

Project Management for Managers
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Lecture – 13
Market and Demand Analysis-I

Good morning friends, I welcome you all in this session. As you are aware we were doing market and demand analysis in previous session and we have seen several components of it we have seen situational analysis, we have seen collection of secondary information, we have seen initial market survey, we have seen characteristics of the market let us look at demand forecasting; one of the very important concepts of market and demand analysis. So, we will see this topic in detail.

So, we will see what are different methods of forecasting and before looking at methods of forecasting. You should know what is forecasting the forecasting is to know a priori about future events. Now we want to know future demand of a product we want to know what would be the temperature in summers this time and we want to know what would be the share price after one year or after one month. So, all these are future events. So, that is known as forecasting.

Now, let me tell you that there is little difference between forecasting and prediction. We do forecasting on the basis of some past data we apply some statistical tools and we also use our own experience. When we combine these two things we call it prediction otherwise if we use only data and some statistical analysis it is known as forecasting. So, let us look at different methods of forecasting basically there are 4 types of forecasting methods, the first one is qualitative methods.

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Methods of Demand Forecasting

I Qualitative Methods : These methods rely essentially on the judgment of experts to translate qualitative information into quantitative estimates. The important qualitative methods are :

- Jury of executive method
- Delphi method

II Quantitative Methods: These methods generate forecasts on the basis of an analysis of the historical time series. The important time series projection methods are :

- Trend projection –method
- Exponential smoothing method
- Moving average method

III Causal Methods : More analytical than the preceding methods, causal methods seek to develop forecasts on the basis of cause-effect relationships specified in an explicit, quantitative manner. The important causal methods are :

- Chain ratio method
- Consumption level method
- End use method
- Leading indicator method
- Econometric method

IV Simulation

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So, in qualitative methods generally we do not use numbers and statistical analysis. So, they are based on the opinion of experts. So, experts will tell you what would be the future demand. So, there are two types of methods in qualitative methods jury of executive method and Delphi method we will see these two methods on the on the other hand you have got quantitative methods. So, we use the past data of let us say sales of a company, and we will try to predict forecast we will try to forecast what would be the demand of that particular company in future. And there are again different methods you have got trend projection, you have got exponentially smoothing you have got moving average method.

The third one is causal methods; causal methods deal with cause and effect relationship. So, there would be a cause and it would have some effect on something. So, as I said it is the basis of cause and effect relationship is to be found out and there are couple of causal methods you have got chain ratio methods, you have got consumption level method, and use method leading indicator method and econometric method and finally, you have got simulation.

Generally we use simulation to know how the output will change, when we change our input. So, simulation is generally used in highly uncertain situation. So, these are basically 4 methods. So, we will see in detail about qualitative methods this is. So, the first one is jury of executive opinion method.

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The slide is titled "Qualitative Methods" and "Jury of Executive Opinion Method". It describes the method as soliciting the opinion of a group of managers on expected future sales and combining them into a sales estimate. It lists two pros: it is an expeditious method and it permits a wide range of factors to be considered and it appeals to managers. It also lists two cons: biases cannot be unearthed easily and its reliability is questionable. The slide footer includes logos for IIT ROORKEE and NPTEL ONLINE CERTIFICATION COURSE.

Qualitative Methods

Jury of Executive Opinion Method

This method involves soliciting the opinion of a group of managers on expected future sales and combining them into a sales estimate

Pros

- It is an expeditious method
- It permits a wide range of factors to be considered
- It appeals to managers

