how to forecast the seasonal demand? Now, if you see, just by the very nature of the word, “seasonality”, just by the very nature of the word “seasonality”, we are seeing that seasonal demand will behave like this. Once the season starts, the sale will pick up, at the peak of the season the sales will also peak and as the season comes to an end, the sales will come down. Like very glaring example is of winter garments. When the winter starts, slowly you start buying new design pullovers and jackets.

Once the winter is in peak, no additional sales will happen. But then slowly, demand will fall because the winter is also going away. Then again, before the next winter, your demand will rise. It will reach a peak and then again, it will fall. This is an example of seasonality in demand. This is an example of seasonality. Now, the issue is how to forecast such seasonality that is what we will learn.

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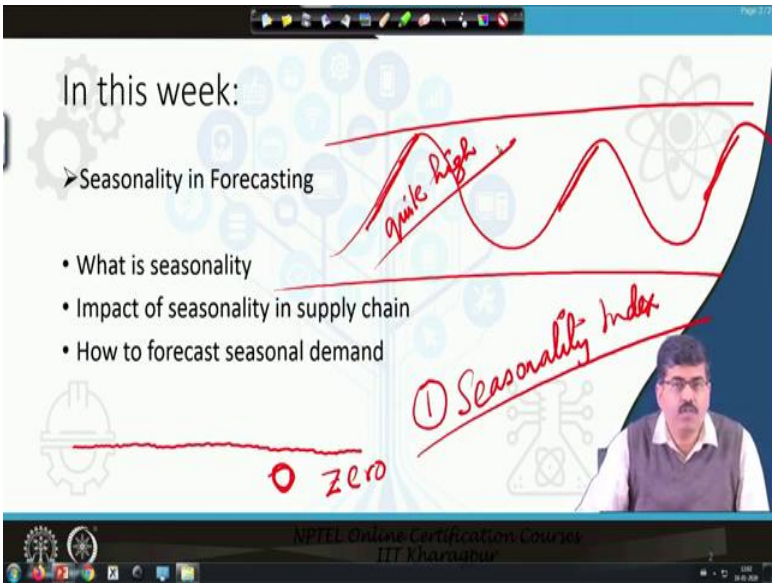

Now, see, one thing you notice very carefully, this is a pattern of seasonality, this is the pattern of seasonality. Now, if you can find out, see, point number 1, if you can find out what is the extent of the seasonality? What is the extent of the seasonality? Then half of your job is done and that is called as the seasonality index.

Now, let us take this graph. Very fine thin line. Let us take this graph. What is the extent of seasonality? 0. Let us take this graph, what is the extent of seasonality? Quite high. So, first job for us is to find out the seasonality index. Okay, and then, we will go ahead. So, this is what with which we will start off.

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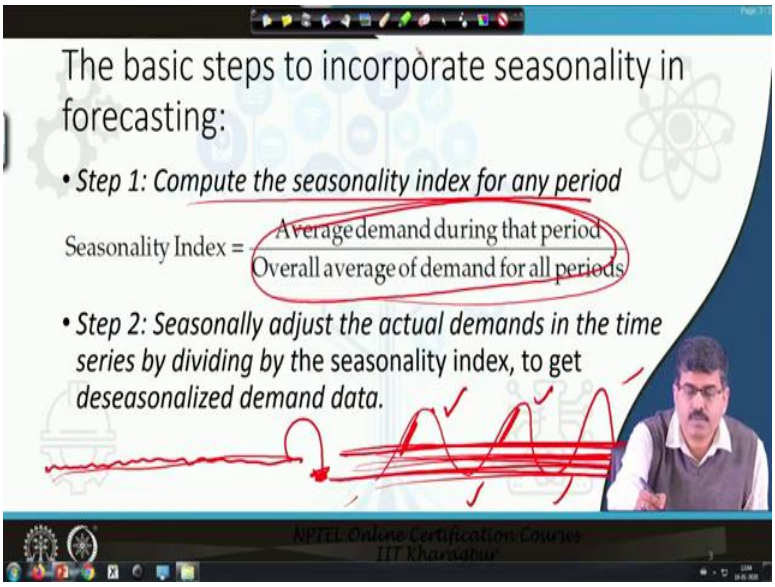

