Managerial Economics
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Lecture - 42
Theory of Cost (Contd...)

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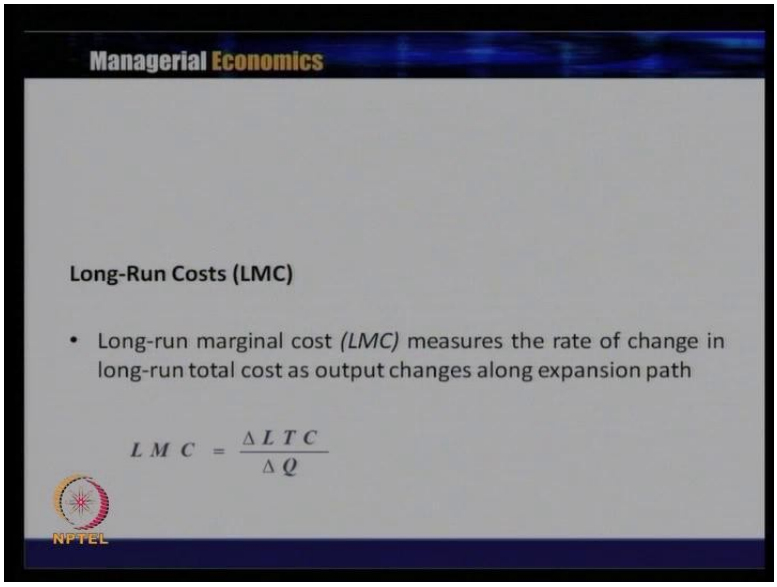

Then we will come to the long-run marginal cost and as you know marginal cost is nothing but the addition to the total cost when there is a production of one more unit of output. So, long-run marginal cost curve measures the rate of change in the long-run total cost as output changes along the expansion path. So, it is the rate of change in the long-run total cost as output changes along the expansion path. So, long-run marginal cost(LMC) curve is the change in the long-run total cost curve; that is $LMC = \frac{\Delta LTC}{\Delta Q}$. So, LMC is the change in the LTC with respect to change in the Q or we can say this is the first order derivative of the total cost with respect to the Q.

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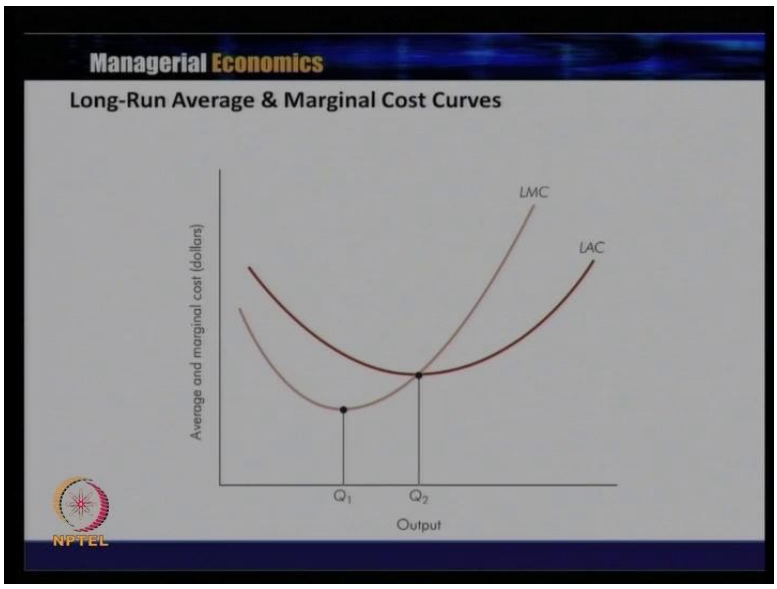

When you graph the long marginal cost curve and long-run average cost curve, both the costs are U-shaped. Initially it decreases with the increase in the output, but it increases when there is an increase in the output is more than that. The long-run marginal cost curve will always intersect long-run average cost curve at the minimum point. So at the minimum point of average cost curve, the long-run marginal cost is equal to the long-run average cost curve.

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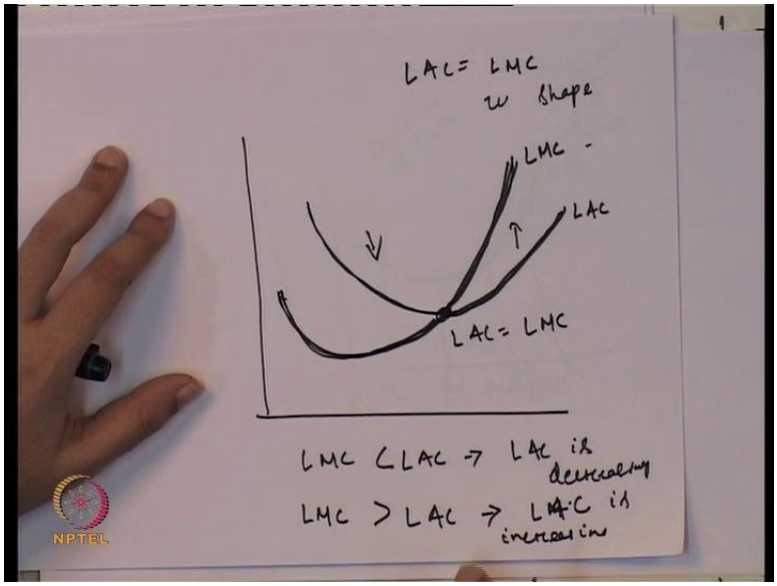

So, if you look at the relationship between the long-run marginal cost curve and long-run average cost curve, the first evidence comes here is that when long-run average cost curve is minimum at this point, the long-run average cost curve is equal to the long-run marginal cost curve. So, long marginal cost curve is U-shaped. The long-run marginal cost curve is below the average cost curve. LMC is less than LAC, when LAC is decreasing and long-run marginal cost curve is greater than long-run average cost curve, when long-run average cost curve is increasing; that is in this segment and corresponding to this, the long-run average cost curve is equal to the long-run marginal cost curve.

