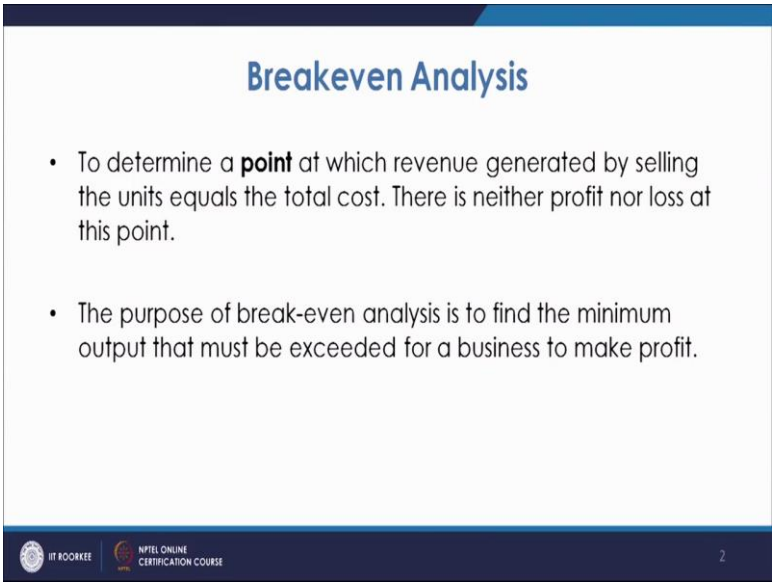
Engineering Economic Analysis
Professor Dr. Pradeep K Jha
Department of Mechanical and Industrial Engineering
Indian Institute of Technology Roorkee
Lecture 28
Breakeven Analysis, Effect of Fixed and Variable Cost on BEP

Welcome to the lecture onbreakeven analysis. So when we manufacture any product, for the organization, it generates the revenue by selling the product. Now initially the organisation has incurred a large number of cost, we have already discussed about different costs and based on that basically we will talk about fixed and variable type of cost which are required to see that what is the total cost incurred for production of the product.

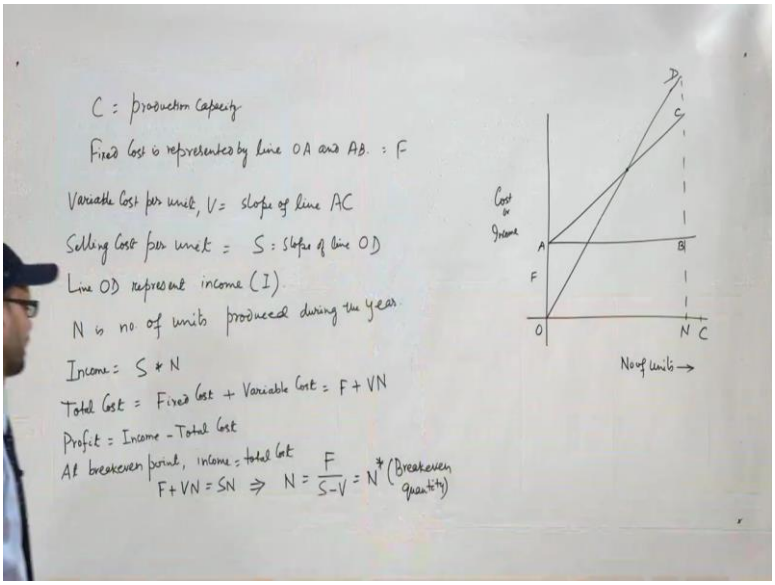
(Refer Slide Time: 01:32)



Now once the product is ready for selling, after sale it gets the income. So as the number of units sold increases, the income increases. Now at what point you feel that you are at a point where there is no profit no loss for the company. And that point, that number of products, at that point is known as breakeven point. So the purpose of breakeven analysis is to find the minimum output which must be exceeded for the business to make profit.

So if the organisation is not making the product more than this breakeven point that the organisation will have lost and if it is going beyond that according it will have the profit. So we can do the analysis of having the breakeven point, how to calculate it. Let us see, we have already discussed about the 2 types of cost, fixed cost and variable cost.