Cons

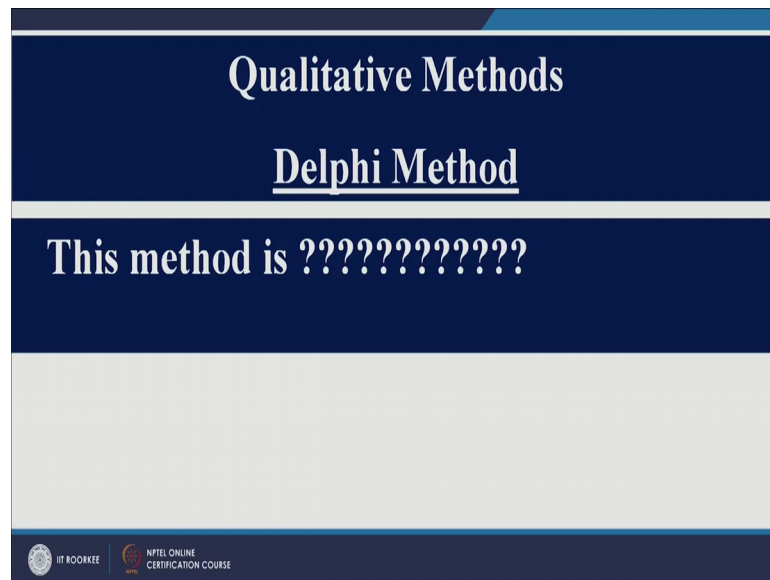
- The biases cannot be unearthed easily
- Its reliability is questionable

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So, as I said in this method we get we want we get opinion of experts or managers to know what would be the future sells. But there are certain pros and cons of this method the pros are you have got you can get easily what would be the forecast of a particular product by talking to experts. So, it is an expeditious method and it appeals to managers because managers would like to tell you what would be the forecast of a particular product, but the cons are the bias cannot be unearthed easily, because there would always be biasness in this particular type of method, and that is the problem with this method and it is reliabilities also questionable.

Now, how would you ensure the reliability when a manager says that the next year the demand would be this much right he may be wrong, right. So, you need you cannot test it is reliability. So, these are couple of cons of this particular method, but there are certain organizations especially small businesses they go for this type of forecasting method. If you look at second method it is called Delphi method widely used method better than previous method.

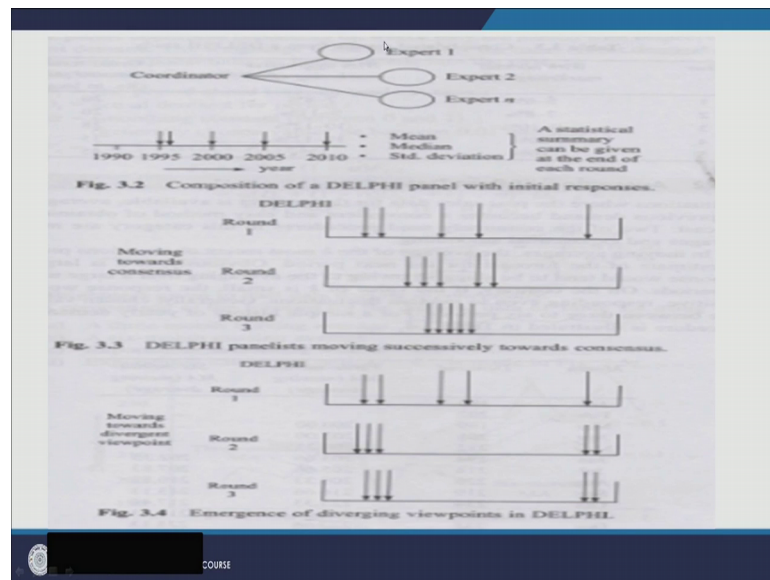
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So, what do we do in Delphi method? In Delphi method generally what we do we get the opinion of group of experts with the help of mail survey now you can send emails you can you can talk to them our phone and so on right. So, a group of expertise send to a questionnaire and we will ask them to reply to those questions. So, once we receive those questions we summarize those questions and then we go for second round of sending questionnaire to those experts, and we also you know tell the experts the views of each others. So, that they can know what other experts are thinking.