So, long-run marginal cost curve is below long-run average cost curve when it is decreasing and long-run marginal cost curve is above long-run average cost curve when it is increasing. At this point the long-run average cost curve is equal to the long-run marginal cost. Apart from this two more facts that both the curve that is LMC and LAC both of the both the curves they are U-shaped and always the LMC intersect LAC at the minimum point of the long-run average cost curve.

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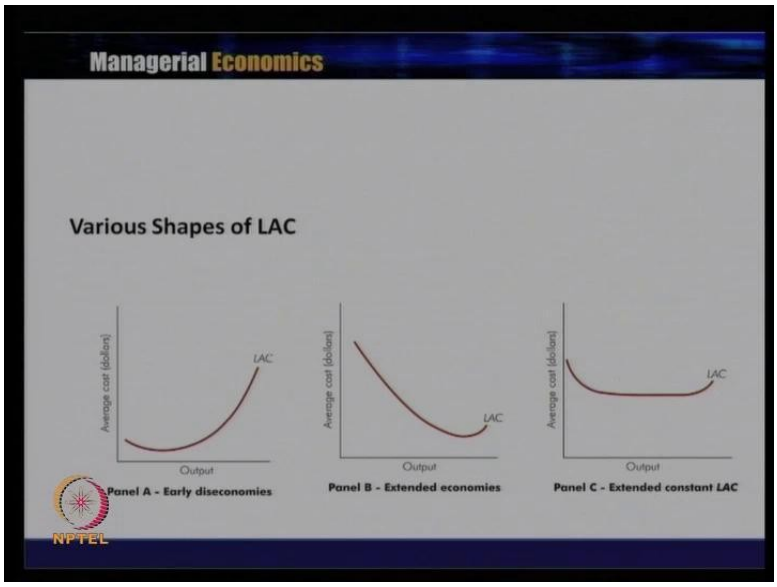

Then we will discuss about may be few more types of long-run average cost curve, which generally not follow a regular shape of the long-run average cost curve; that is U-shape and then we will find out what is the reason behind not following a specific shape or regular shape of the long-run average cost curve. So, if you look at the graph, initially in the first graph you are taking the average cost in the left axis and output in the right axis; that is x-axis and if you look at, it is a case of early diseconomies because the long-run average cost curve

is increasing much before reaching the minimum cost or much before reaching the midpoint of the curve.

So, this is the evidence of early diseconomies and what is the implication of early diseconomies. The input increases at the higher cost of production or when the firm expanding its production; when the firm is increasing the scale of production. Generally the input or generally the cost of production is increasing. So if it is the case of the general trend, then in this case generally it initially decreases but first decreases. But in case of early diseconomies what it has happened; that the cost of production has reduced much before the optimal point or much before the minimum point

Then if you look at the second graph that is extended economies; in this case, the minimum point or the decreasing portion is the decreasing portion of cost of production is more than the normal level or the regular level, and this is the evidence of the extended economy. The extended economies means, the reduce cost of production is enjoyed to a larger extend by the firm. So, economies of scale are reduced cost of production when the scale of output increases. But in this case of specifically in the case of the second graph the economies of scale has been enjoyed by the firm to a larger extend and that is the reason this is the case of the extended economies of scale.

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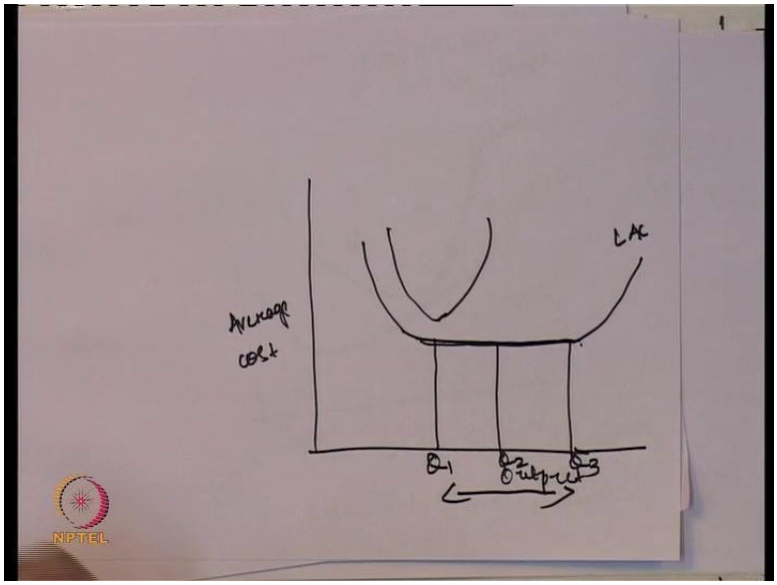

If you look at the third graph, it is the case of the extended constant LAC and what is this extended constant LAC. This is interesting to look that the minimum cost of is not a point

rather it is in a segment. So, this output level, this output level, this output level. Suppose this is Q_1, this is Q_2, this is Q_3. This is long-run average cost curve and if you look at the economies of scale has been achieved from this point, because the cost of production is decreasing. But this should be the minimum point and ideally after this point again, it should follow an increasing trend if it is a case of the long-run average cost curve of the normal shape of the long-run average cost curve. But if you look at the minimum point is extended over a range of production, which implies that at the minimum cost at the same level of cost the firm has moved from Q_1 unit of output and Q_3 unit of output.