(Refer Slide Time: 09:25)



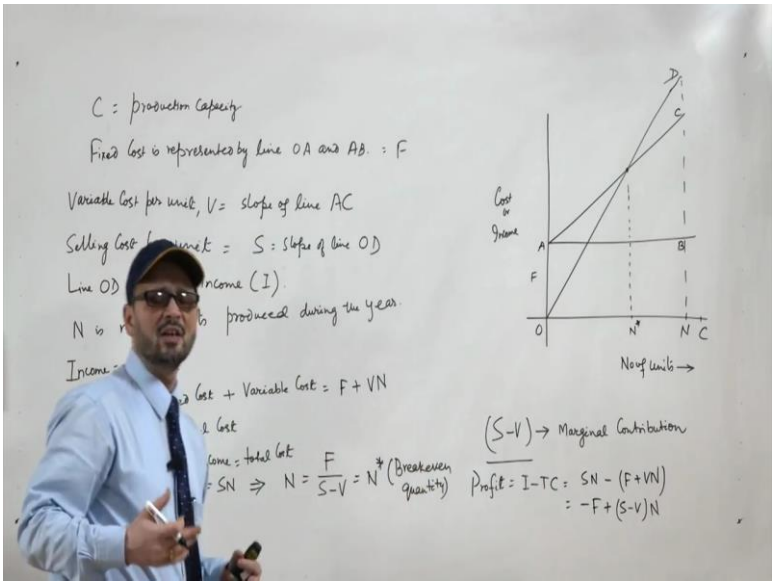
The fixed cost is the one which does not depend upon the number of units produced and the variable cost will be changing with the number of units produced. So if this is number of units produced and if this is the cost or income, in that case there is a fixed cost line and also there is variable cost per unit line. Now we have an income line which goes like this. Now in this suppose the organisation has a capacity that is C. So C is the production capacity.

Now organisation need things of making n units in the year. So basically, now this is the unit number n. Now at this point, this is the income line, so if we give the names to these lines, this is point A, this is B, C and D. So fixed cost is represented by line OA and AB. So this shows the cost. Now the slope of line AC is variable cost per unit, so variable cost per unit that is B is nothing but slope of line AC. So now this is fixed cost is, we are presenting as F.

Now we have OD as the income line. So if we have the setting cost, selling cost per unit, we can have it as S. So selling cost per unit will be nothing but the slope of this line OD. Ya, now once we generate the income based on the number of, so basically the line OD, line OD represents income that is I. So income will be nothing but S into number of units produced.

So if n is number of units produced during the year, income will be, income will be nothing but the selling cost of per unit multiplied by the number of units produced, so it will be S times N. Now total cost will be fixed cost plus variable cost. So fixed cost is for the whole year, so fixed cost is given as F. Variable cost will be the variable cost per unit multiplied by number of units produced. So profit will be income minus total cost.

(Refer Slide Time: 11:44)

