Decision Support System for Managers
Prof. Kunal Kanti Ghosh
Vinod Gupta School of Management
Indian Institute of Technology, Kharagpur

Week - 03
Module - 05
Lecture - 15
Decision Support Systems for Forecasting (Contd.)

Hi, welcome to all of you on our 5th Module for the 3rd Week on "Decision Support Systems for Forecasting"! In the last 4 weeks, we have almost discussed all different cases that are normally encountered in practice. We have said that for estimating demand particularly, through quantitative methods related to time series method of forecasting.

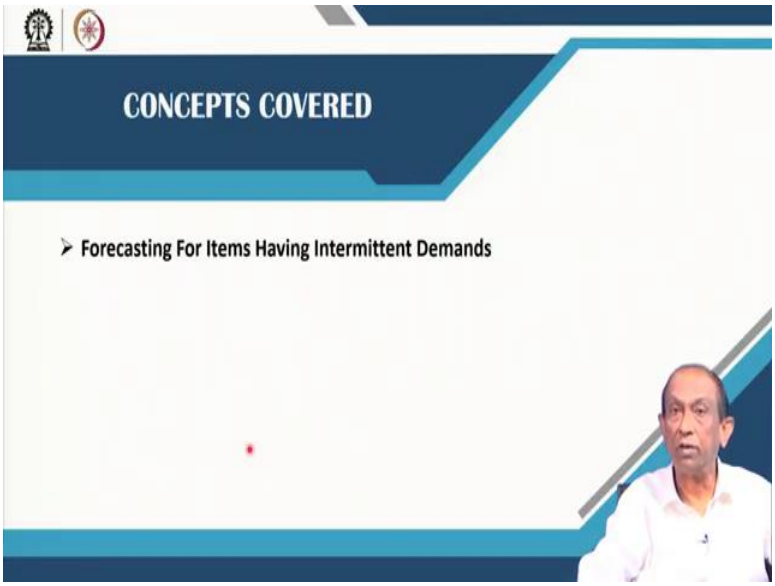
We have seen that normally if we plot the past demands over period of time, it exhibits a series which is we call time series and we have seen that this time series, they have different components. There can be an average level of demand associated with random fluctuations over the mean, there can be an upward trend. There can be downward trend in the demand, along with this random fluctuations, there can be seasonality there can be the effect of business cycles.

So, we have said that simple exponential smoothing methods, moving averages or weighted moving averages. They are commonly used as models where there is no trend or seasonality. Then we have discussed one method to take care of trend and one simple method to take care of seasonality, there are other complicated models.

But all these things require that the model output be reviewed and validated by the decision maker and then in a decision support system. The managers need to interact with the model and the computer, in revising the output based on their intuition judgment and past experience.

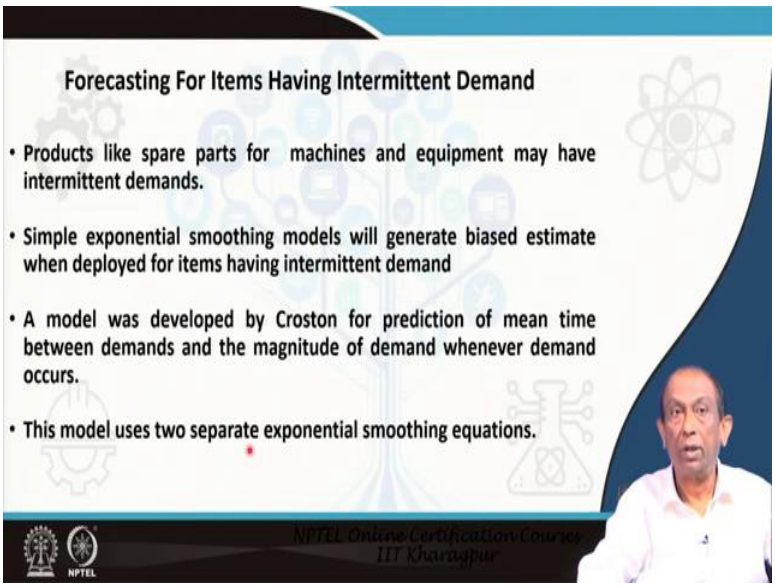
There is one case the special case which needs little more elaboration with an example and today, we will discuss one such technique for estimating the forecast demand for items whose demand is not continuous rather intermittent.