Basic steps to incorporate seasonality in forecasting is, first of all, compute the seasonality index. Compute the seasonality index. What is seasonality index? Seasonality index is the average demand during that period; divided by, overall average demand for all periods. What is it? We will show you a bit later. Average demand during that period divided by overall average demand for all the periods.

Now, once the seasonality index is calculated, then we will adjust the seasonality by dividing with the seasonality index to get deseasonalized demand data. So, this is the seasonality, okay, this is a seasonality, we find the seasonality index and divide this demand by that seasonality index so that we get a deseasonalized demand data. This, these ups and the downs are removed. These ups and the downs are removed. So we get an average.

So now, once we get this, then it does not look like? It looks like a normal average demand that we are studying over the last two weeks. So, this is what is called as deseasonalizing the time series. Season, you have a peak, you have an 'm' so what happens? You are removing both the peak and the 'm' and what is remaining is somewhere in the middle. So, that is your deseasonalized one.

Then, what will happen after some time? With this deseasonalized one, which looks like exactly like earlier ones, you predict what will be the forecast for the next. Then, bring back the seasonality to this prediction and then that is your forecasted demand. As simple as that. That is what is seasonality index.

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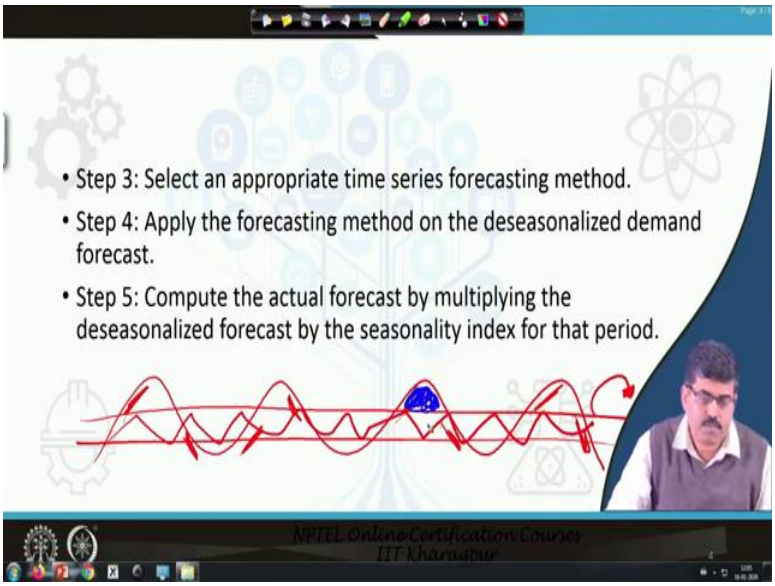

So, select an appropriate time series forecasting method. Apply the forecasting method on the deseasonalized demand data and compute the actual forecast by multiplying the deseasonalized forecast by the seasonality index. So, what we said? Again, we are repeating these points and this diagram will help you.

So, first we calculate what is the extent of seasonality? What is the extent of seasonality? Remove them, divide this entire thing by this portion so what will remain? Only the middle portion will remain which is pretty much a zigzag within a normal time frame. This is called your deseasonalized demand data. Once you have deseasonalized it, forecast with this normal deseasonalized data. Once you have forecasted, bring back this top up that you had deleted. So, that will give you the actual forecast. This is what we meant.