Generally when you look for the evidence of this type of average cost in the real world maybe it is difficult to find. But it is possibility that sometime if it is a batch production and the same level of cost of production is used for a specific batch of production. So, initially when the cost of production is decrease or the cost of production is incur for a specific level of output; generally at the same level of output in case of batch of production, the possibility is there that you get a constant long-run average cost curve. Otherwise finding evidence for this type of constant output relationship is difficult when you take this example to the real world scenario.

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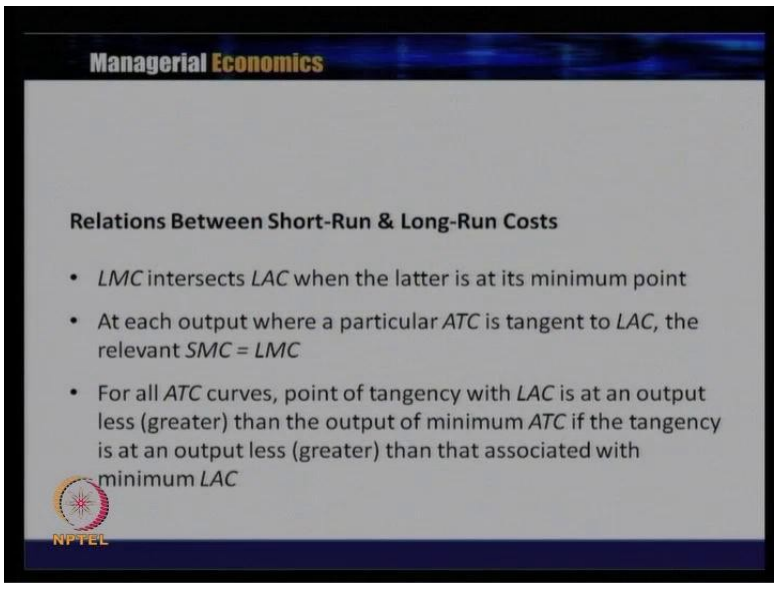

So, when it comes to the relationship between the short-run and long-run cost curve again, the long-run marginal cost curve intersect LAC when latter is at the minimum point. At each output where particular to ATC is tangent to LAC the relevant SMC is equal to LMC, and we will examine this relationship again with the help of the long-run average cost curve; how it

becomes a series of long-run average cost curve and then how they both of them they are related to each other.

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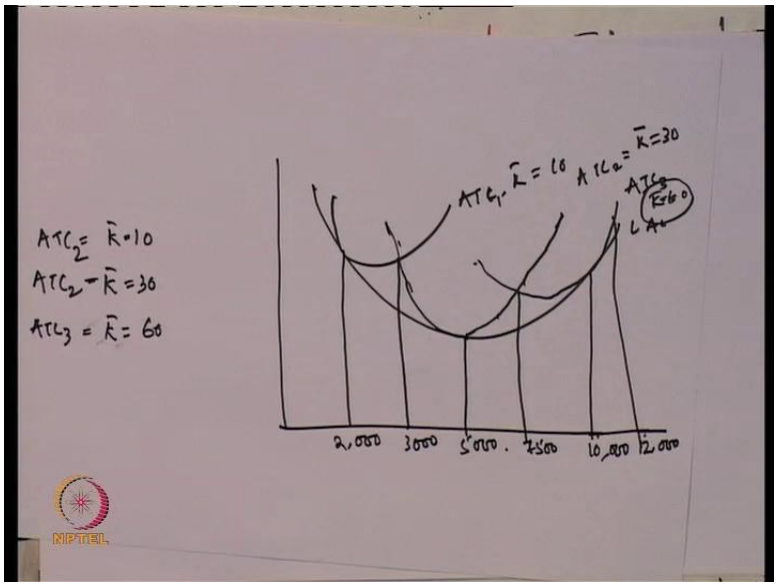

This is a ATC 2 where k is equal to capital is fixed at 3, because this is a case of short-run and this is average total cost curve 3, where k is equal to 60. So, if you look at what is the difference between ATC 1, ATC 2 and ATC 3. It is three different short-run cost curves. In case of average total cost this is short-run. Capital is fixed at 10 in case of average total cost curve in case of 2; that is capital is fixed at 30 and in case of average total cost curve 3, the capital is fixed at 60.

So, this is 2000. Suppose this is 2000 then this is 5000, may be this can be called as the optimal level of output. This is 3000, this is 7500, this is 10000, and this is 12000. So, if you look at if it is the output level 2000, there is no much choice left for the firm to; only they have to operate at the short-run cost curve by capital as 10. When the output level is 3000, either it can be produced through average total cost curve 2 by using capital as 30 or through average total cost curve 1 that is using capital at 10.

