Financial Mathematics
Prof. Pradeep K. Jha
Department of Mechanical and Industrial Engineering
Indian Institute of Technology – Roorkee

Lecture – 36
Introduction to Break-Even Analysis

Welcome to the lecture on introduction to break-even analysis. So, you know in this lecture we are going to discuss about what the break-even analysis is what is a break-even point how it is important and what are the you know different terminologies related to the break-even analysis.

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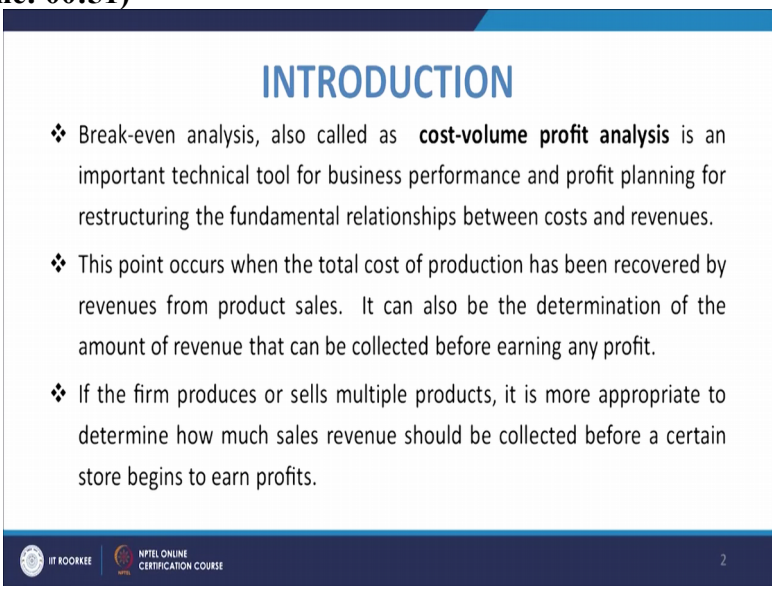

So, break-even analysis it is also known as the cost-volume-profit analysis because here we are talking about the cost we are talking about the volume of production and then profit related profit so that analysis is done and it is an important technical tool for business performance and profit planning for restructuring the fundamental relationship between cost and revenues.

So when we talk about the you know business organizations there we know that we have a different type of cost so you have to first put in you have to set up the plant you have the investor has to put a lot of cost. Then there is production of the; you know product and that product goes for sale from the sale we get the revenue and then I mean that is how after getting revenues for a long time.

We come at a stage when we think of having profits so as basically any business has the aim of having profit and in this analysis we are going to talk about that quantity which you know which talks about the in the stage from where the profit starts. So, we will talk more about it

this point occurs when the total cost of production has been recovered by revenues from the product sales.

So, what that is what we discussed that when we start selling the product and we get the revenue from the sales then slowly we are coming a taste when the cost which has gone into and the revenue which we are getting so they are you know balanced. So, it can also be the determination of the amount of revenue that can be collected before earning any profits. So, we reach at a stage from where onwards if we get the revenue then we are in a stage where we get the profit.

So, that is what that stage is that is so if the farmer produces or sends multiple products it is more appropriate to determine how much sales volume should be collected before a certain store begins to earn profit. So, you have to know that how much sales revenue has to be collected so that after that you are sure that you are going to earn the profit.

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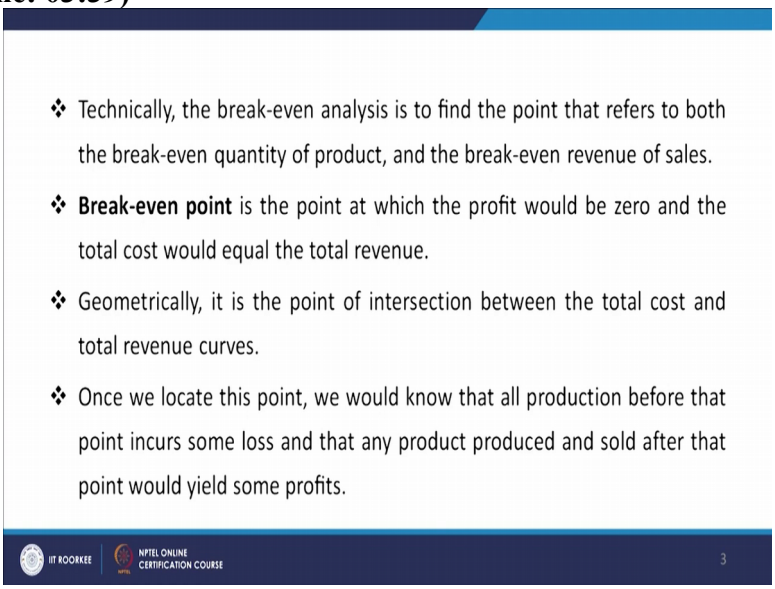