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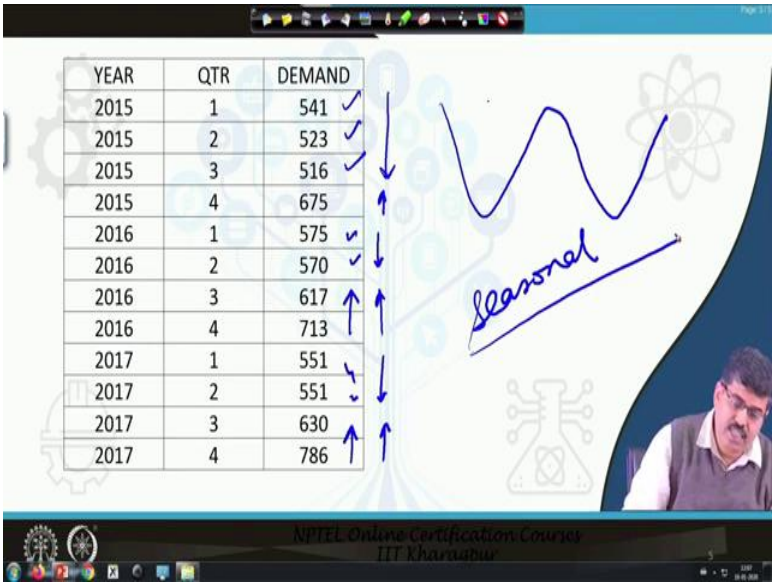

Let us take a problem; this is the year, 2015, 16 and 17. We have taken three years and every year we have taken four quarters, 1, 2, 3 and 4. Now, quarter 1 has a demand. If you can see on your screen, 541. Quarter 1 has a demand of 541, 523, and 516. So, apparently, it looks that the demand is falling.

Then suddenly, here, the demand surges, moves up. Then again, you see, it is falling, falling and then again, you see there is a sudden surge in the demand. Again, same demand then suddenly surge in the demand. So you see, falling-surge, falling-surge, falling-surge. So, falling-surge, falling-surge. So, this is a seasonal product.

So, how to, so what did we say? We said that first get the seasonality index. That is our first step and what is the first step we said? We have to calculate the seasonality index by doing

something. What is that something? Let us now see. Yeah, anyway, we have given the results. What is the something that we will do now? Let us see.

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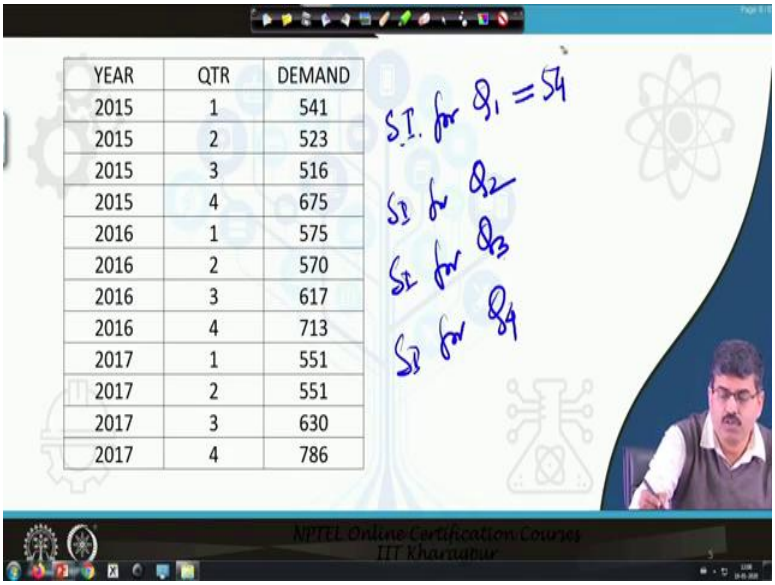

So, first step, step1 was to get the deseasonality index. So, first we will write down seasonality index for quarter 1, seasonality index for quarter 2. Why are we doing it separately? Because the quarters are not the same. Seasonality index for quarter 4. Quarter 1, quarter 2, quarter 3 and quarter 4. What is seasonality index for quarter 1? Average demand for all the quarter 1's. Average demand for all the quarter 1's. That is , let me remove the Q2s and the Q3s. let me clear it.