(Refer Slide Time: 04:17)



So, today's topic of discussion revolves around 'forecasting for items having intermittent demands'. What I did? I looked into the different techniques particularly today it is the world of analytics and from one such reference books, I have found that there is a method called Croston's method for forecasting of items having intermittent demands. And we are going to discuss that particular example.

(Refer Slide Time: 05:05)



So, products like say spare parts for machines equipment automotives, they may have intermittent demands; that means, the demand may not be there for some months and

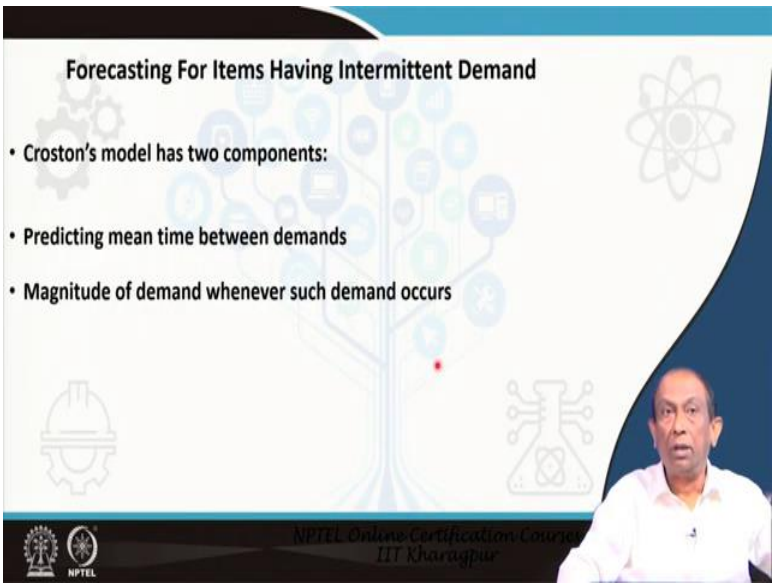
then suddenly some demand has been observed, particularly in case of spare parts this kind of demand patterns are observed.

Simple exponential smoothing models, if we deploy to arrive at the forecast for this kind of items exhibiting intermittent demand we will not get the correct result. Because, this kind of simple models will generate biased estimate; that means, it will be erroneous. So, that is why a special model was developed by Croston for prediction of mean time between demands and the magnitude of demand whenever such kind of demand occurs so; that means, there are 2 aspects.

The first one is what is the average time between the demands? And the second aspect is what the magnitude of this demand is whenever it occurs. So, we will not be seeing evidence of demand in some months.

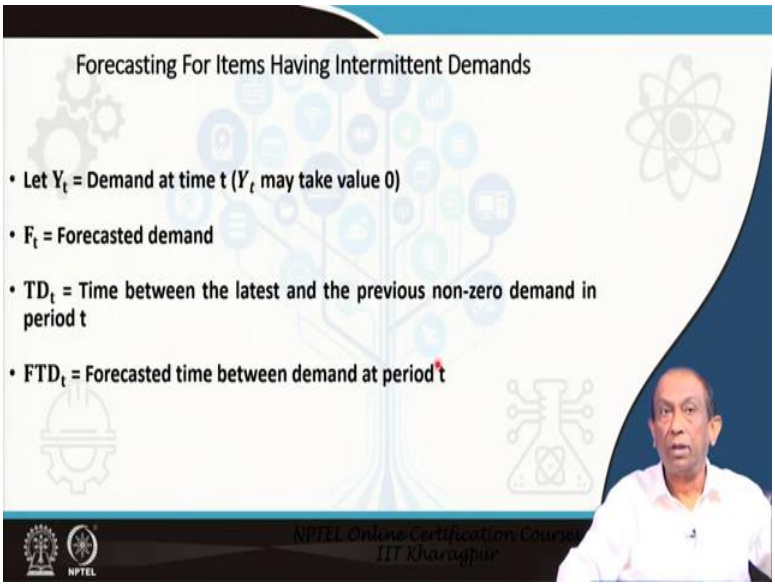
So, this Croston's model is some modification of only smooth simple smoothing techniques. But, the specialty is that this model uses two separate exponential smoothing constants instead of one. So, let us look at how this model operates?

(Refer Slide Time: 08:10)



Once again I repeat that this model has two components. One is predicting the average time between two demands and forecasting the magnitude of demand. Whenever, such kind of demand occurs.