But if the firm is still interested to expand for them, it is always better to operate at the decreasing portion of the cost curve and that is the reason that when 3000 unit of level of output is produced, it is desirable for the firm to operate at a higher capital input mix because with that the firm can still expand up to the point 7500. But if it is a case of means the firm is

no more interested to expand the output, for them it is always preferable to operate at the short-run cost curve ATC 1 where k star($k^{¿}$) is equal to 10 because the capital requirement is less.

Similarly if you look at the output level 5000, this is the optimal level of output because this is produced with the minimum cost of production. Similarly if we look at the output level 7500, this can be produced either by using short-run cost curve 3; that is ATC 3 or maybe the short-run cost curve 2; that is ATC 2. If it is produced with the help of ATC 2, it is lying at the increasing cost portion of the average total cost curve and if it is produced through ATC 3, then it can be produced through the decreasing portion of the short-run cost curve.

So if the firm still interested to expand, they can always pick up the short-run cost curve But if they want to just stop here, they are no more interested to invest more in this capital and they will choose a combination that is average total cost curve 2. So it is always the individual firm decision that, whether for that level of output whether they will take a short-run cost curve where the capital requirement is more, or they will take a short-run cost curve where capital requirement is less. If this is the point beyond which they are not going to expand the output, they will always prefer a short-run cost curve where the capital combination is or the capital input combination is less.

But if there is still scope to increase the output or still they prefer to increase the scale of production, they will always pick up a short-run cost curve which is at a higher capital requirement or higher capital input requirement because that still did the scope. When they further increase the scale of production where or whether they further increase the output; because with the same level of capital, just changing the variable cost, still they can increase the output level.

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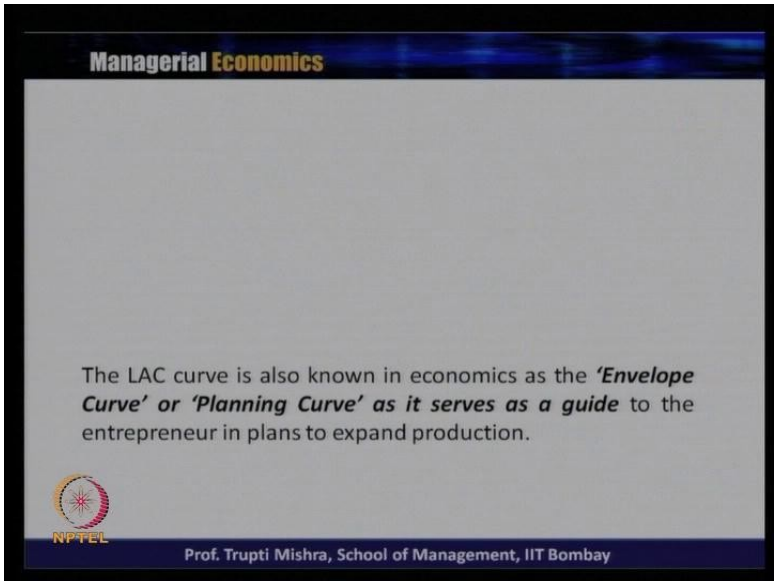

So, this is how the short-run and long-run average cost curve they are related. But this long-run average cost curve is also known as the „planning curve" or the „envelope curve" because it serve as a guide to the entrepreneur in plan to expand the production, and this is called as the envelope curve because in the long-run average cost curve is basically envelopes the different short-run cost curve.

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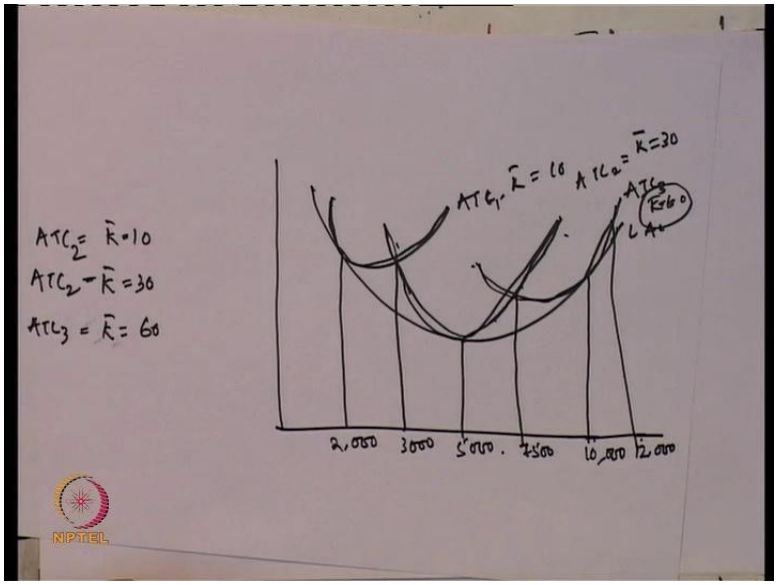

Like if you look at the graph also, this long-run average cost curve generally it envelopes the short-run average cost curve 1, short-run average cost curve 2 or short-run average cost curve 3. So in this case it generally known as an envelope curve, because it takes the different scenario of short-run cost curve and put them as a longer planning horizon. So if this is the capital, this is the input, this should be the level of output or up to this level of output, this short-run cost curve is can be used or in reference case, we can say this is the capital input combination can be used to produce this level of output.