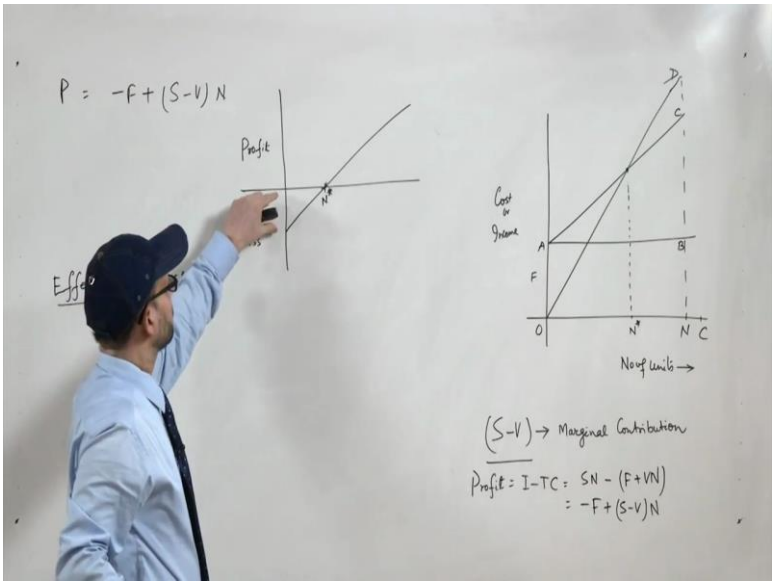


Now at breakeven point, income is equal to total cost. So we have to equate these 2 lines. So what we get F plus VN will be equal to SN. So N will be equal to F by S minus V. Now this N is, we treated as n star that is breakeven quantity. So what we see is that at this N star, so this will be your N star, so in this this is the fixed cost and this is basically known as S minus V is known as marginal contribution.

So basically S is nothing but the revenue you generate by selling the product and this is the variable part. So basically it is to cover up the fixed cost part, so it is known as marginal contribution. So once you know the fixed cost, the selling price per unit and the variable cost per unit, you can have the value of N star as breakeven point. So if you find the function for the profit, profit will be equal to income minus total cost.

And income is SN minus total cost, total cost is F plus VN. So it is nothing but minus F plus S minus V into N. So basically this is a function which represents the value of profit in terms of the number of units which is produced and this is a line of, this is equation of straight-line. So let us see how the profit changes. Now what we see is, we have got profit as line as minus F plus S minus V into N.

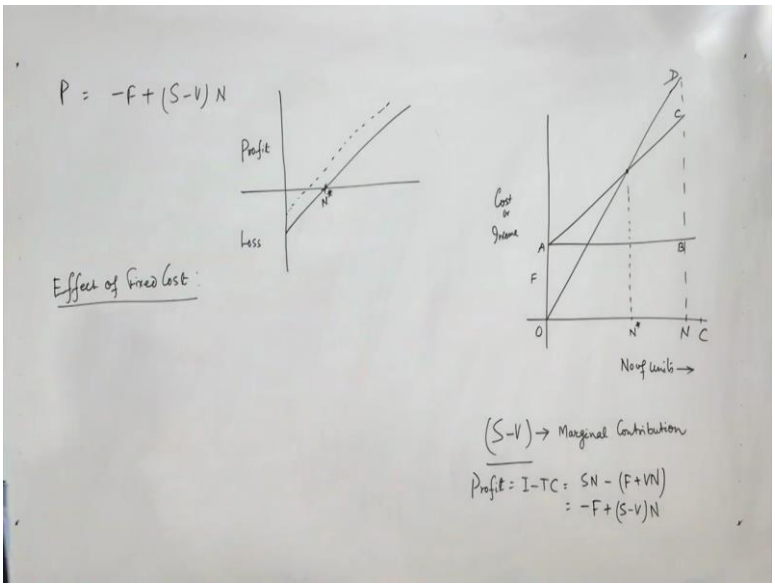
(Refer Slide Time: 13:32)



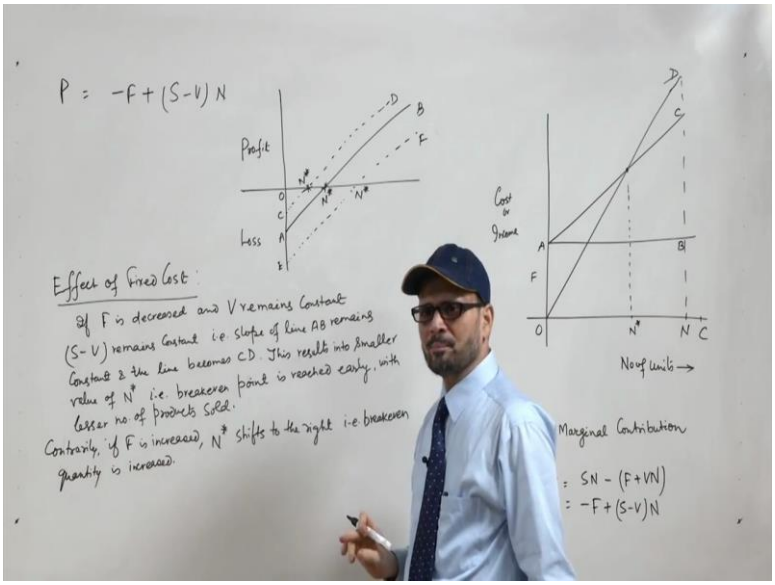
S is constant, V is constant, so this is a constant quantity, so this is the equation of straight-line. And if we draw this line, if this is profit and this is loss, now what we see is, this line can be presented by this and at this point, this is the point where profit is zero and that is why this point corresponds to N star. Now, now what we can see is the effects of changes in fixed cost and the variable cost on this point, that is breaking point, now let us see how it may change.