(Refer Slide Time: 08:43)

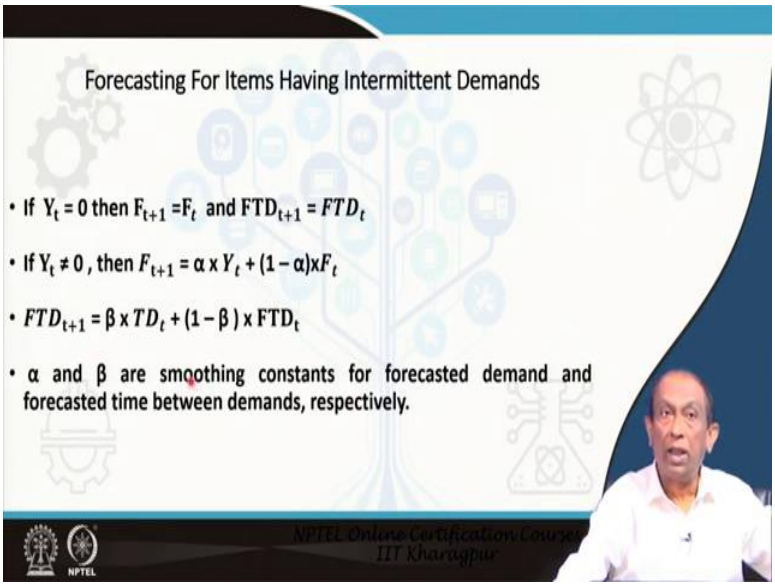


So, let us look at this model let Y subscript t, is the actual demand at the period t or at time t. If there is no demand for a particular period t, then Y t or the demand for that period will be 0 that is why we have written that Y t may take the value 0. Because, the demand pattern is intermittent, there can be demand in some period, there may not be some demand.

We have denoted F t F subscript t, as the forecasted demand for the period t. Then, the other notation that we have used is TD subscript t, which is the time between the latest; that means, when we are going to do this forecasting and the previous nonzero demand in period t. That means, you know there had been demand say 3 or 4 periods prior to when we are doing this forecasting exercise. In that case TD t will be 3 or 4, then when that demand had occurred.

So, we are also interested to know the forecast related to the successive occurrence of demand. So, what is the time that elapses? Before demand is evidenced in a particular period. So, FTD subscript t denotes the forecasted time between two demands at period t.

(Refer Slide Time: 11:41)

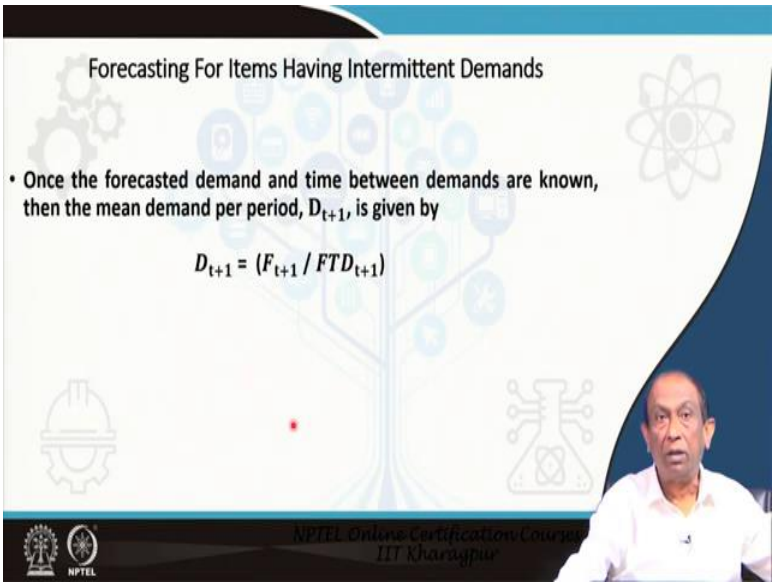


So, what we do? That if Y t equals 0, then this very simple the forecast demand for one period ahead standing at the end of period t is nothing, but whatever was forecasted for the period t. So, F t plus 1 is F t and F t plus 1 is FTD t. This represents the magnitude of the demand one period ahead, standing at the end of period t. And this is the forecast for the estimated time between demands.