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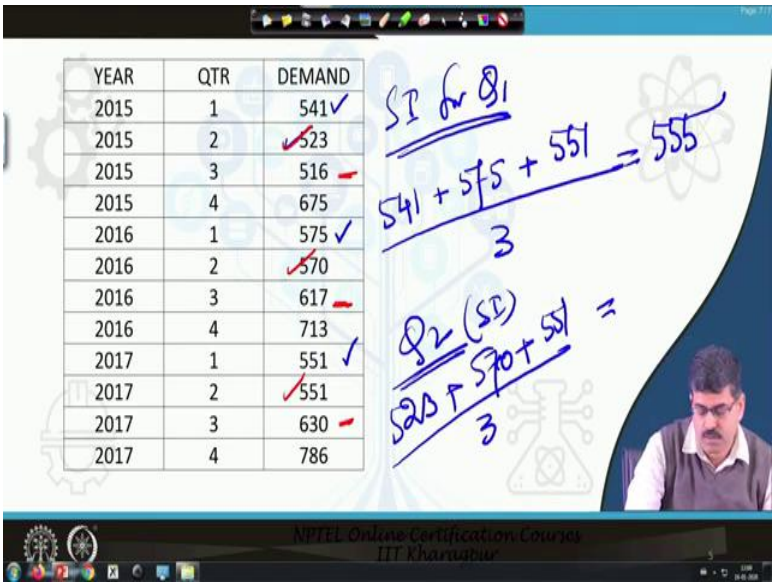

So, let us only do Q1 first. Seasonality index for Q1, that is, 541 plus 575 plus 551, divided by 3. That is coming to 555, which is given in the next slide. For quarter 2, the seasonality index, quarter 2, the seasonality index is 523 plus 570 plus 551, by 3. So, in this, then again, so this was your, 523,570, 551. Next will be quarter 3. That will be 516 plus 617 plus 630, divided by 3. So whatever, so this is your average seasonality index step 1. So, this is for average. 555, 548, 588, 724. This is what we have just calculated. Agreed?

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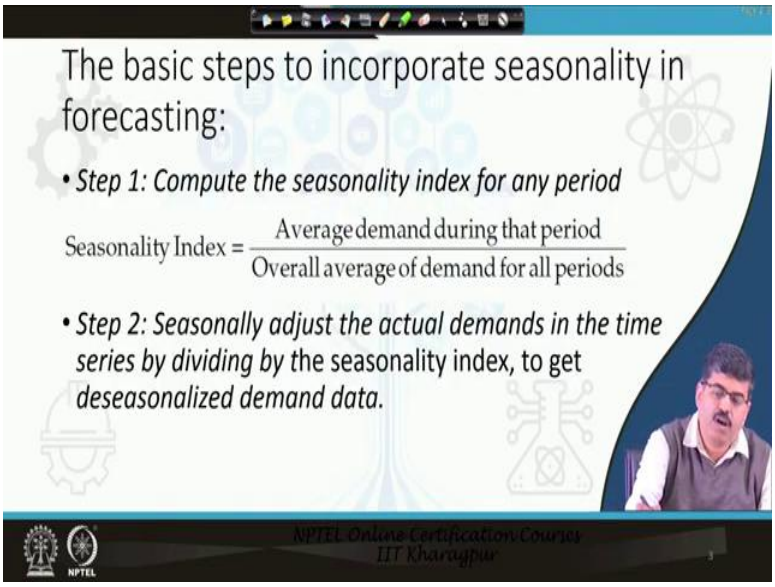

What is seasonality index? What was the formula? What was the formula that we have said? Average demand during that period, so, average demand for quarter 1 we have just now calculated for quarter 1, quarter 2, quarter 3 and quarter 4. Divided by overall average of demand for all the periods. Overall average demand for all the periods.