Effect of fixed cost, this is the fixed cost portion. If the fixed cost is decreasing and it comes here and variable cost remains the same, this graph will have this value.

(Refer Slide Time: 13:47)



(Refer Slide Time: 17:45)

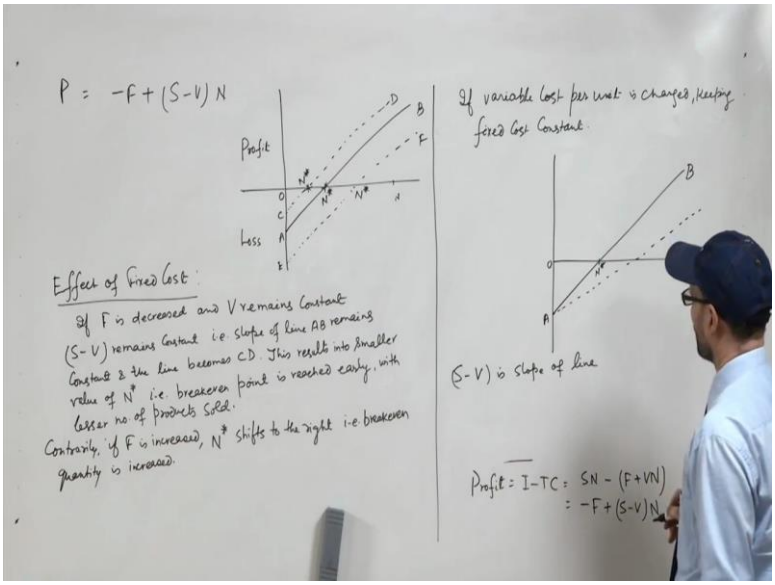


So if F is decreased and V remains constant, so basically, if V remains constant, in that case S minus V remains constant, that is slope of line AB remains constant and the line becomes CD. So basically once you have decreased the fixed cost part, this line has gone to this place and this N star is reached at the smaller value. This results into smaller value of N star, that is breakeven point is reached early with less lesser number of products sold.

So what we see is that once we decrease the V in that case decrease the value of fixed cost that is F, in that case N star is coming early. Contrarily if we increase the fixed cost and V remains constant, contrarily if F is increased, in that case your N star shifts to the right. N star shifts to the right, that is breakeven quantity is increased.

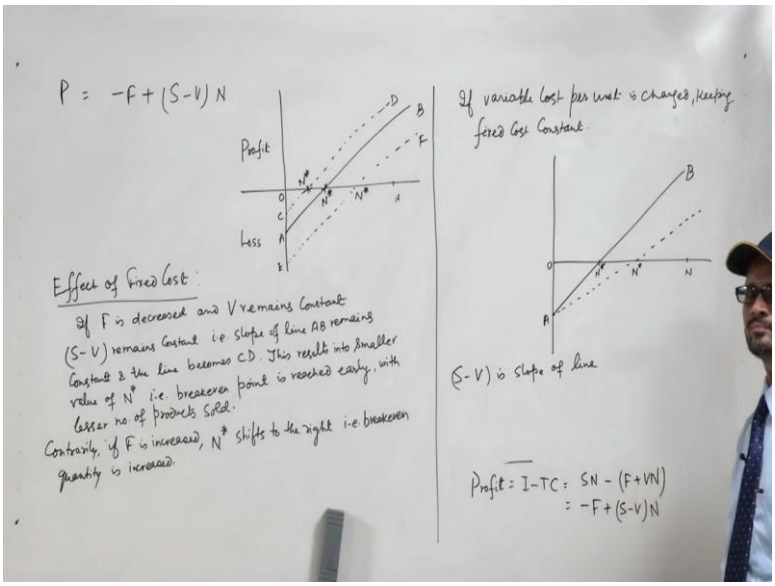
So this is very obvious that if the fixed cost of the asset will decrease, you will have a no profit no loss point early because total cost is decreased. So that is how we see that if there is change in the fixed cost, how it will change the position of the breakeven point. Now let us see how it will affect the breakeven point if the variable cost is changed. So if we change the variable cost, if variable cost per unit is changed keeping fixed cost constant.