If Y t is not equal to 0, then we apply similar formula that we normally use in case of single exponential smoothing model. So, F t plus 1 in that case will be alpha times the actual value of demand that had occurred in the period t denoted by Y t plus 1 minus alpha, into the forecast demand for the period t, simple is simple exponential smoothing model. And, then we introduce another smoothing constant beta to forecast the average time between two successive demands.

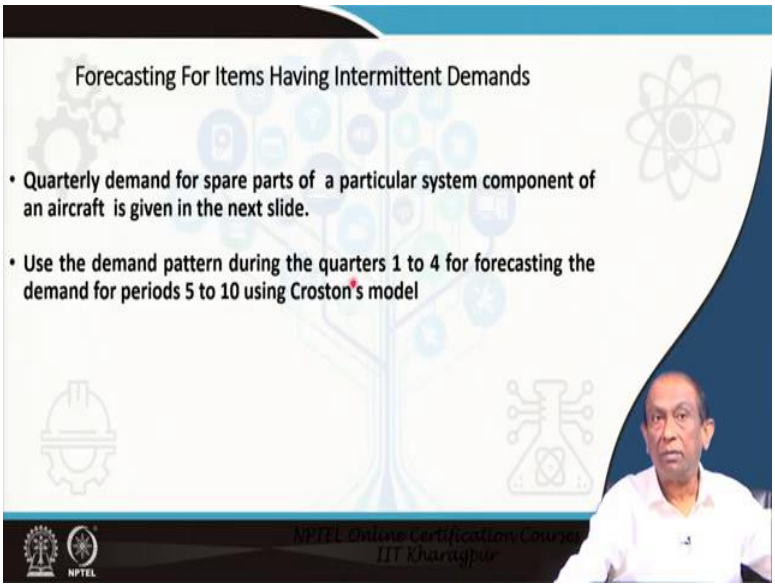
So, FTD t plus 1 is beta into TD t plus 1 minus FTD t, this will be beta into FTD F is missing. So, alpha and beta are smoothing constants for forecasted demand and forecasted time between demands respectively. Sorry about that there will be one F here.

(Refer Slide Time: 14:45)



Once the forecasted demand and the time between demands are known, then the mean demand per period is given by nothing but the magnitude divided by the forecasted estimate for the time between demands.

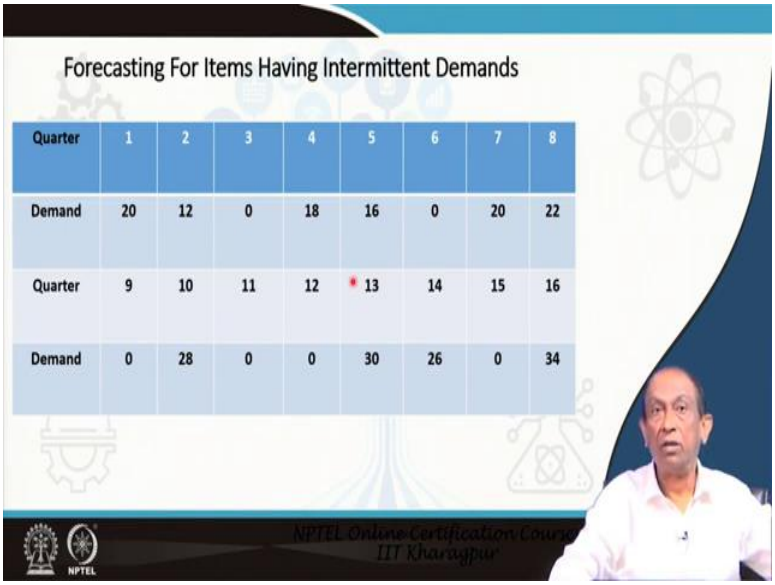
(Refer Slide Time: 15:13)



Let us look at one simple example, quarterly demand for spare parts of a particular system component of an aircraft is given in the next slide. We, have to use the given demand pattern during the quarters 1 to 4 for forecasting the demand for periods 5 to 10 using Croston's model.

So, I came to know about this technique from this business analytics book written by, Professor Dinesh Kumar of IIM Bangalore. And I am going to discuss the same example. And this particular technique is normally discussed by him during his you know analytics course. So, this I came to know about this technique and I have used this and I found very good results.