So, in this way we will go for further probing of a particular question in that questionnaire. So, we will try to know insights from those experts, worse you go for second round then you may go for third round or fourth round right. So, you should continue these rounds unless and until you reach to a particular consensus right. So, there might be some agreement amongst those experts on a particular topic are there might be different opinions, you may have two different opposite opinions right. So, it depends on experts and what are those different questions. So, this is Delphi method I will give you this example let us say.

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So, in this Delphi method you will have a coordinator. So, there is a coordinator and these are different experts right.

So, you can send questionnaire to these experts and let us say in the first round these are different opinions of experts right, so first, second, third, fourth and fifth. So, there are five experts. So, they have given some opinion right when you go for second round then you see they are trying to converge on a particular decision right. So, just see this second round, in third round they are now they have converged fully right. So, this is one example you might have a situation where let us say these in the first round these are your opinions, opinions of the experts. In second round you have got 3 experts giving opinion and two experts giving exactly opposite opinion.

In third round again now this is they are this is very clear now, you have got 3 experts going together and to express going together in other direction right. So, you may have a situation like this. So, it all depends on experts and what is the question. So, the pros are it is more accurate than previous method because you have got group of experts and the problem with this method is there are people who said that what is the need of additional rounds, what would be the contribution of additional rounds and what is the value of experts opinion. So, there are some critics also, but let those critics be there, but at the end of the day this is a better method.

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Quantitative Methods

Trend Projection Method

The trend projection method involves:

(a) determining the trend of consumption by analysing past consumption statistics and

(b) projecting future consumption by extrapolating the trend.

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Let us look at couple of quantitative methods so far we talked about qualitative methods right. So, in quantitative methods there are several methods we will see couple of them. So, the first one is trend projection method. So, what we do we will have the past data and we will try to find out trend, so the trend maybe increasing trend or decreasing trend or a constant trend. So, once we know the trend we can extrapolate it right. So, that is the correct of this particular method find the trend and extrapolate it.

So, trends trend projection methods can be you can have a linear relationship. So, when I say linear relationship you have got a dependent variable and you have got independent variable. So, it is possible that when you change one unit of independent variable there is a change in one unit of dependent variable also. So, you will have a perfect linear relationship, but in real life situation generally you do not have linear relationship, you will always have some non-linear relationships. So, you can have exponential relationship also. So, the value of y which is a dependent variable let us say profit of an organization depends on let us say r and d investment right.

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Trend Projection Method

Linear relationship: $Y_t = a + bt$

Exponential relationship: $Y_t = ae^{bt}$

Polynomial relationship: $Y_t = a_0 + a_1 t + a_2 t^2 + \dots + a_n t^n$

Cobb Douglas relationship: $Y_t = at^b$

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It is possible that there is exponential relationship between r n d investment and profit right you can also have polynomial relationship. So, this is the equation for polynomial relationship and there is something called Cobb Douglas relationship. So, we will not go into detail of all these things we will we will look at linear relationship.

So, let us look at an example on linear relationship. So, the question is there is a transportation company which has got several trucks, and the manager of the transportation company wants to know what is the relationship between age of the truck and repair expenses. So, the manager has collected a sample of 5 trucks, and the repairing expenses. So, the first truck he selected has got age of 5 years.

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Age (x)	Repair expenses (y)
5	7
3	7
3	6
1	4

What would be expenses for a 4 years old truck.

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So, the truck is 5 years old right and the repair expenses let us say 7000 rupees per month. So, you can take it either 7000 or 70,000 whatever you like right.

So, when the age of the truck is 5 years repair expenses 7000, 3 years 7000, 3 years 6000 one year 4000. Now since you have selected trucks on the basis of sampling you may have a truck which is 3 years old, but repair expenses 7000, but the some other truck which is also 3 years old repair expenses 6000 it is possible right. So, the question is what would be the expenses for 4 for a 4 years old truck right. So, you want to find out a relationship between this age of age and expenses right. So, how would you proceed?