Technically the break-even analysis is to find the point and that refers to both the break-even quantity of product and the break even revenue of the sales. So, both the things are basically important and it is referred to. And break-even point by definition it is the point at which the profit would be zero and total cost would equal the total revenues. As we discussed that you have a cost component and cost component as we will discuss there are two types of cost components that generally is discussed and these two types are fixed type of cost and one is variable cost so, all together they make total cost.

Now total cost should be equal to the total revenue that is the stage where there is no profit and when the total revenue will be more than total cost then there is a stage of profit that there are the stages of profit. And if the total cost is exceeding the total revenue so those

stages are the stages of losses. So, geometrically it is the point of intersection between total cost and total revenue curves.

So, you have a total you know cost curve and you have a total revenue curve and their intersection geometrically will be defined as the point of breakeven. Now once we locate this point we would know that all production before that point incurs some loss and that after that you will have the profit so, that we will see that how we analyze those situations. So, now what we see what we discussed that normally when we talk about the cost.

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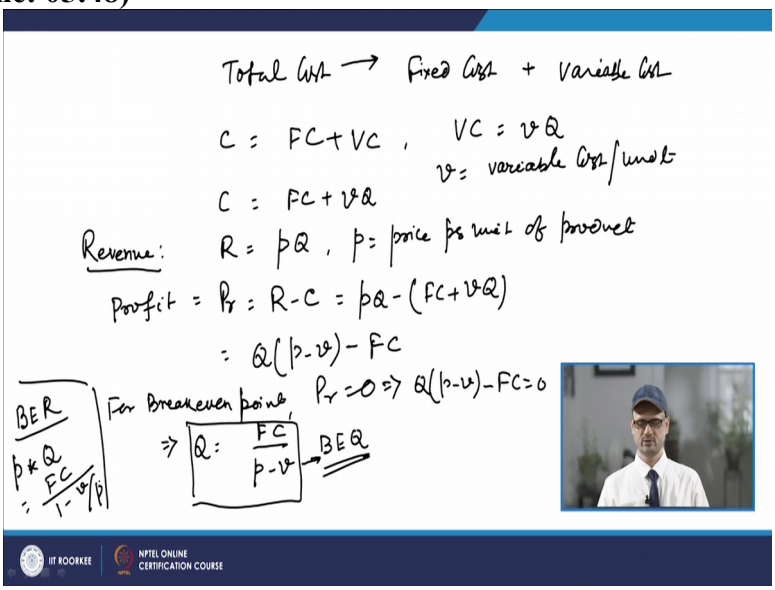

So, total cost basically when we talk about the total cost so you know total cost will be comprising of fixed cost and the variable cost. So, in the plant normally you have the fixed cost and then that basically does not change with the quantity of production. So, what will be the quantity of production these costs do not change much like depreciation or maybe salaries of the employees you know indirect though those who are not directly involved with the production operations.

Administrative expenses and all that so that comes under fixed cost and variable cost is normally those cost which are changing which are changing with the quantity of production of the items so that way as the quantity will be increasing these costs are increasing like direct material cost or direct labour cost these are basically the variable cost. So, they are normally expressed in terms of per unit and fixed cost is always cost what so depending upon what is up capacity of production.

So, till that the fixed cost will be constant. So, we have total cost C will be known as the fixed cost plus variable cost so we normally define that. Now you know a variable cost will be basically equal to V * Q and V is defined as the variable cost per unit. So, that is how this

V small V is defined and then the number of units will be Q. So, you know total variable cost will be V into Q. So, the total cost becomes FC + VQ now this is the total cost of the product when we are producing Q units.

Now we talked about the revenue which is generated because of the sale of the company the item or the product. Now the revenue will be denoted by R and it will be equal to small p * Q so p is nothing but the price which has been fixed for the product and it will be price per unit of the product. So, now what happens that now what we do in this case is depending upon the revenue and the total cost you will have a stage of either profit or loss.

So, profit will be basically the revenue what is generated and minus the total cost. So, profit which is also known as the operating profit or you know earnings before interest and taxes so that is EBIT it is also known as and this will be denoted by Pr and that will be your revenue minus total cost. So, whatever revenue is generated that has to be more than the total cost then you have profit.