And this is known as the planning curve because since it gives a scenario of different capital input combination, this is different short-run cost curves and that helps the entrepreneur; that helps the firm to identify the capital input combination at the different level of output on

what is the cost associated with that, or may be sometimes it helps in the planning the efficient cost analysis when at the different level of the output, and that is the reason it is known as the envelope curve and it is also known as the planning curve; this long-run average cost curve.

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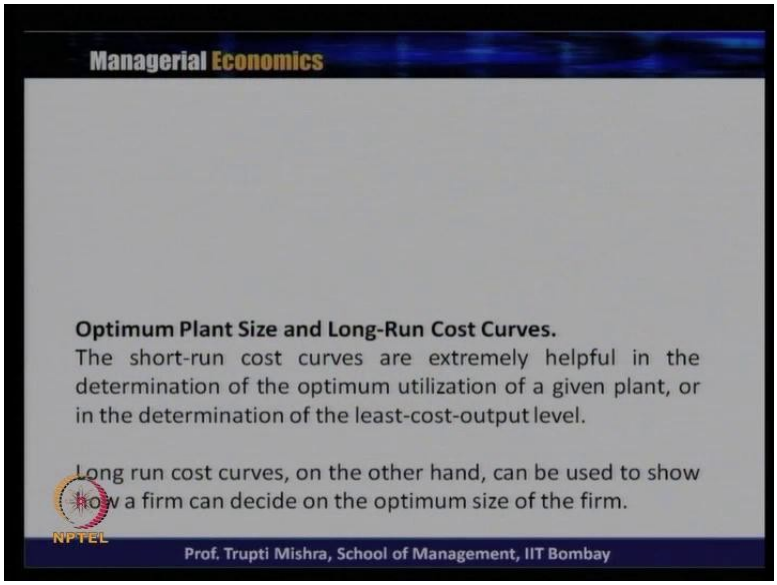

Then we will come to the discussion of optimum plant size, how it can be achieved in case of case of a long-run cost curve. The short-run cost curves are helpful in the determination of optimum utilization of a given plant. The given plants size is 500 units. The short-run cost curve will help you in identifying what is the optimum utilization of a given plant, what is the right input makes when there is a fixed input and the output can be changed only by the variable input. Generally the short-run is helpful in the determination of the optimum utilization.

If it is a case of a given plant or in the other hand we can say that they helps the firm, they helps the business for determining the least-cost-output level; means what is the optimal output which can be produced with the lowest cost of production. However when it comes to long-run cost analysis, long-run cost curve on the other hand can be used to show how a firm can decide on the optimum size of the firm. So, in the first case we talk about the optimum utilization of the given plant. But in case of long-run, we generally use this long-run cost curve to decide what is the optimum plant size; means how best it can be achieved with the

same level of the plant size or what should be the optimum capacity used on the basis of the input requirement, on the basis of the output level.

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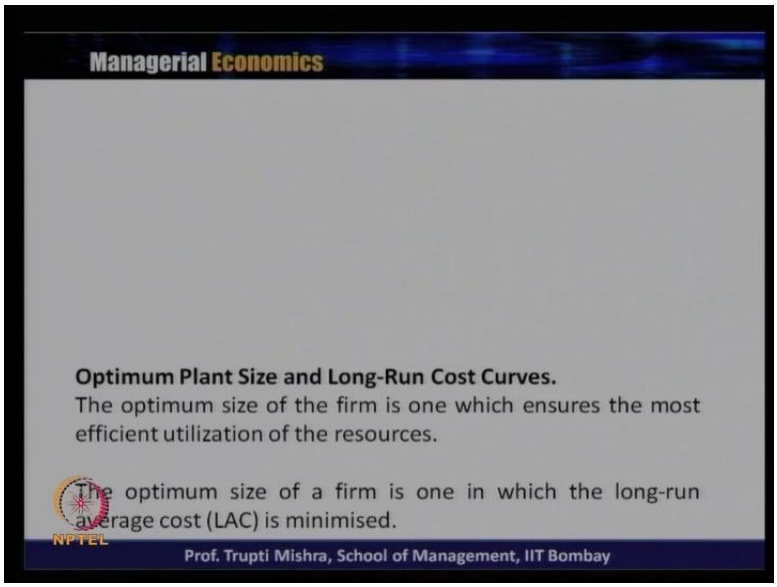

So, which one is the optimum size of the firm or how to decide the optimum size of the firm. The optimum size of the firm is one which ensures the most efficient utilization of the resources. So, the optimum size of the firm is one in which long-run average cost curve is minimal. So, how to define an optimum size of a firm? The optimum size of the firm is one which ensures the most efficient utilization of the resources and the optimum size of the firm is also one in term of the long-run average cost curve, when the long-run average cost curve is minimized.