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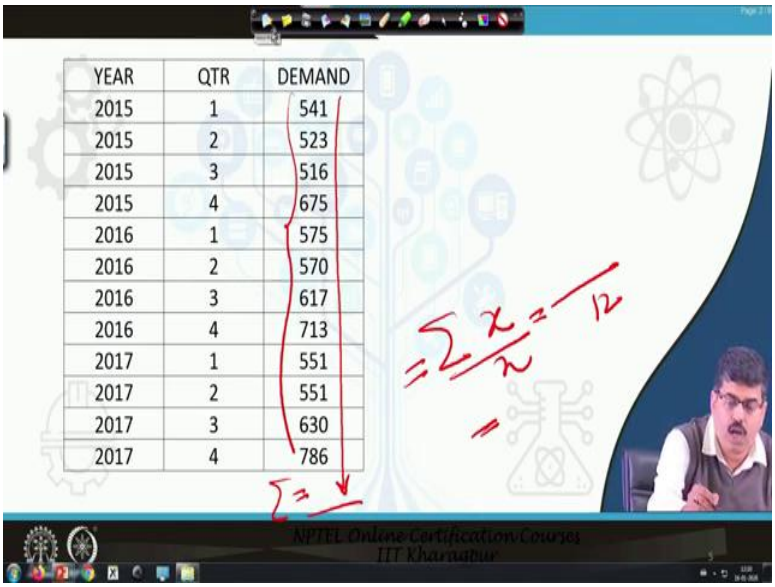

So, that means, here we are, seasonality index divided by overall average demand. So, this column, this demand column, that is your summation x by n. This entire thing is summation. Summation divided by how many observations we have, divided by 12. 12 observations we have. 3 years, 12 observations. So, this is your average.

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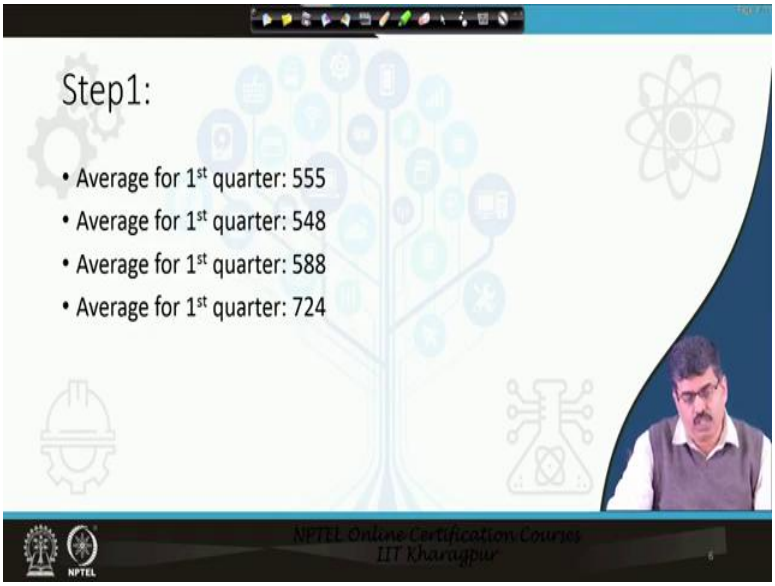

So, how are we proceeding? So, average for this was average for this.