In case of loss this quantity will be negative. Now if you see that R is your pQ and the total cost is FC + VQ so this way you have you know it will be coming as Q * P - V and then you have FC so this is the expression for the profit. Now when we talk about the break-even point now at break-even point your sales and you know I mean after sale the revenue which is generated it is same as the total cost that is your profit is zero.

So, you know for break-even point your profit has to be zero so you have Q minus so that implies that Q * p - V - for fixed costs would be zero and that leads to the value Q will be fixed cost divided by p - V so this is the expression for the break-even quantity. So, FC /p - V this is the break-even quantity. Now if you have to find the revenue at the break-even you know point so that is known as break even revenue and the break even revenue so if you go for the BER.

So, BER that is break even revenue will be this is the quantity so and rate is p so break even revenue will be p * Q so that will be FC and then multiplied by so it will be 1 - V / p so it is defined as the break-even quantity and you have the definition of break even revenue that it is that amount which is generated at the break-even you know point. So, that is how we define this break-even quantity and break even revenue.

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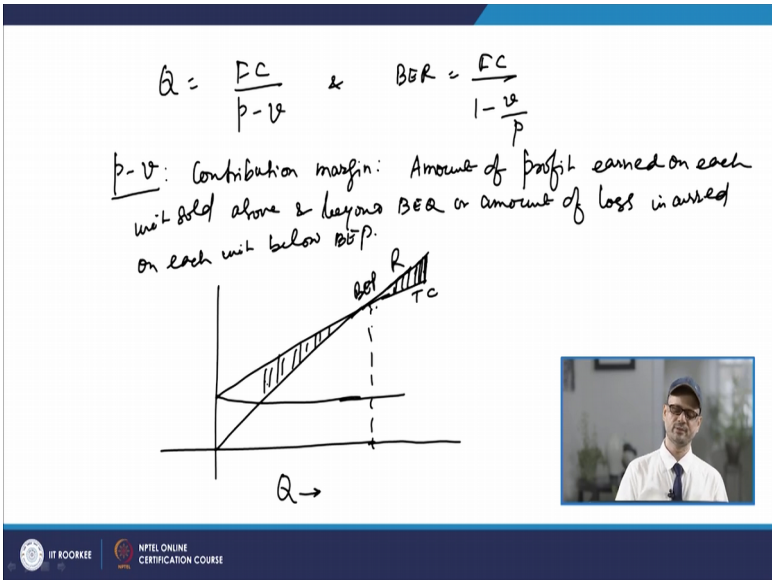

Now we will talk about the variables which are the; you know related to the break-even quantity and break even revenue. So, what we see we have seen that your you know Q is fixed cost by p - V so you have Q as fixed cost by p - V and the break even revenue will be fixed cost by 1 – V/ p so that is what we have got now what we see that in these cases you have for the break-even quantity you have one is fixed cost and another is you know this is your price per unit and this is your variable cost per unit.

Now as we know that fixed cost as a function of time it does not change so like rent lease payment and all that comes into it and then variable cost is something which is changing with the you know quantity of production and the V that is your this p - V so this is known as the contribution margin so this is defined as contribution margin so this is nothing but the amount of profit which is earned on each unit sold above and beyond this break-even point.

So, amount of profit earned on each unit sold above and beyond BQ break-even quantity so if you go above or beyond BQ it will be profit and if you are below that you will have the case of loss so or amount of loss incurred on each unit below break-even point. So, you know it is defined as the contribution margin. So, now this is how the transition margin is defined. Graphically also you can see you know how you can look that how these break even quantities are basically defined.

See the normal case when we talk this is the quantity of production. So, your fixed cost will be something going like a quantity which is fixed and your variable you know will be going on so you know you will have variable quantity like this. So, ultimately you will have the; this as the total you know so you will have this is your income line. So, whatever you generate whatever you sell based on that you will be getting this you know income from the

sales this will be for the p * Q line and then this will be your you know this will be your total cost line.

So, this is your total cost line and this is your revenue line. So, this is going to cut it here so as it is going to cut here so you will have this point and this point will be your economic order quantity because this is the fixed so as the it was the fixed cost and then as the variable cost has you know increased then so fixed cost plus gradual cost line will be this. So, this is your total cost line and this is your revenue line.

So, this point will be your; you know the point of break-even, break-even point. You can further see that this is the ordinate ease for the cost different type of cost.