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	Age (x)	Repair expenses (y)	xy	x ²
	5	7	35	25
	3	7	21	9
	3	6	18	9
	1	4	4	1
Total	12	24	78	44

$\bar{x} = 3, \bar{y} = 6$

$a = \bar{y} - b\bar{x} = 3.75$

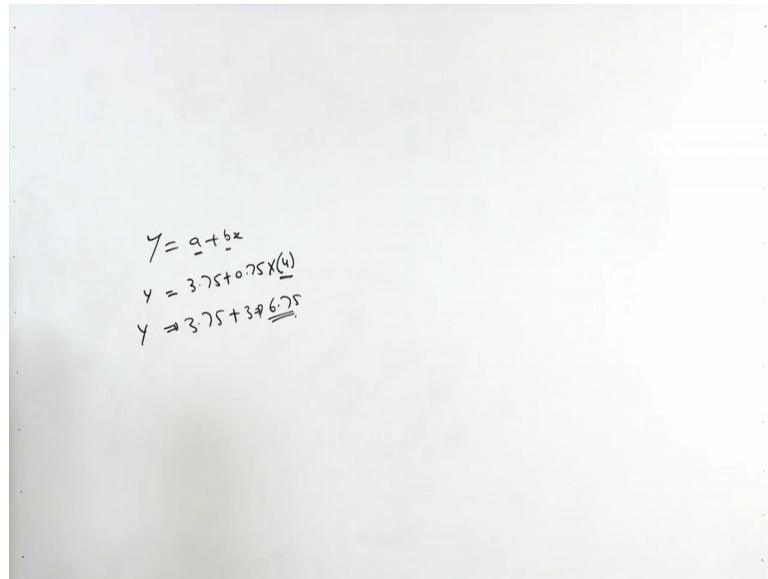
$b = \frac{\sum xy - n\bar{x}\bar{y}}{\sum x^2 - n\bar{x}^2} = 0.75$

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So, this is basically very simple question. So, what you can do you just take the you just find out \bar{x} value right, \bar{x} is nothing, but average of this column right. So, this is 12 and average is 3. So, 12 by 4 right because n sample size is four. So, this is 3 and \bar{y} is 6. So, this summation of all these all these values is 4 24 and divided by 4 right. So, this is 6 right similarly $\sum xy$ you can multiply these two columns and you can find out total similarly $\sum x^2$ here, so total is 44.

So, this is your equation. So, \hat{y} is equal to $\bar{y} - b\bar{x}$. So, if you want to find out a you just calculate \bar{y} that is six minus b into \bar{x} right. So, \bar{x} is not which is 3 right. So, you do not know b here right in this equation. So, to calculate b just use this formula. So, $\sum xy - n\bar{x}\bar{y}$ right you need to multiply \bar{x} and \bar{y} that is 18 right n is 4 4 is the sample size right. So, this is $\sum x^2 - n\bar{x}^2$ right just 9 right. So, when you apply this particular formula to calculate b you will get b is equal to 0.75. So, a is now you have calculated a and you have calculated b right.

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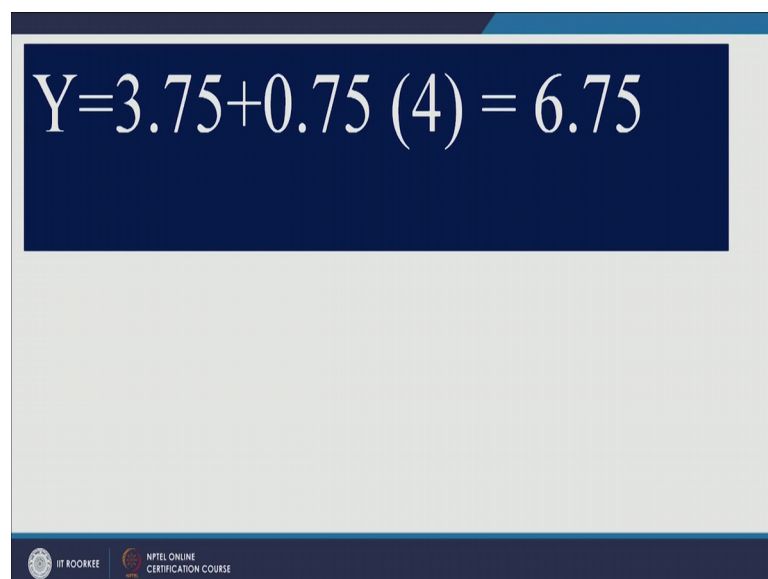


