Engineering Economic Analysis
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Lecture 31
Cost Estimation: Methods of Cost Estimation, Adjustment of Data, Learning

Welcome to the lecture on cost estimation. Now basically engineering economic analysis what we study, here you are estimating something at present which has to be useful in the future. So you have to evaluate some of the proposals or some of the recommendations by you how it will behave inn future.

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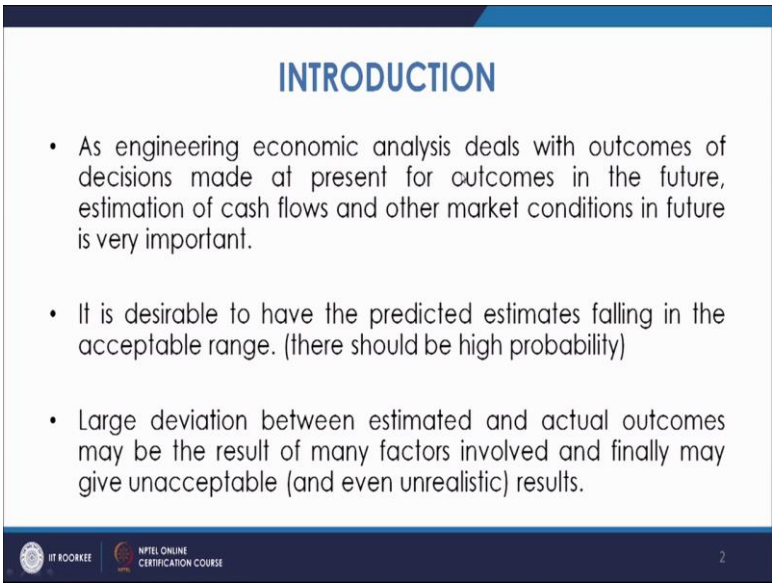

So I mean we want to tell that it deals with outcomes of decisions made at present for outcomes in the future. Estimation of cash flows and other market conditions in future is very important because if you do not do the estimation properly, it may lead to unrealistic results. It is desirable to have the predicted estimate falling in the acceptable range. So once we do the estimation, it must for in a certain range which can be taken as a practical value.

So the probability of estimating those values which have a realistic meaning and which should not have very bad accuracy, this probability must be more. Large deviation between estimated and actual outcomes may be the result of many factors involved. So basically we have to estimate certain final output and there are many factors involved. There are many parameters which are to be taken into account.

Now while estimating all these parameters if we do the error in estimating all the parameters then their cumulative effect can be even more. So if there is large deviation, it may result into

unacceptable type of results. There may be large deviation and there may be even unrealistic results. So estimation basically is a very important process and there must be a very good estimator who should estimate more than more accurately.

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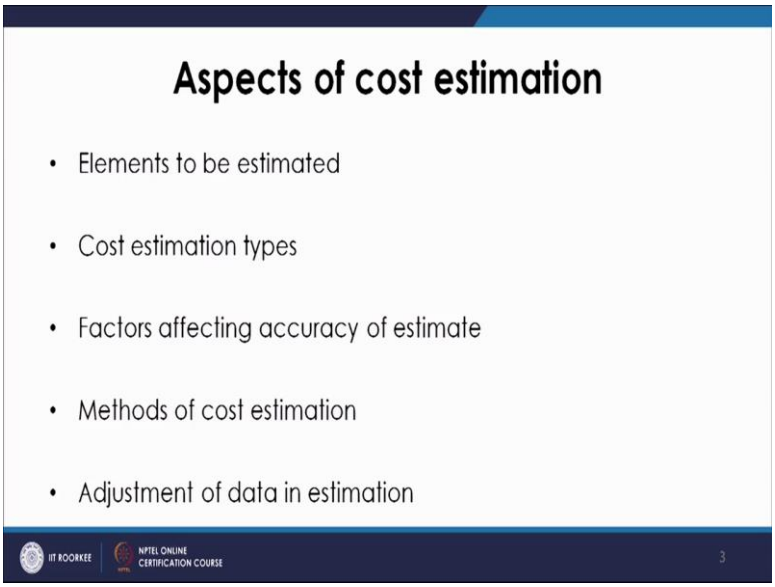

Now we will discuss about different aspects which are to be looked into while cost estimation. The first is elements to be estimated. Now what are the elements which we estimate? Basically you have first the estimation of output. So first of all you see what output you need. Now output can be in terms of if you say manufacturing operations output can be number of units of liquid, metal or number of forgings to be done, all these are outputs.