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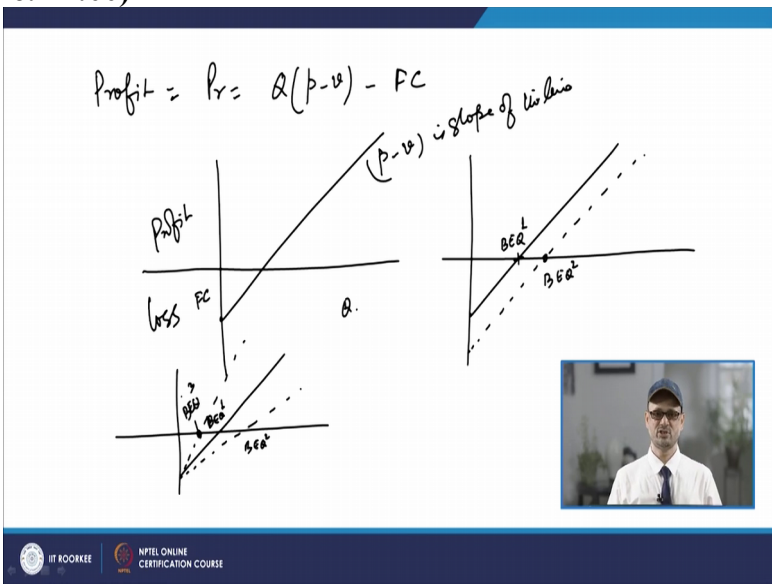

Now you can see that what we have seen the profit line is Q * p - V - FC so that you can see the profit is Pr that is Q * P - V - FC so that is what we have calculated platoon to P - V minus fixed cost now what this line also indicates that this is nothing but you know Y = X + C basically so this is again a straight line and this straight line has C component that is minus so this will be your minus line and then if it is Q and this is the cost in that case if it is Q so this line will be we will be the line representing this Q * P - V - FC and P - V is the slope of this line.

So, just this P - V is a slope of the line so if this is a profit this is a profit and this is the loss. Now initially you have; this is the you know this is a fixed cost this is FC this is FC basically and this is your P - V is the slope that is marginal contribution or contribution margin is the slope of this line. What we can see that if this fixed cost changed then this may lead to a line. So, this is your original line and if the fixed cost is increased to this much in that case this was the break-even quantity 1 and this will be your break-even quantity 2.

So, what you see that when the fixed cost will increase and there is no change in the marginal contribution in that case the break-even point, the break-even quantity will increase and it will shift towards right so it means that when the fixed cost is increasing you require you know larger units to be produced so that you come at a break-even point. Second case may be the change in the marginal contribution and if you change the marginal contribution suppose in these cases so this was your earlier situation.

Now in that case either you can increase V or P or in you know decrease V so that that way the slope will increase or you can you know decrease P or increase V so that way slope will be decreasing. So, now if the slope is either increasing or decreasing and the fixed cost is changed suppose you are decreasing the slope means the variable cost is increasing or the revenue the cost per unit that from the sale whatever they when you are getting that is decreasing in that case this value will decrease and the slope of this line will decrease.

In that case what you see that the break-even point break-even quantity 1 so that will be changing it will go to 2 so that way it will move towards right and you require larger units to be produced you know so that you reach our breakeven point. And if conversely if the is P is increased that is income from per unit is increased price of the is set more and variable cost is you know fixed that way so then if this will increase the slope will increase so slope increases then this situation will be like this and this will be your break even quantity 3.

So, in that case the break-even point will move towards left and it means lower amount of you know units are required to be produced you know to come at a stage where the profit is same as the loss. So, this is the you know effect of these you know parameters like fixed cost or the marginal contribution which is affecting the you know quantity produced to reach so that you are you are at a break-even you know stage where there is no profit or there is no loss.

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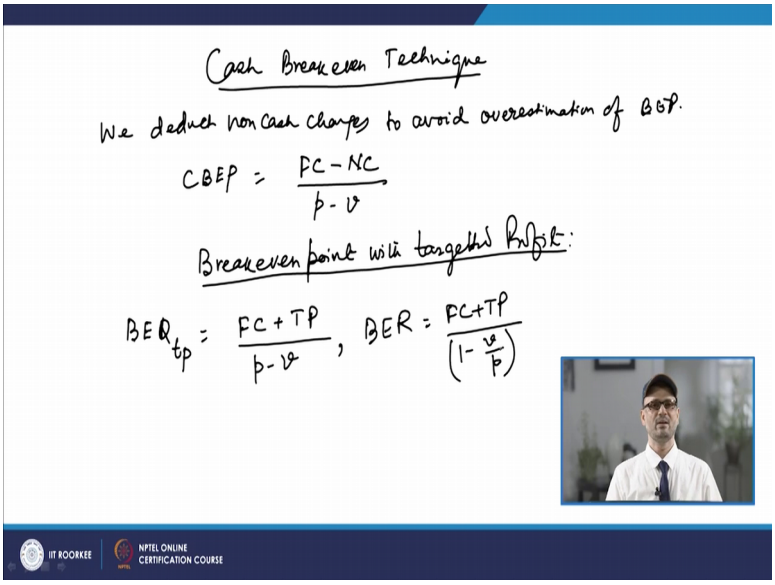