(Refer Slide Time: 19:51)



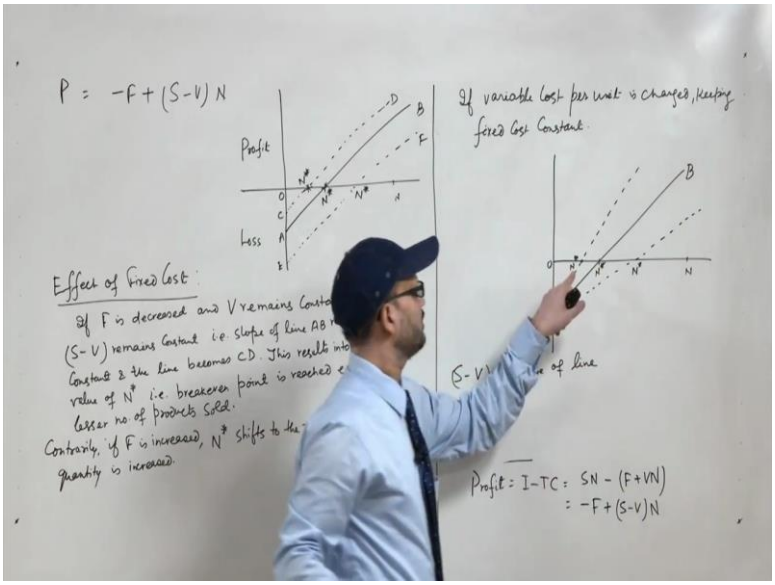
Now we will draw the same profit volume function, we have this function. Now what we see, if the variable cost is increased, so if the variable cost will be increased, this S minus V, S minus V is slope of the line. Now if we increase the variable cost, the slope of the line will decrease. So keeping the fixed cost same if the slope of the line is decreasing, the line will take this fall. Now in this you can have N side, what we see is the earlier we had N star here.

(Refer Slide Time: 19:58)

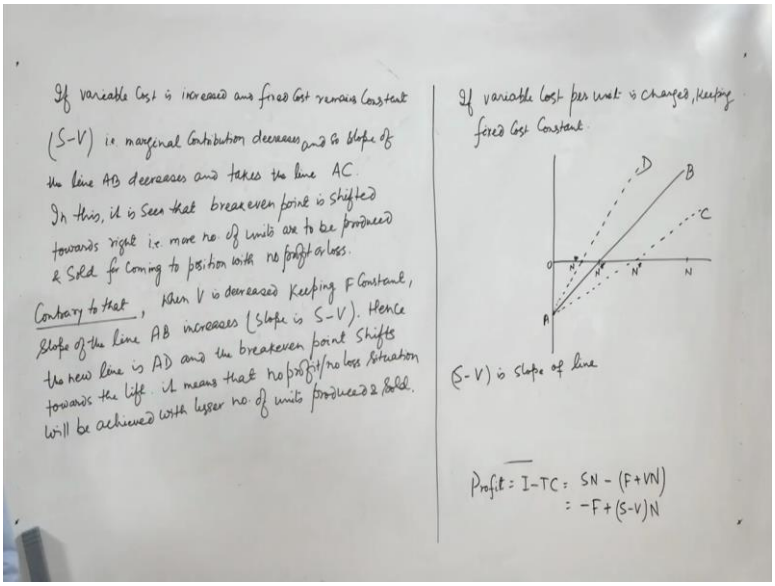


When the variable cost is increased, the N star has come towards the right. Further at the same time, if the variable cost is decreased, S minus V will increase which will shift this line towards the left.