(Refer Slide Time: 16:55)

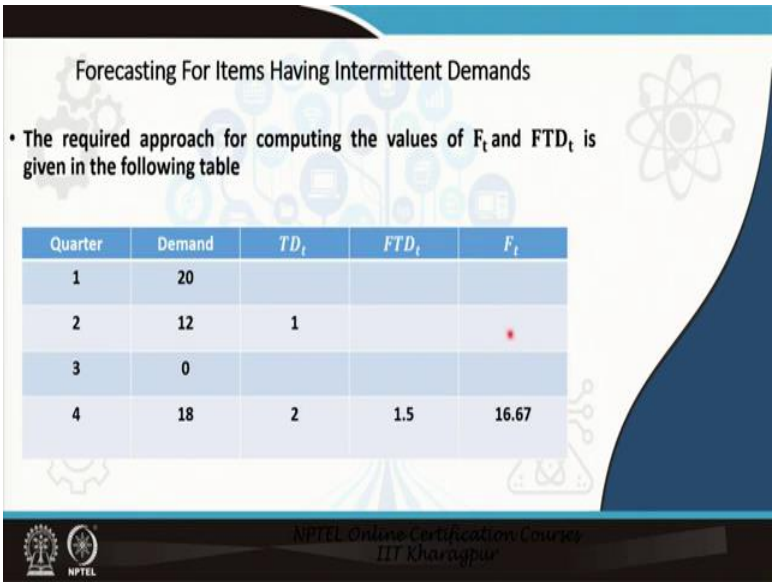


So, let us look at the given demand pattern, for quarter 1 the demand for that system component is 20 units for quarter 2 it is 12 units, for quarter 3 there was no demand. Because, this is an intermittent demand item for quarter 4, the demand is 18 units for quarter 5 16 units. Again for quarter 6 there was no demand, for quarter 7 and 8 the demand is 20 units and 22 units.

For quarter 9 again there was no demand, for quarter 10 the demand is of 28 units again for 2 successive periods, quarter 11 and quarter 12 no demand had been evidenced for that spare part. Again for quarter 13 and 14 there were demand for 30 units and 26 units respectively, again for quarter 15 there was no demand. And for quarter 16 the demand for that spare part was 34 units.

So, you see this item is exhibiting a particular pattern, where we have observed that there may not be demand for this particular item in a particular quarter that is why these are basically, items having intermittent demand.

(Refer Slide Time: 19:06)

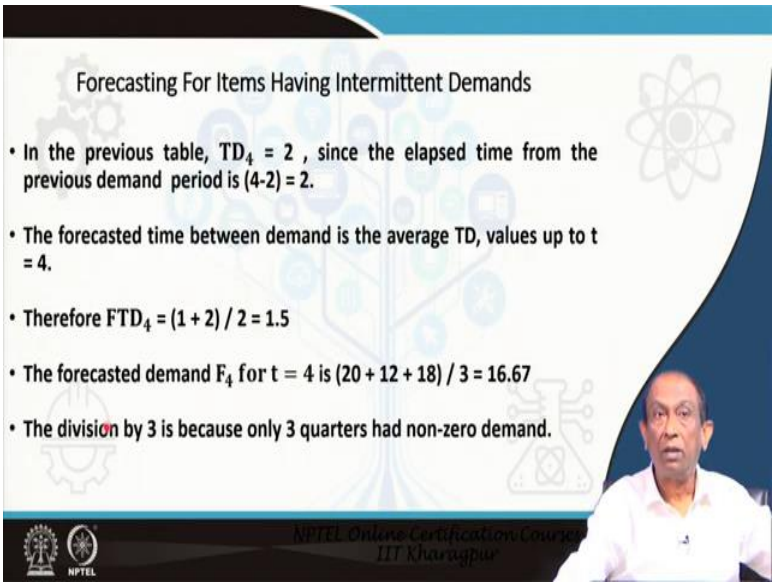


Next, the required approach for computing the values of F t and FTD is given in the following table using the equations that we have already discussed.

So, you see we have taken the data and TD t subscript t, is basically the time between the demands. And FTD standing at the end of period t, we are going to estimate what is the likely time before we can see another occurrence of demand for such items. And if that demand occurs after such a period. What will be the magnitude of that demand which is represented by F subscript t?

Now, for this example it is 1.5 and 16.67 for the values which were computed at the end of period 4. Now, where from this 1.5 and 16.67 is coming?