Now we are going to further study about you know cash breakeven technique. So, there is a term known as cash breakeven technique. So, that is in that case we are going to deal with the charges you know some non-cash charges so when there are certain non-cash charges when we talk about the fixed cost which also involves certain non-cash charges like the depreciation of the assets and all that basically in those cases we can have the break-even point that is known as the cash break-even point.

Because basically we are overestimating by taking these depreciation charges into the fixed cost although they are a part of fixed cost but then basically we can take the benefits of these charges by other means may be in taxes or so we can exclude them while doing the break-even analysis and when we do that, then they are known as the cash break-even analysis. So, you know we deduct you know so we deduct these non-cash charges so that is to avoid over estimation of the given quantity or break-even point.

So, what we do is that that is known as cash break-even point and cash break-even point is as we discussed that you have otherwise you have FC /p - V and in this case we will you know subtract these non-cash charges and then this will be p - V so this will be your non-cash charges so that will be subtracted and basically there is this is this is having a sizable portion among the fixed cost.

So, basically that will reduce or that will decrease the break-even point to have been quite considerably in such cases. There is another you know terminology that is your break-even point with targeted profit. So, many times we deal with those cases where we think of having a certain profit in mind so that is your break-even point with targeted profit and in that case the break-even point with so break-even quantity with targeted profit again here in this case

we have to add these you know targeted profit whatever we have thought of what is the target profit which we think of.

And then that will be divided by p - V so this will be known as the break-even point so that is this quantity which will give you certain profit. You know so if you have to calculate that how many much quantities would be produced so that this much profit is you know minimum desired so in those cases that is your break-even quantity only desire mean defined but with a targeted profit.

So, that way this break-even quantity with targeted profit will be defined similarly you will have break even revenue you know also in those cases will be nothing but you have FC + TP and it will be multiplied with p so that will be 1 - V / p at the denominator so that will be your break even revenue at that you know particular value of targeted profit this is your break even revenue generated.

So, this is also calculated you know using these breakeven point analysis with targeted profit or the technique for these non-cash charges what we see that when we talk about these cash breakeven technique in that case we are subtracting these non-cash charges and in this case we are basically adding these you know a targeted profit that is the only difference when we talk about this cash particular point and the break-even quantity with targeted profit.

That is the basic difference that in one case we are subtracting to avoid any overestimation of the break-even quantity and in this case we are basically adding which will tell you that what will be the break-even quantity it will talk about the break-even quantity but it will include those cases I mean it will include the profit which is to be earned at that particular quantity. So, that is that is why it is defined as the break-even quantity with targeted you know profit and that is why you have here addition of TP in the numerator with FC and here it is subtracted.

So, ultimately we as we discussed we had discussed these you know a profit volume this curve this is already a profit volume curve and this was the case of the you know the break-even analysis break-even point and here now what we see that this you know this is the reason which indicates the loss so this will be loss and as you go up you have the cases of the profit so this is a reason of profit so that is what we discussed that you have this shade shaded region which is towards the left of this break-even point which indicates about the area where there is loss.

And when you move to from here you assume that this is a case of profit so as you go on you will have profits increasing. And here we have assumed that the zero cost line is basically or revenue line is a straight line and they are meeting at a point where as the revenue line may be you know non linear and in that case there may be situations when it may cut at 2 points so the is known as the dual breakeven point.

So that we will discuss later and in those cases you will have a reason where you have profit and below and above you have the reasons of losses. So, that way also you have the reasons which can be indicated that whether there is profit or there is loss. So, these analysis are the ones which are basically you know required to be known and as we know that the break-even analysis is very much useful many times.

Suppose you are selling the stocks and you are purchasing the stocks so in those cases these are useful. When we are estimating many a times people estimate or they try to you know come to conclusion whether to retire take retirement prematurely or not so these are the typical applications where these break even analysis will be giving you the option whether you will be at you know profit or at loss while you know doing that.

So, in that case what is the income what is the; you know so all these taking into point you can come to that conclusion. So, that way this analysis is useful in such cases, thank you very much.