Handwritten mathematical derivation on a whiteboard:

$$y = a + bx$$
$$y = 3.75 + 0.75x(4)$$
$$y \Rightarrow 3.75 + 3 \times 6.75$$

So, can you now find out what would be the expenses for a 4 years old truck. So, there is you can have a relationship like y is equal to a plus b x right. So, you know a value you know b value right. So, y is equal to a is you already know a which is 3.75 plus b , b is also known to you 0.75 into 4 right because you want to find out the expenses for 4 years old truck right similarly you can further do this. So, this 3.75 plus 3 right 6.75. So, this is your answer right. So, a simple linear relationship can be used here right. So, it is nothing, but simple linear regression. So, this is your answer right. So, this is this was a very simple question.

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Slide showing the final calculation:

$$Y = 3.75 + 0.75(4) = 6.75$$

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So, let us move onto moving average method; the name of this method is moving average it is not average method.

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Moving Average Method

As per the moving average method of sales forecasting, the forecast for the next period is equal to the average of the sales for several preceding periods.

In symbols,

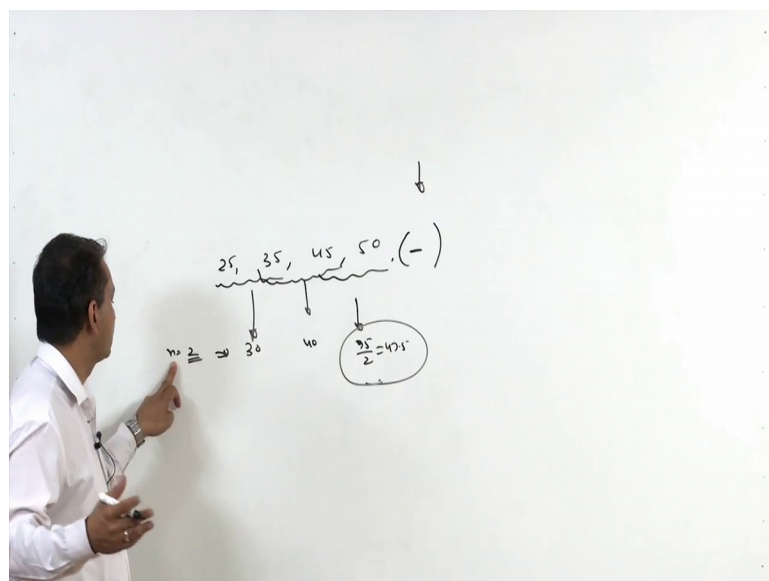
$$F_{t+1} = \frac{S_t + S_{t-1} + \dots + S_{t-n+1}}{n}$$

Where F_{t+1} = forecast for the next period
 S_t = sales for the current period
 n = period over which averaging is done

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So, do you know anything about moving average are why it is called moving what is moving in this average method. Just think for a while. So, we call this method as moving average. In fact, in this method we take move averages of couple of numbers, but we keep moving in in a way for example.

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Let us say you have got past data past sales data of a company let us say 25, 35, 45 and 50 right.