So first of all the output has to be in mind, what output you need. Now once you have the outputs, the output even maybe for the satisfaction you have to achieve all for the number of selling for any particular product, all these are coming under output. So that is to be estimated. That can be estimated by different processes if these are the products which are going to the market to be sold, it will be done by markets surveys, by research into that area.

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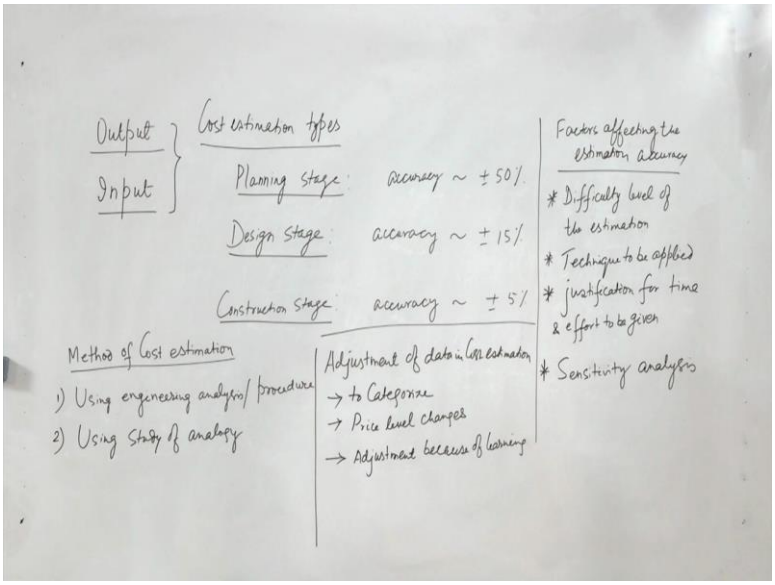

And if these are in the area of manufacturing, you can have the idea of these outputs by weighting by having the idea physically. Now once you have the estimation of output you need estimation of input, these are the elements which are to be estimated. Now once you have the estimation of output, you need the input what is required for getting this output. So input can be in terms of raw materials if it is an engineering activity.

Input can be in terms of machines required which is used for the operation to be done. Input can be in any form. So basically the elements to be estimated means these are basically the main units main parameters which are to be estimated. Now cost estimation types, now in this cost estimation types we will discuss about the different situations how at different stages different destinations are to be carried out.

So let us say when we want to estimate something, when we want to have certain output, initially we are having a planning stage. Now in this stage basically we do the analysis in a very broad manner and the accuracy is something of the order of plus minus 50 percent. Now this is done through the conferences, symposia.

We have some idea in mind, something is coming into the mind, something has come into the mind of the organization so that you develop some unit. For that there is meeting, symposia and conferences and in that very broadly the estimation is done and this is normally of the order of 50 percent of deviation.

Then comes the design stage, now once you have given the okay for the project to go ahead, then comes the design stage where it is all decided which process to be adopted, how to go

ahead. So this is known as the design stage and here accuracy is said to be something of the order of plus minus 15 percent. So here the planning is done, how to use, which machines to be used, all that and this is basically the design stage.

Then comes the implementation stage or construction stage. Now once this is also finalized then you go for the construction of the project and for that all the minutest level of details are to be furnished. So here comes the persons were basically experts, they will talk about all the minute details and the deviation here will be not more than about 5 percent, so accuracy you can say, it will be something close to plus minus 5 percent.