(Refer Slide Time: 20:27)



(Refer Slide Time: 25:06)



So your x axis is cut at this point and your breakeven point is shifted towards left. So we can write these things, so if variable cost is increased and fixed cost remains constant S minus V, that is marginal contribution decreases and so slope of the line AB decreases and takes the line AC.

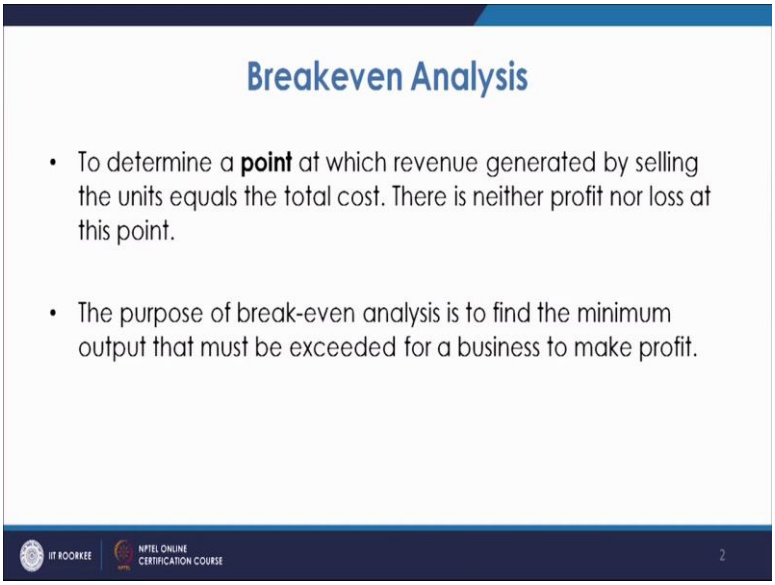
So the slope of AB now it is AC. In this way it is seen that breakeven point is shiffted towards right that is more number of units are to be produced and sold for coming to position with no profit or loss. So contrary to that when V is decreased keeping F constant slope of the line AB increases. Slope is S minus V. Hence the new line is AD and the breakeven point shifts towards the left.

It means that no profit no loss situation will be achieved with lesser number of units produced and sold. So what we see that how this extra cost or variable cost is changing the breakeven point either towards the left or towards the right. So if we know the fixed cost, the variable cost and the number of units to be produced, we can use the formula which we have calculated for computing the breakeven point.

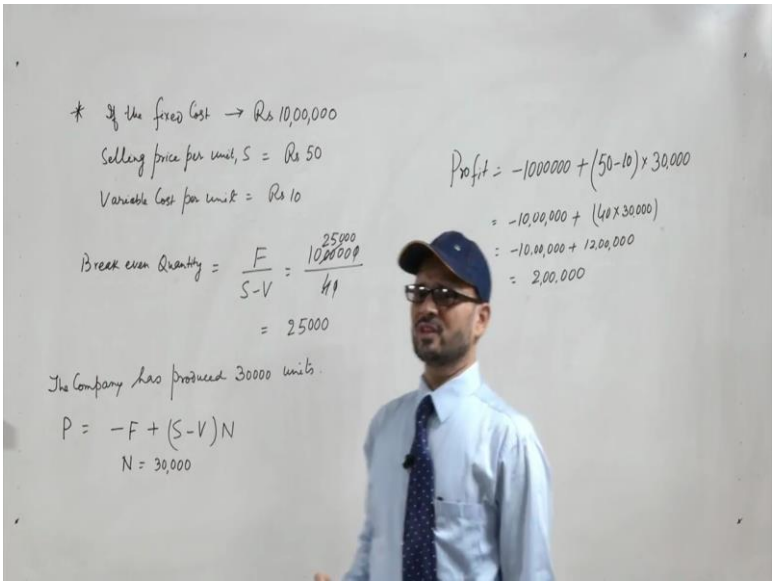
And also if the change in the fixed cost or variable cost per unit is mentioned, it can also be used to calculate the shift in the breakeven point, either towards the left or towards the right. We can also draw the fixed cost per unit line and variable costs. So as we have seen, the fixed cost per unit line will be a variable quantity which will basically decrease as the number increases and the variable cost per unit will be a constant number.