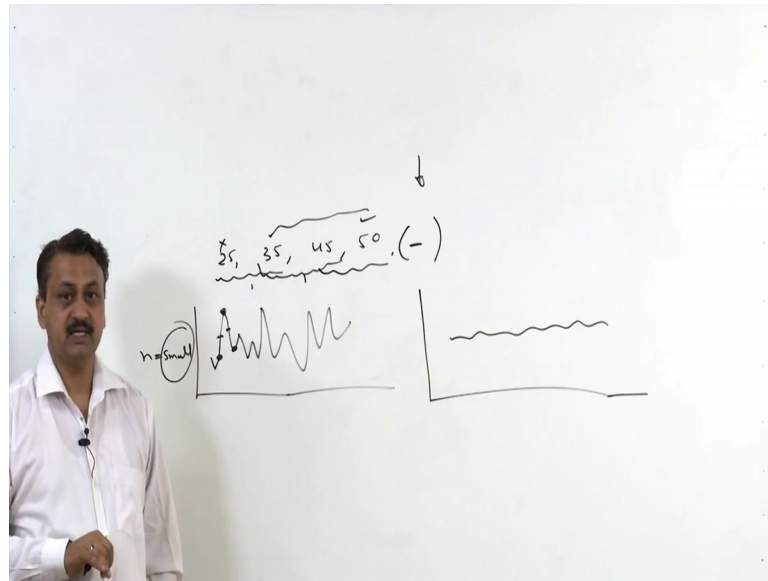
So, I want to know the forecast for let us say next period I can take average of all these values right. So, that would be average method right, but when I say moving average method. So, moving average method can be two period moving method 3 periods moving average 4 period moving average and so on. So, if I want to know what is the forecast of fifth period by let us say two periods moving average method, two periods moving average method. So, I will take average of these two. So, the average of these two would be 30, so this is 30.

The next value would be the moving average of these two. So, this would be you can have just this is 40 right. So, the moving average of next two periods right the moving average of next two period would be these two. So, you exclude the previous point and you include the next point is not it for example, when we calculated this 40 we excluded this, but we included this point right. Similarly for calculating moving average of these two we excluded this and we included this right. So, average would be again what would be you just calculate it right it is 95 by 2 right it is 47.5 right.

So, the answer to this question would be what we want to know we want to know what would be the forecast for fifth period right. So, we will take a moving average of these two which is this right. So, that. So, what is moving? We are moving in a way we are excluding previous data pound and we are including next data pound right similarly you can have 3 periods moving average or 4 periods moving average right . So, in 3 period moving average, average of these 3 data points and then next time exclude this and include this right. So, you will have 3 periods moving average. So, this is moving average method.

Now, here the important point is should be let us say in this case should be select two periods moving average are 3 periods moving average. Now this is an important point important question you should know the value of n it should be small if there is lot of variation in data.

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Let us say let us say you have got lots of variation in data. So, this first data point second third fourth fifth and so on right. So, if variation is this is very high then you should use n is equal to small 2 periods 3 periods and so on right, but if you think that your sales is like this then you can use 6 6 7 8 9 right why this why we are selecting small value of n here and why large value of n here.

Because let us say if you look at these two points right first second and third right these are 3 points. So, when you take average of these two that would be somewhere here right is not it? Similarly average of these two it would be somewhere here right. So, this will help you in smoothing your values right. So, you need to select value of n very carefully. So, this is the formula F_{t+1} means the forecast for next right F_t means forecast of previous period, this is S_t is equal to sales for the current period and n is number of periods right.