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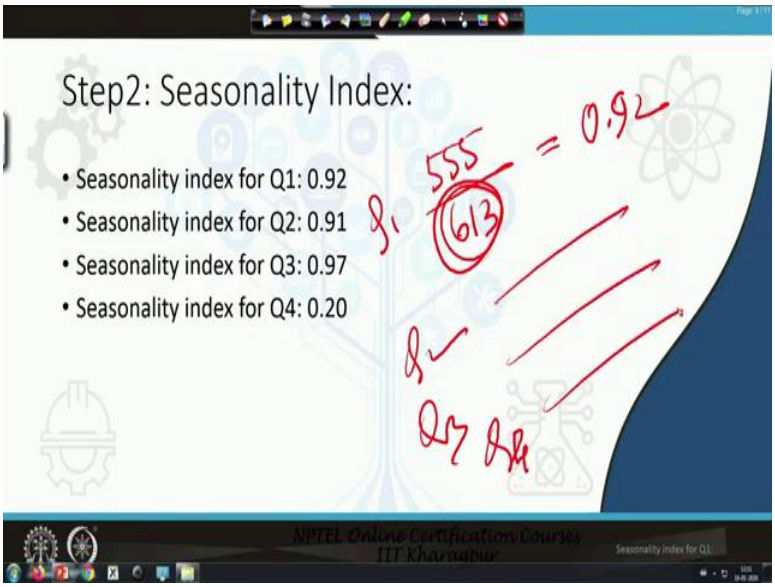

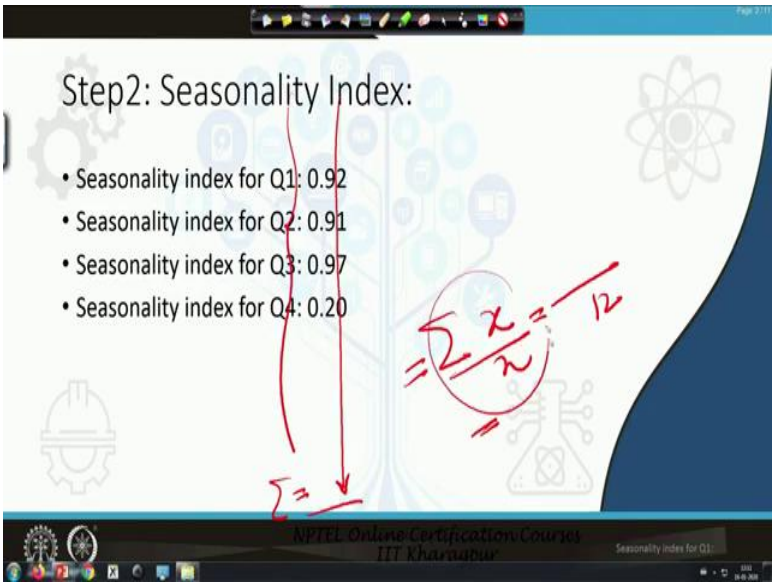

Seasonality index is that average that 555 for quarter 1 divided by, I think the total is 600. The average here is 613. The average is 613 something like that. So, Q1 you will get something, something, something, something, something, zero point something. So, the total average of the entire series. Just now, we did it. I am just going back, this one.

So you see, summation X by n, just going back and seasonality index is this, divided by the average of the entire series. Similarly, you can do for quarter 2, quarter 3, quarter 4. You can get some numbers. That is first step.

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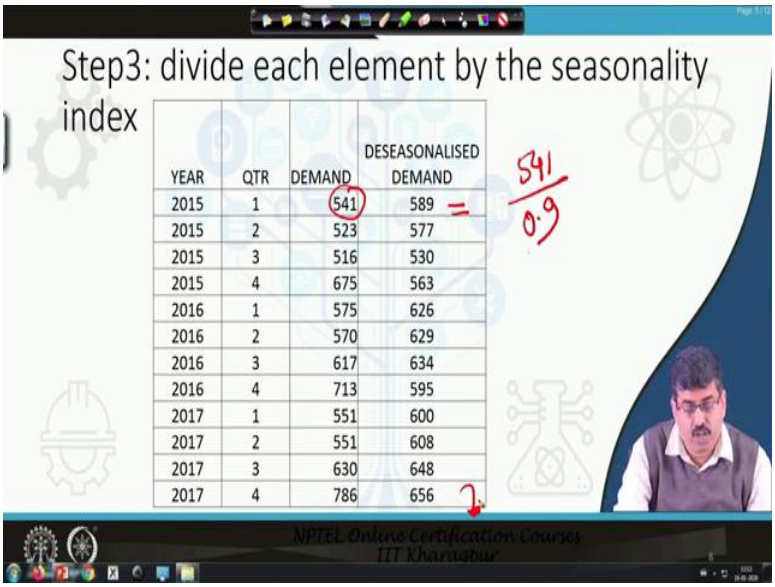