So that can also be a way to basically judge this graph using and for this the total cost can be drawn we can also find the breakeven point.

(Refer Slide Time: 26:42)



(Refer Slide Time: 30:15)

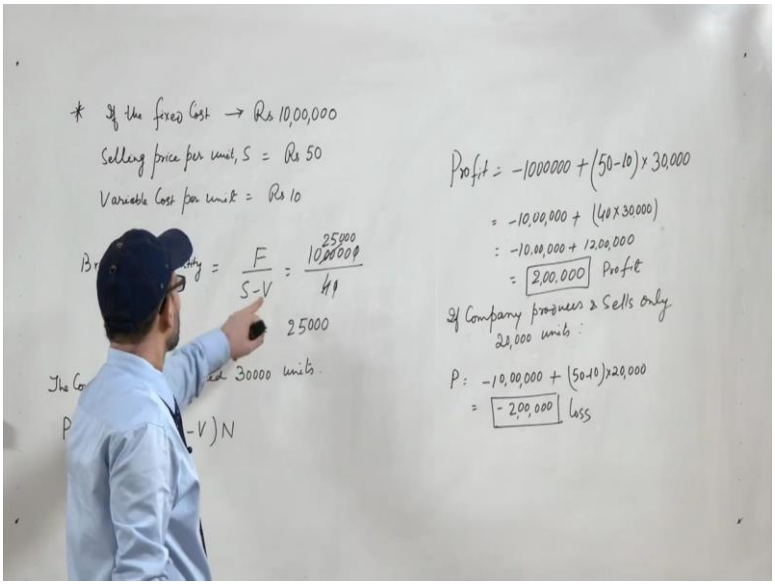


We can discuss a problem based on this breakeven analysis. So let us see we have a problem given as this that if the fixed cost per year is given as Rs. 10,00,000, selling price per unit that is S is given as Rs. 50 and variable cost per unit is given as Rs. 10, in that case what you need to know is what will be the breakeven point at which the company will have no profit no loss situation.

So we can use the formula, breakeven point, at that breakeven quantity will be F by S minus V. So it will be 10,00,000 divided by S minus V is 40. So we can have this value 25,000. So when the company produces 25,000 equipments and sell it, it will come to a situation of breakeven that is no profit no loss. Now let us say the company has produced 30,000 units, in that case what will be the profit of the company?

So we can recall the line of profit and profit volume function. P is given a minus F plus S minus V into N. Now in this case, N is 30,000. So profit will be, we know the values minus of 10,00,000 plus S minus V, so S we have 50 minus V is 40, V is 10 sorry, into 30,000 units. So it will be minus of 10,00,000 plus 40 into 30,000 that is minus 10,00,000 plus 12,00,000 that is 2,00,000. So it means, if the company produces 30,000 units it will earn a profit of 2,00,000.

(Refer Slide Time: 31:45)



If the company on the other hand is able to produce and sell only 20,000, if company produces and sells only 20,000 units, in that case we will P as minus 10,00,000 plus S minus V into N, so this N will be replaced with 20,000 and S minus V is 50 minus 10 that is 40 into 20,000. So this comes out to be minus of 2,00,000. So this results into a loss and this is the profit.

So this is how you can calculate the profit and loss using the profit volume function and using the expression for the breakeven quantity to be produced. Similarly if you are given the change in the variable volume or the fixed cost value, how it will affect the breakeven point that also can be calculated and a graph can be plotted and it is seen that how this point shift towards the left or towards the right. Thank you.