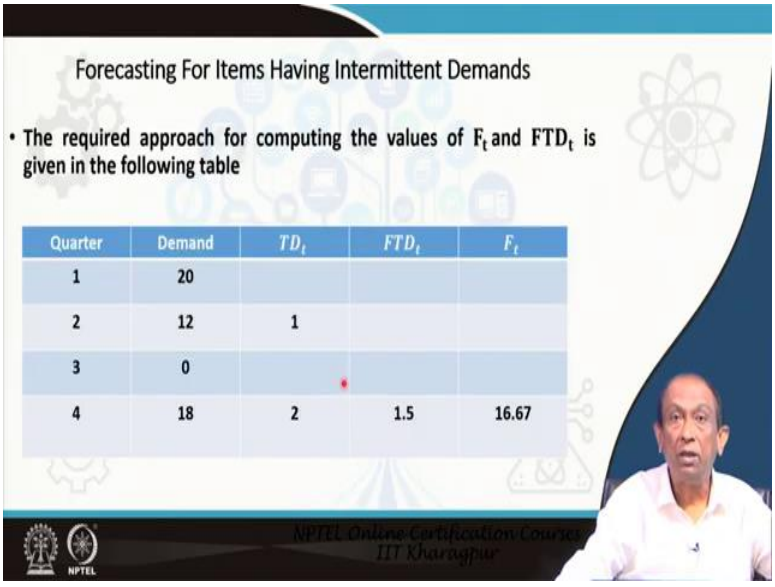
(Refer Slide Time: 21:12)



So, you see in the previous table the computed value of TD 4 is 2, since the elapsed time from the previous demand period is nothing but 4 minus 2 equals 2. And the forecasted time between demands is the average TD, values up to t equals 4. So, there were 2 such observations and hence FTD 4 is computed as 1 plus 2 divided by 2 equal to 1.5 units.

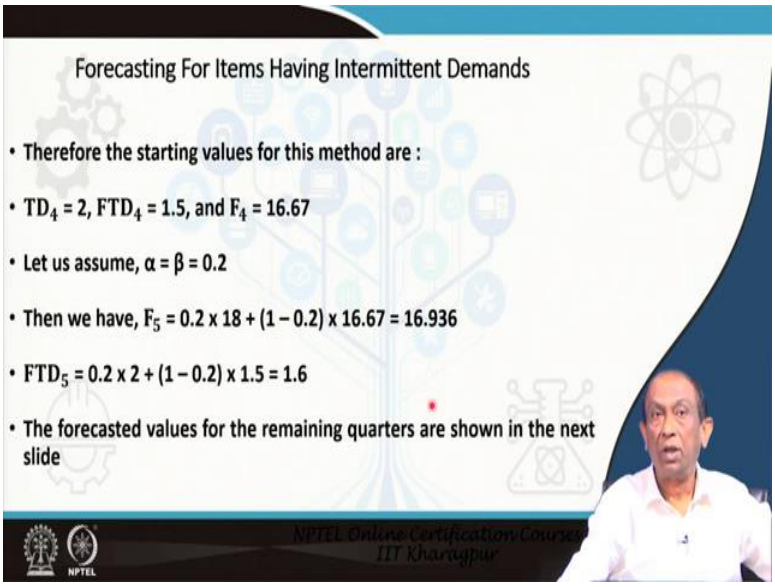
The forecasted demand for period 4 which is denoted by F subscript 4 is initially to start with, is basically the average of the 3 occurrences of demand which is nothing but if you look at the previous table.

(Refer Slide Time: 22:25)



It is 20 plus 12 plus 18 divided by 3 which is nothing, but 16.67. So, you have to start with these values like the way you start with such computations, in case of single exponential smoothing model. The division by 3 in this case is because, only 3 quarters had exhibited non zero demand pattern.

(Refer Slide Time: 23:01)