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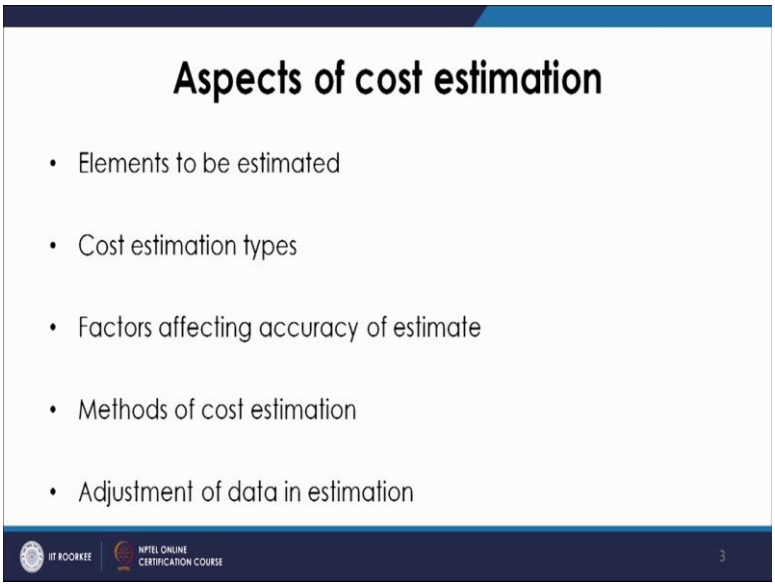

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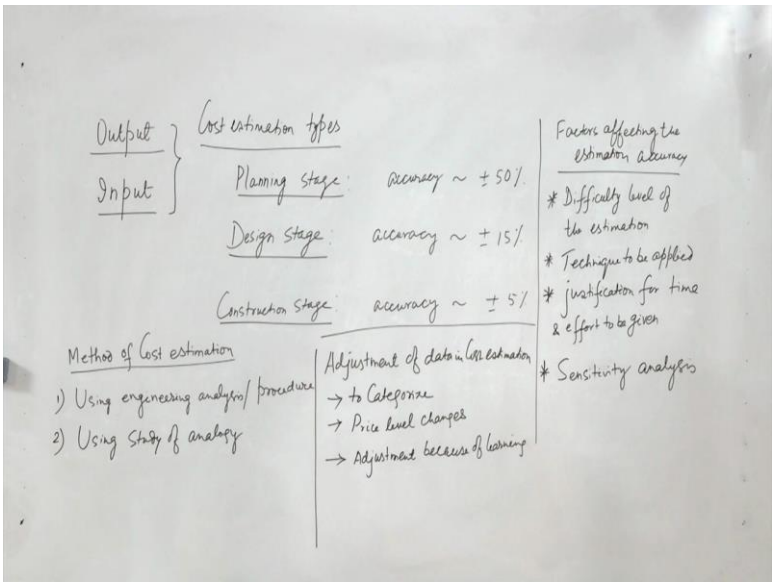

So basically this estimation types, we discuss about what kind of estimation we do depending upon the importance. Now let us see the factors affecting the accuracy of estimate. Now there are certain factors which talk how the estimation should be done. So the first factor is the difficulty of estimation. So it depends that what should be the level of detail which you need.

What is the difficulty level of the estimate, depending upon that you have to see what type of estimate is required, what should be the expertise of the person who should be doing in that? So it is difficult level of the estimation. Now once you have gone through the difficulty level of the estimation, you have to see which techniques should be applied. Technique to be applied. You have to be aware of all the kind of techniques which are required for your estimation.

Now for that you have to also show the justification for time and effort to be given. So basically you have also to ascertain that what is the importance of this estimation. If any estimation takes large number of resources, large number of resource time, in that case it must be very important work. So depending upon the importance of the work, that justification is required to be given.

Now we have also to see the sensitivity analysis. By sensitivity analysis it is meant to say that there are different parameters, the study is to be carried out, the end result how it is affected by changing the parameter levels. So this is these are the different areas where you need to focus and you need to decide what level of estimation is required to be done.

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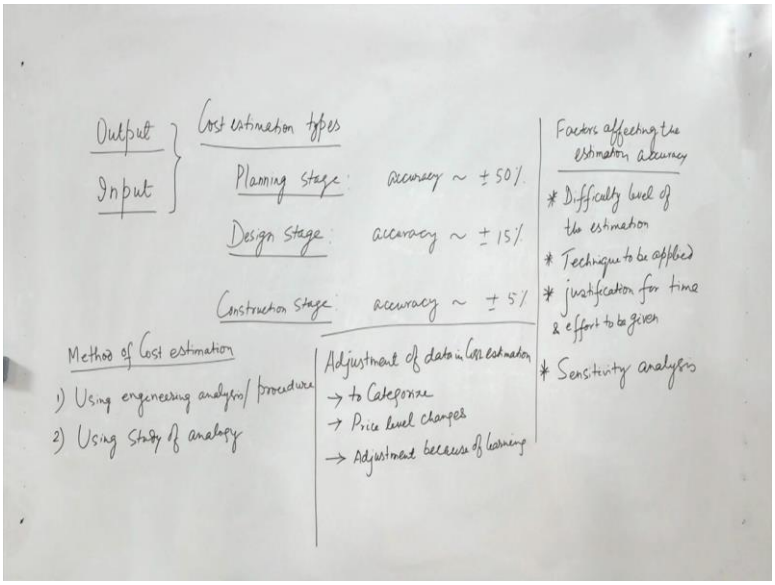