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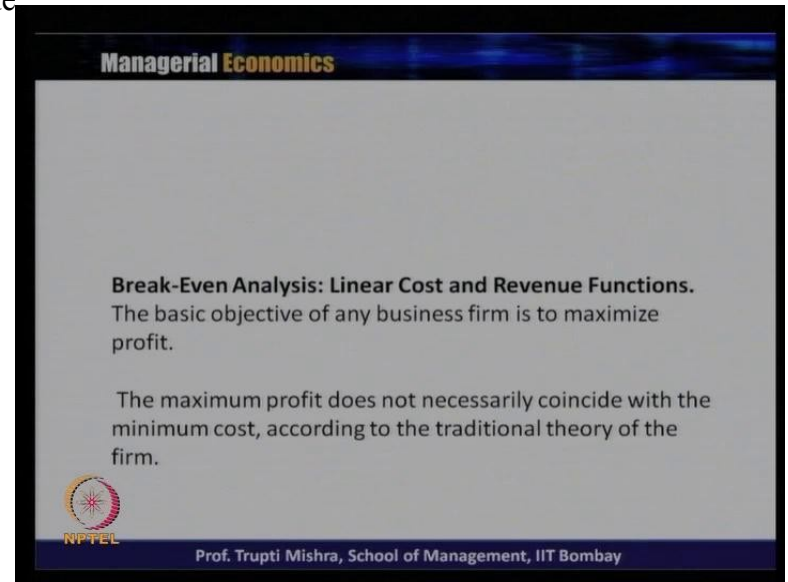
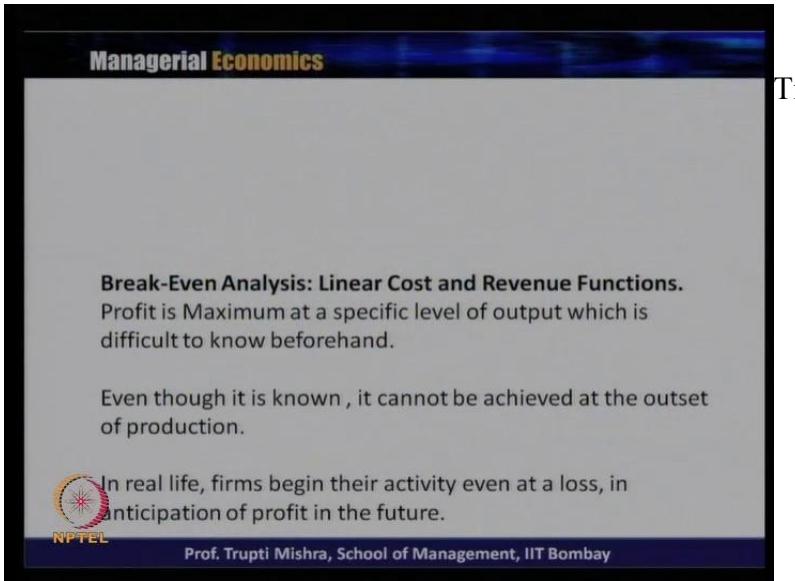


So, that will analyze this optimum plant size with the help of the break-even analysis maybe that is through revenue analysis; that is through profit analysis; that is through cost analysis. But in general when it comes to the optimum output, the optimum size of a firm in the long-run; this is always the point at which the long-run average cost curve is minimized. So then we will introduce the break-even analysis, specifically in case of linear cost and revenue function and then we will analyze in case of non-linear cost and revenue function.

So, the basic objective of any business firm is to maximize the profit. So if you look at any economic agent, if their optimization problem it is related to either for the maximization of profit or for minimization of cost. So, the basic objective of any business firm is to maximize the profit, but it is not that the maximum profit always coincides with the minimum cost. If it is maximum profit coincide with the minimum cost that is the optimal level of output or that is the optimum operational level for the firm.

So even if the optimization problem is to maximize the profit, it is not that always the maximum profit coincides with the minimum amount of the cost and if you look at go back to any traditional theory of firm in economic analysis, they say that maximum profit can be achieved with a minimum cost. But when you take this example to a real world scenario, it is not that every time the maximum profit coincide with the minimum cost and that is the difference; points over here is that maximum profit can be achieved also not at the minimum point of the cost of the production.

(Refer Slide 

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Profit is Maximum at a specific level of output which is difficult to know beforehand. So, which level of output where profit is maximum it is difficult to know at least in the beforehand; because it is not that before production start or before production level, it is easy to know at which level of output profit is maximum and in case if it is known, it cannot be achieved when the production operation is on. So first difficulty comes here is, it is difficult to know which one is the specific level of output where profit is maximum. Second, the second difficulty comes even though you know at which level the output is leads to maximum amount of profit it cannot be achieved at the outset of the production.

So in real life, firms begin their activity even at loss, in the anticipation of profit in the future. So when someone starts business, it is not that at the day one they get the profit. So initially there is a threshold time, where the firm begins the activity. They continue the activity even if it is a loss, and why they continue the activity even if they are incurring a loss; because there is a anticipation that they will get profit in the future. So, the production level is not known generally. If it is known also, it is difficult to achieve the production level where profit is maximum and there is one more dynamics here also in the firms behavior is that, the business activities continues even if there is loss because there is a anticipation of profit.