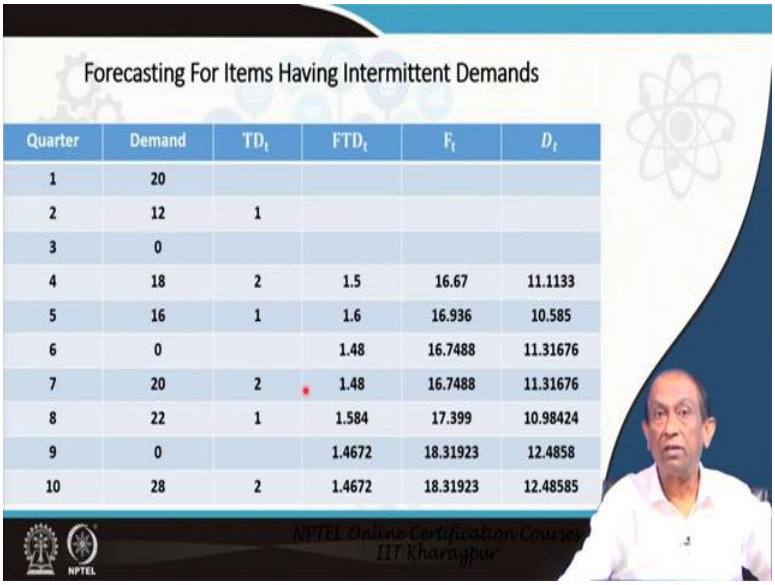
Therefore, the starting values for this method are TD 4 equals 2 FTD 4 is 1.5 and F 4 is 16.67. Now, for this case let us assume that the 2 smoothing constants alpha and beta required for this computation is equal to 0.2, we have taken the same values for alpha and beta. Then, the forecasted demand, if there be any demand for the period 5 is F 5 F subscript 5 given as 0.2 into the actual demand that had occurred which is 18.

If, you look at the table the actual demand for the period 4 is 18. And we are doing the forecast standing at the end of period 4. And that is why what we are doing that alpha into F 4 plus 1 minus alpha into 16.67, which is the computed forecast for the period 4. And this F 4 is the starting value, arrived by taking the average amount of demand for the periods, where such occurrence of demand had been evidenced.

So, F 5 is nothing but 16.936. So, the forecasted demand for the period 5 standing at the end of period 4 is nothing about 16.936. Now, we have to compute FTD 5; that means, time between demands and that is nothing but 0.2 into the value of TD 4 which is 2 plus 1 minus beta multiplied by the estimated time between demands for the period 4 which is taken as the starting value substituted here gives 1.6. So, in a similar manner the forecast

values for the remaining periods have been computed and shown in the next slides. For period 1 to 10.

(Refer Slide Time: 26:37)

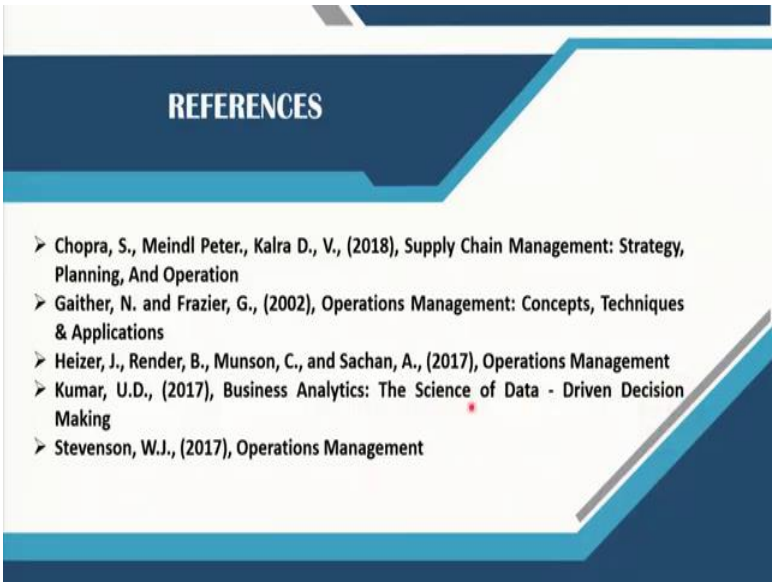


Now, this is the outcome of the model, but the manager has to review this outcome consult with the technical experts, use his experience and judgment. In revising these values before it gets implemented and the principle is same, for every such semi structured decisions problems decision problems basically.

So, this is all about the different forecasting models, which are embedded in a decision support systems. Used for forecasting mainly these kind of systems, using such model is used by materials managers by production planners and by other executives who are engaged in the area of operations management.

But, decision makers mainly the executives who are engaged in strategic planning where the problem is completely unstructured. Mainly qualitative forecasting models are used and one such technique is a Delphi method of forecasting. So, that is a separate issue altogether.

(Refer Slide Time: 29:33)



So, this is all about the models, simple models deployed in decision support systems for forecasting. And particularly this topic we have, you know, consulted all these references particularly, this reference from business analytics book. I have used this example by Dinesh Kumar, Professor of IIM Bangalore in explaining you this kind of technique used for spare parts.

Thank you all for your patience!