Now method of cost estimation. Now while we do the estimation, there are many ways by which we do the cost estimation and first is using engineering analysis or procedure. Now this means that if it needs any engineering activity, in that case you have you have to specify all the details in the form of blueprints, and the form of the process chart, you have to give all the details so that proper estimation can be carried out.

So also suppose you are doing the estimation related to the selling of the product or related to the manufacturing of any unit, every details should be prepared in hand. All the engineering activity which are to be done, all these must be properly addressed and then estimation will be easy. It will tell you why any estimate has given any particular value because all these calculations will be based on engineering principles.

So this is known as estimation using engineering procedure. Next is it is sometimes very difficult to estimate by engineering procedure, especially when you are estimating something which is very new. So that time our past experience, we used a study by analogy. So using study of analogy.

Now this happens many times when basically you are producing certain unit, although it is similar in characteristic to the existing some of the units but the cost is very much difficult to be predicted. So in that case, the person who is expert in that area by analogy he can have a better estimate. Suppose the first time the helicopter is to be made and estimation of the cost of a helicopter is to be made.

Now there is this helicopter has not been manufactured earlier and there is no idea what cost will be incurred in making a helicopter. It is also known what will be the cost incurred when you make an aeroplane.

So a person who is expert in the knowledge of aeroplane making, he will basically model, he will give the idea that if you are making a helicopter which will have this capacity, which has the materials as a fraction of the material used in the aeroplane or which has an engine of this much smaller than the engine of aeroplane, in that case by analogy he can do the analysis and he can give a better estimate of the product which he is estimating.

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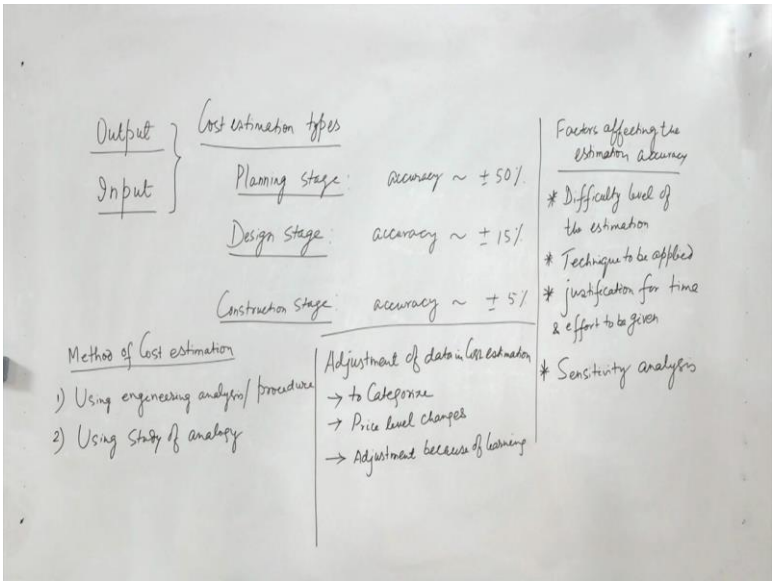

Now we will discuss about adjustment of data in estimation. So we need many a times to adjust the data. So what happens, you have different categories of data which are to be handled and basically you need to put the date of one category at one place. If you are using supposed materials which are to be used for a particular part you should know that this basically belongs to a certain category. So basically they just of different categories is required.

So first of all you know you should know how to categorise the data, so to categorise. The next important thing while discussing about the adjustment of data is the effect of inflation or price level changes. Now what we see is because the economic analysis is done for any estimation in future and since every transaction involves the use of money, the time value of money has to be kept in mind.

So with time what will be the fact on the worth or what will be the effect on the cost of units in future, this is to be kept in mind. So price level changes are to be kept in mind, for that you need to have certain past data which talk about the inflationary changes, the change in the value of money in the past few years and based on that and predict certain changes in the value, certain in changes in the price.