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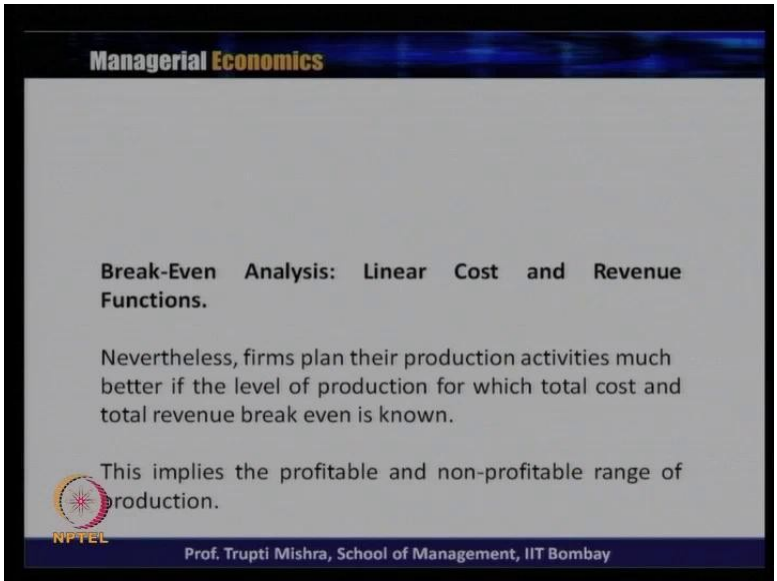

Nevertheless, the firm plan their production activity is much better way if the level of production for which total cost and total revenue break even is known. So, even if all these uncertainties are there, still firm plan their production activity much better if the level of production for which total cost and total revenue break even is known. This implies if the firm knows the profitable and non-profitable range of production. So, the relationship between the total cost and total revenue at different stages of output that gives us, which one is the profitable level of profit range to operate for the firm, and which one is the non-profitable range to operate for the firm.

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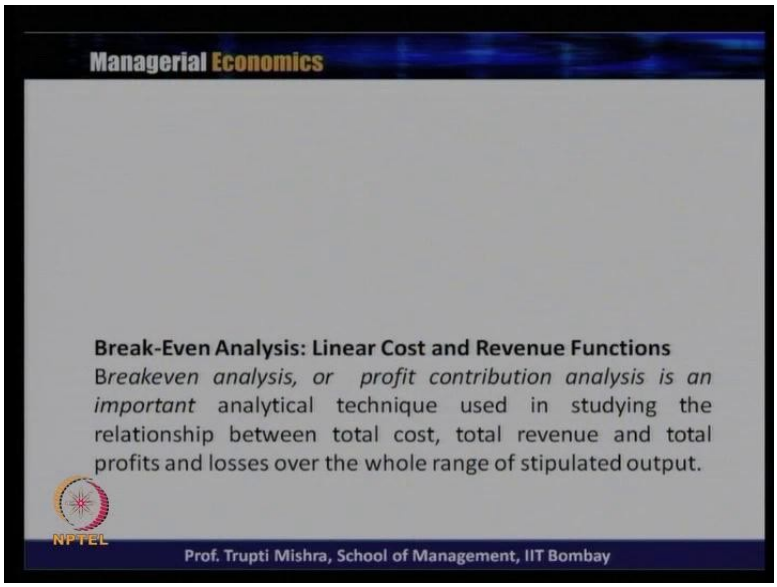

So, that we will see through the breakeven analysis or it is also called as the profit contribution analysis. This is an important analytical used in studying the relationship between the total cost, total revenue and total profit or losses over the whole range of stipulated output. So, break even analysis or else known as the profit contribution analysis is a technique through which we study the relationship between the total revenue, total cost,

profit and loss over a stipulated level of output, because there is a certain level of output and with a certain level of output, we can study the relationship between revenue, cost, profit and the loss, and the technique through which we study the relationship between all these four variables that is generally known as the breakeven analysis or profit contribution analysis

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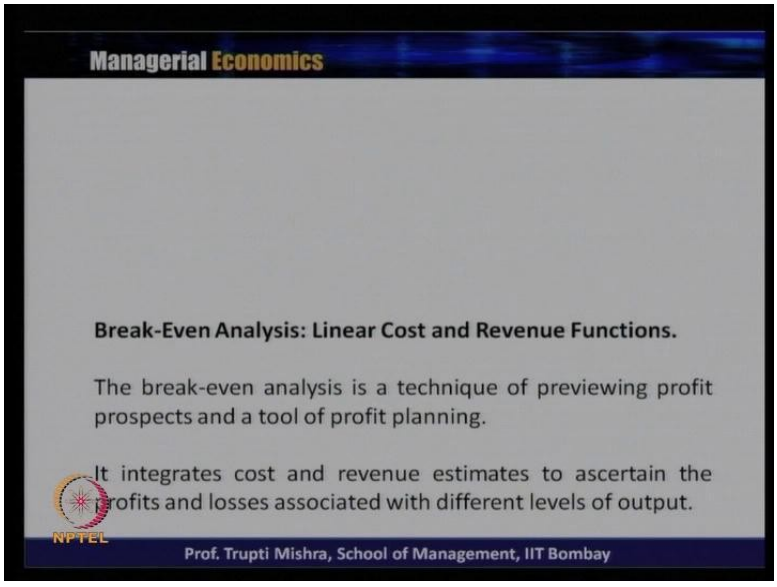

So the breakeven analysis, it is a technique of previewing the profit prospect and the tool for profit planning. It integrates the cost and revenue estimate to ascertain the profit and loss associated with the different level of output. So, it is a technique that previews the profit prospect and tool of profit planning. Because when you know the relationship between profit total revenue, cost, loss over a period of time that helps the producer to plan for the profit planning for at what level they have to operate, and it generally integrates the cost and revenue function in order to study the profit and loss.