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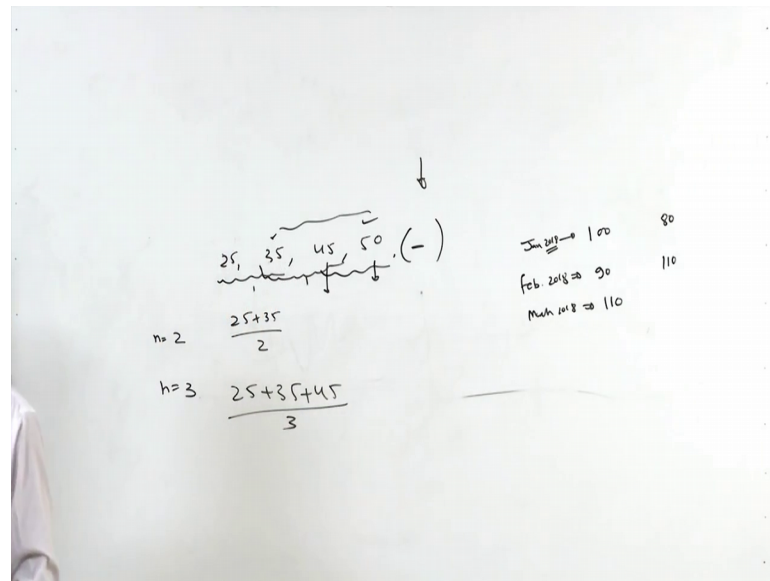
Year	Demand	4 MA
2010	32	
2011	36	
2012	40	
2013	35	
2014	32	35.75
2015	35	35.75
2016	45	35.5
For 2017		36.75

So, this is very simple formula right we will take up an example let us say you have got demand data of 2010 32 units, 11 36, 2016 45 right. So, if I want to know what is the 4 months moving average forecast for year 2017. So, we want to know 4months moving average right.

What would you do 4 months are 4 years right it is not month right. So, it is good to it is good to call it 4 period moving average right rather than calling month or year right. So, 4 period moving average. So, what would be the answer? So, first of all you just take the average of first 4 data points right. So, 32, 36, 40 and 35 average of all these 4 would be 35.75. The next 4 periods moving average would be 35.75. So, you just exclude 32 and you just include this 32 right similarly exclude 36 include 35, exclude 40 include 45 right. So, the last 4 periods average is 36.75 right. So, how did you get this 45 plus this plus this plus this divided by 4 right you will get 36.75. So, the answer by moving average method for this question is 36.75.

Now, let us move on to another methods called exponential smoothing method. If you look at the moving average method then you would have observed that we have given equal weightages to all the data points for example, if you look at this this example when we say when we go for two period moving average we have taken average of these two right it means it is 25 plus 35 divided by 2. So, 50 percent weightage is given to this 50 percent weightage is given to this right is not it.

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When n is equal to 3 you will take average of these 3 right it is 25 plus 35 plus 45 right divided by 3. So, what is the average given to this data point? It is 0.33 right 1 by 3 1 by 3 1 by 3 . So, we have given equal weightages and that is the difference between moving average and exponential smoothing method. In exponential smoothing method what we do the weightage which we give to last data point then weightage given to this data point would be less than weightage given to this data point weightage given to this would be less than weightage given to this data point weightage given to this data point would be less than weightage given to this data point and how much less it would be it would decrease in exponential manner. So, that is why we call it exponentially smoothing method the weightage given to the older data points decreases in exponential manner right.

So, that is why it is known as exponentially smoothing method. In this method generally we modify our observations depending upon error. Let us say I have forecasted demand of a particular period and my sales is less than the forecast. So, there would be some error right. So, this error I will keep in mind and whenever I forecast the demand of next period, I will forecast by keeping error in mind. So, I will give you an example, let us say I have forecasted demand of a particular product in next period as 100, let us say January of 2018, but this sales is 80. So, there is an error of 20 units.

Now, whenever I forecast for February 80 I will reduce my forecast to let us say 90 is not it. So, what I have done? Initially I forecasted hundred, but sales was this next time I

just by looking at error I just you know reduced my forecast right, but let us say sales in February is 110 again there is some error. So, I will now reduce I will now increase forecast for March month and it would be let us say 110 right. So, here I will take corrective action and I will forecast appropriately.

So, let me stop here in this session. So, and in next session we will continue with this method.

Thank you very much.