And this way if you take this into account you can come to a reasonably accurate value of cost estimation. The third point which is required to be studied while we adjust the data is related to the adjustment because of learning. Now this learning is basically a process which

means that the labour hours directly labour directly required to make any component basically when you are making this component for the first time, it takes certain others.

But it tends that as you go on increasing the number of units and you are going on making the units, especially it is more suitable for those items which are very large in size, which take large amount of directly labour hours. So it is seen that as you go on doubling, double the number of units produced, the direct labour hours is seen to reduce by a certain factor. So this is known as a concept of learning.

So basically the amount of direct labour hours may reduce by any factor, it may reduce by 80 percent, it may reduce by 70 percent. In that case if it is reducing by 80 percent, it is known as 80 percent learning curve. Means if for one unit, for the first unit if you are taking 100 direct labour hours, in that case the second unit using 80 percent learning curve will take 80 hours and the fourth unit will take point 8 into 80 that the 64 hours, so this is the learning curve.

We will see how this learning curve can be used to adjust the cost data while making the any unit in the future. So let us discuss about the adjustment because of learning. Now we will discuss about adjustment because of learning.

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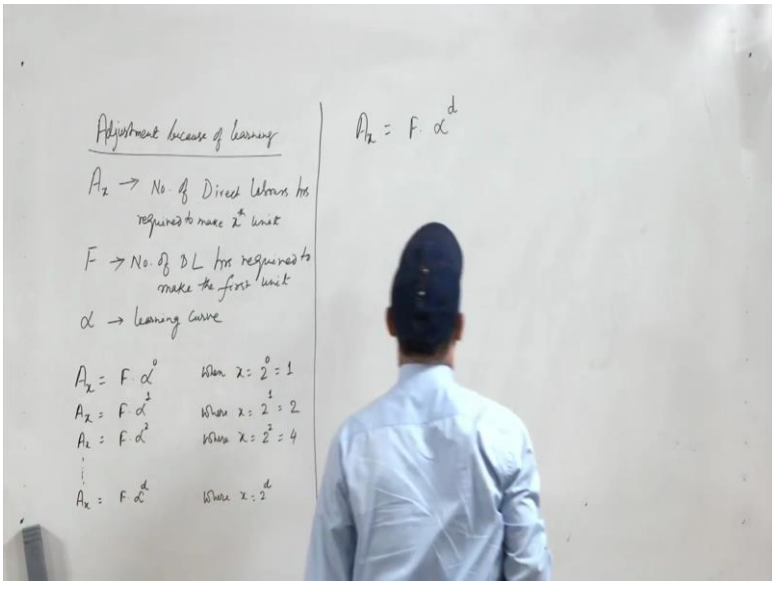

Now let us say you are making any product where Ax is the number of direct labour hours required to make xth unit. X is the unit number, so A1 means the labour hours required for making the first unit, A2 will be the labour hour required the second unit and so on. Now F is

the number of direct labour hours required to make the first unit. Now let as say alpha is the learning curve.

So what we see is, if we see Ax as F into alpha to the power zero when the first unit is produced, that is when X is nothing but 2 raised to the power 0 that is 1. So for first unit when X is one, basically you need number of direct labour hours is F and it can be written as F into alpha raised to the power zero where X you can write as one because X is one. So it is nothing but 2 raised to the power zero.

If we assume, this is based on the assumption that every time you are doubling the production, in that unit the number of directly labour hours required some factor times the labour hour required which is in the previous time. So if suppose you take A2 Ax F into alpha 1 and it will be to, so you can write X as 2 raised do to the power 1 that is 2. So this one comes here and this is 2.