So, what did we do? We divided every demand by seasonality index. What was the seasonality index for first quarter? It was something, somewhere like 0.9. So, what did we do? The original demand of 541 is being divided by 0.9. Then we get what is called as a deseasonalised demand. Original demand divided by the seasonality index. So, we get the deseasonalised demand.

And once you are done with the deseasonalised demand for every quarter, now you forecast what will be the demand for the next quarter with some mechanism. Be it simple average, be it weighted average, be it some exponential smoothing, something you forecast what will be the demand for the next quarter.

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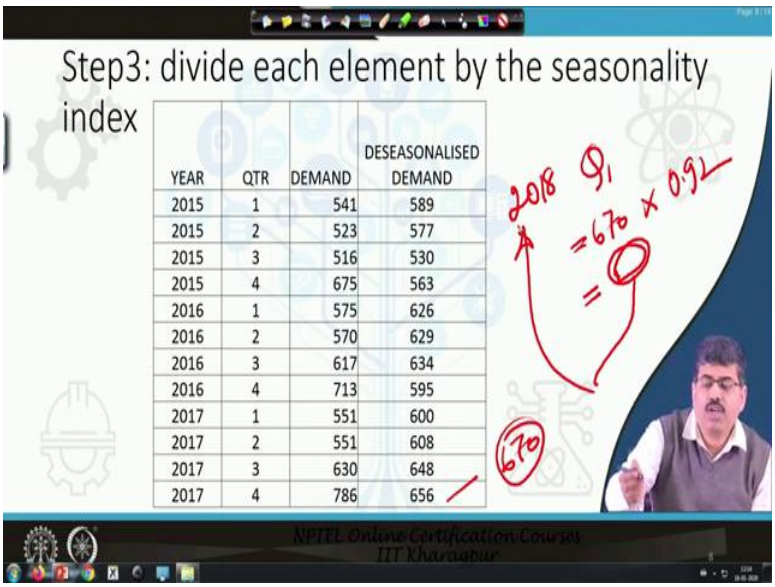

Now, once that is forecasted, say your forecast here is 670, okay, so your forecast for 2018, Q1 that is the next year is 670. Now, that forecast, what was the seasonality index? Let us say 0.92. So, 670 into 0.92, whatever that number is, that is your forecast for 2018, quarter 1. So, multiply, first we got the seasonality index, with that we divided.

Now, we are getting back the original number by multiplying the seasonality index. So, this is the basic of demand forecasting. In that way, what you can do is, for a multi period, at least for another 2 quarters, you can forecast. Though only one period forecasting is very very appropriate, where at least you can forecast that.

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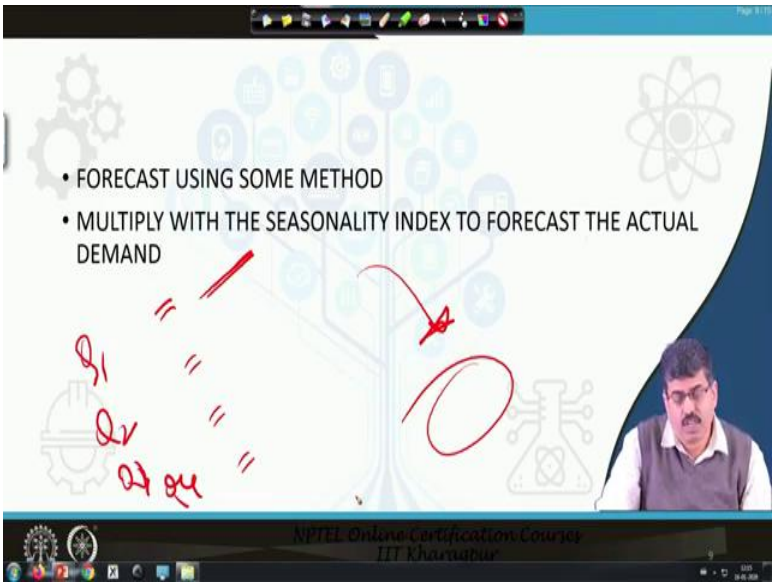