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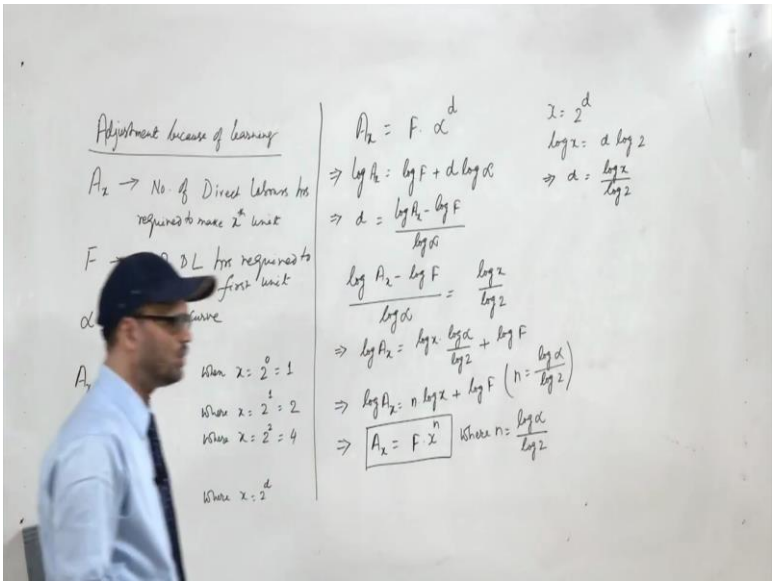

So you can further proceed, a X will be F alpha raised to the power to where X is 2 raised to the power 2 that is 4. So when the fourth unit is produced, you see that it will be F alpha times alpha. So if it goes like this, we can write Ax will be F into alpha D where X is nothing but 2 raised to the power D. Now we can see, you can solve this further. Let us take the log on both sides, so on one side we have got Ax is equal to F into alpha raised to the power D.

So we can write taking logarithm on both sides, log Ax will be log F plus D log alpha. So D will be equal to log Ax minus log F divided by log alpha. On the other side you also get X equal to 2 raised to the power D. So in this also if you take logarithm on both sides, log X

will be D log 2. Should be will be equal to log X by log 2. Now this D and this D will be equated. So log Ax minus log F by log alpha will be equal to log X by log 2.

Now we can get the values, log Ax will be equal to log X into log alpha by log 2 plus log F. Now you if we take log alpha by log 2 as n, so this can be **re** written as log Ax equal to n into log X plus log F, if we take n as log alpha by log 2. So further you can write as Ax equal to F into Xn where n is log alpha by log 2.

So this is the expression by which you calculate the value of direct labour hours required to make the xth unit when you know the number of directly labour hours required to make the first unit and X is known to you and it is also known to you the value of n which is nothing but log alpha by alpha two by log 2. Alpha is the percentage value of the learning curve.

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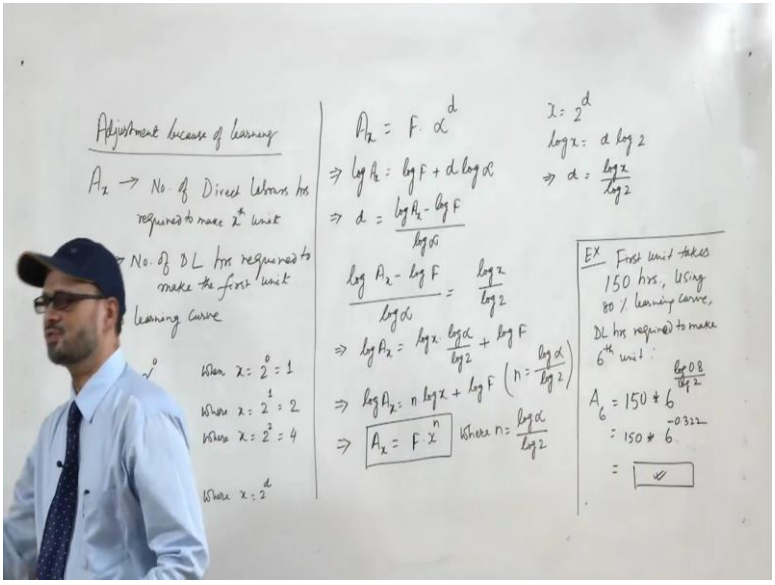

So if it is a 80 percent learning curve, it will be log of point 8 by log of 2 and you will have the values and you can keep it here. Now let us see an example that suppose the first unit takes 150 hours using 80 percent learning curve. Directly labour hours required to make sixth unit. So in that case what you do is, you have to find A6 and this will be equal to 150 multiplied by X is 6 raised to the power n. n will be log of point 8 by log of 2.

So if we take that, it will be minus point 32, so you can do 150 into 6 raised to the power. So divided by log to is point minus point 322. So you can have this value as the value which you get, that will be the value for this sixth unit. So this is how you can compute the value of the direct labour hours required for the sixth unit. Thank you.