Now, one thing is that this seasonality in forecasting, you have forecasted something, some quantity of forecasting for Q1, Q2, Q3 Q4, but very decently, we have seen that people's taste, preferences and habits are changing. So, you have to be a bit careful about whether, whatever number you are getting, whether, as an analyst, you should recommend and give that number only to the management and also look at the other economic and social dimension that are there in the economy that is shaping my demand.

So, you have to be very careful whether, which, whether the forecast data that you have obtained, whether that has to be modified or relooked, etc. So, that is what is seasonality in forecasting.

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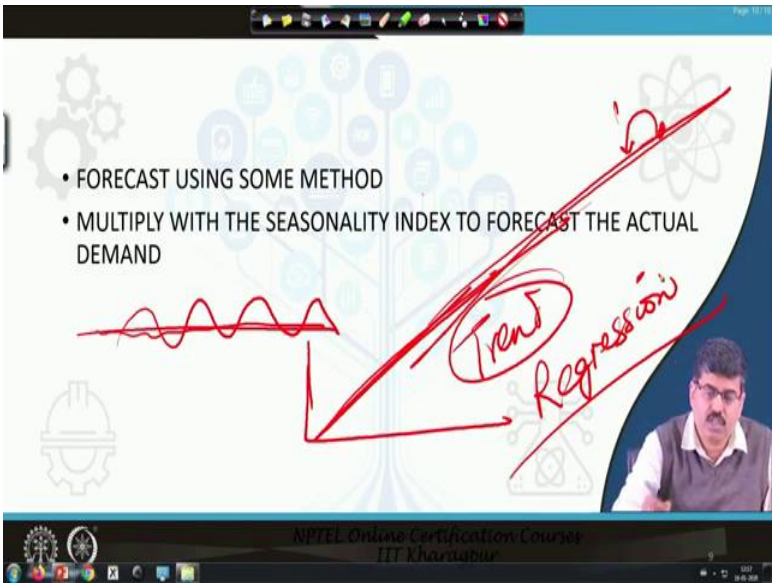

Now, next is other one in which we are getting you see, all along, we were doing like it is a straight line, constant level. Constant level with seasonality, without seasonality. Now, our next question is what if the demand is like this? Demand is increasing. What if the demand is like this? If the demand is like this, then we call it as 'trend'.

Now, if you see, it looks very simple. If you know that this is the trend, the same trend will continue for future. So, it is very easy to predict what is the sale here, what will be the sale here based on what has been the sale in the previous quarters. So, it is very very easy to do the trend and this has been the mostly used method for forecasting where there is a linear trend and that method is called as 'regression'. Most commonly used method for forecasting is termed as 'regression'. This we will take up in the next lecture. Now, so this we will take up in the next lecture.

So, how much have we learned? We have learned the constant level, basically we have finished the basic constant level forecasting methods and today, we are just giving a hint about regression. Now, next week, what we will do is, regression we will do as a trend, increasing trend method of forecasting and at the same time we will give you introduction to Holt's method of forecasting, where, not only the trend but the level is also to be looked into. So, that will also have to be looked into. So, with this, we will end this week's lecture on the seasonality part of forecasting. In the next class, thank you.