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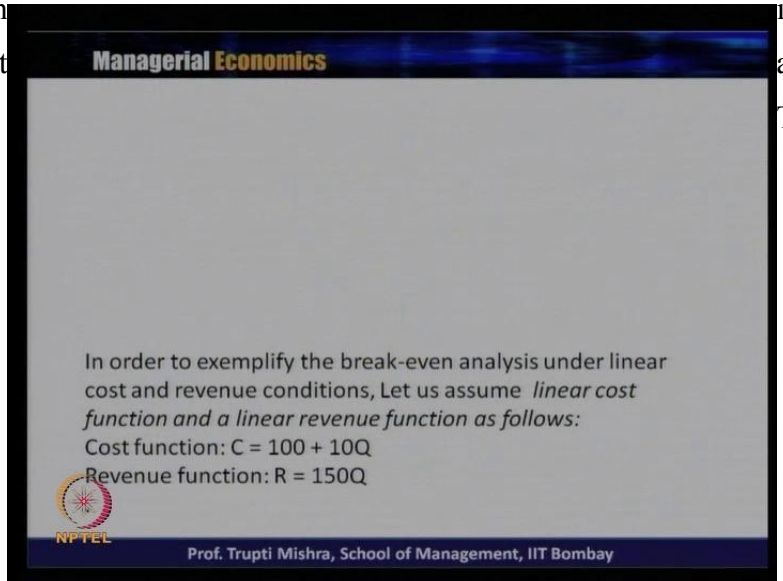

So to understand this breakeven analysis more, we will just take an example of a numerical function to understand how this cost and profit they are related.

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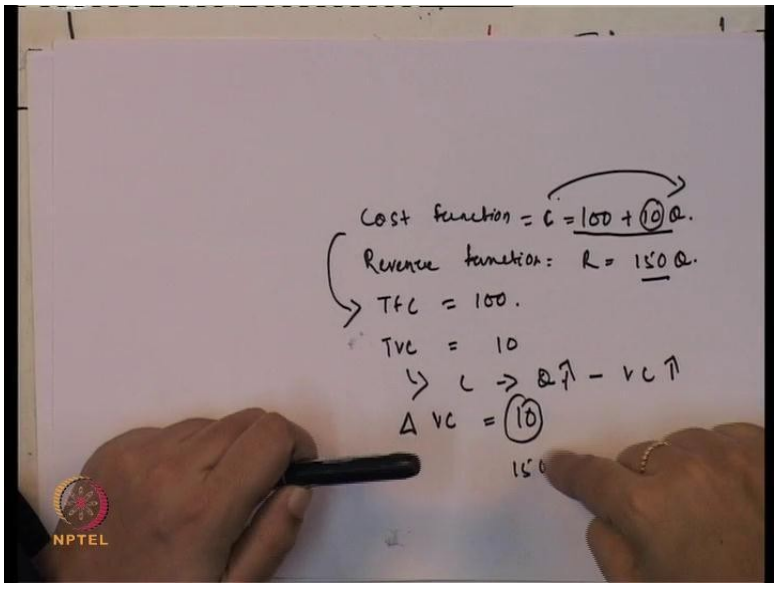

We will take a linear cost and linear revenue, and let us assume that the cost function is C which is equal to $100+10Q$ and revenue function is R which is equal to 150Q. Now if you look at what is the typically in the case of total fixed cost. Here this is the total cost function $C=100+10Q$. What is the fixed factor over here in case of the cost function? The fixed cost (TFC) is equal to 100 and what is the total variable cost(TVC). The variable cost varies at a constant of 10 because the C will change with the respect to Q. This happens in case of variable cost because fixed cost in constant at 100.

Whenever there is a change in the output that will lead to change in the variable cost and the variable cost will change by which change at ten times, because this is the rate at which the variable cost is changing. So, the total fixed cost is 100. Variable cost is increasing at a

constant rate of 10 per unit in response to increase in the output, and the revenue function implies that the market price for product is 150 and when it comes to the per unit sale. This is equivalent to this is equivalent to 150Q. So, this implies that the market price for firm product is 150 per unit of sale.

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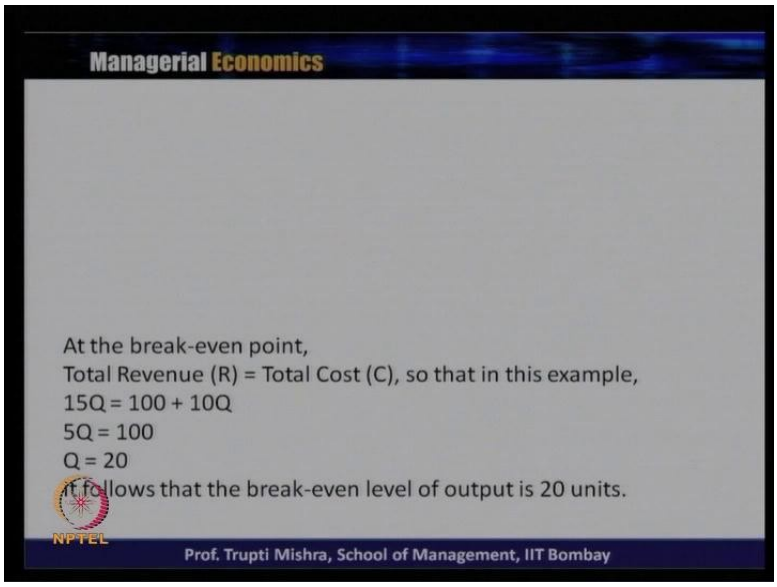

So, when you identify the break even points. So looking at this, how we should identify the breakeven point.

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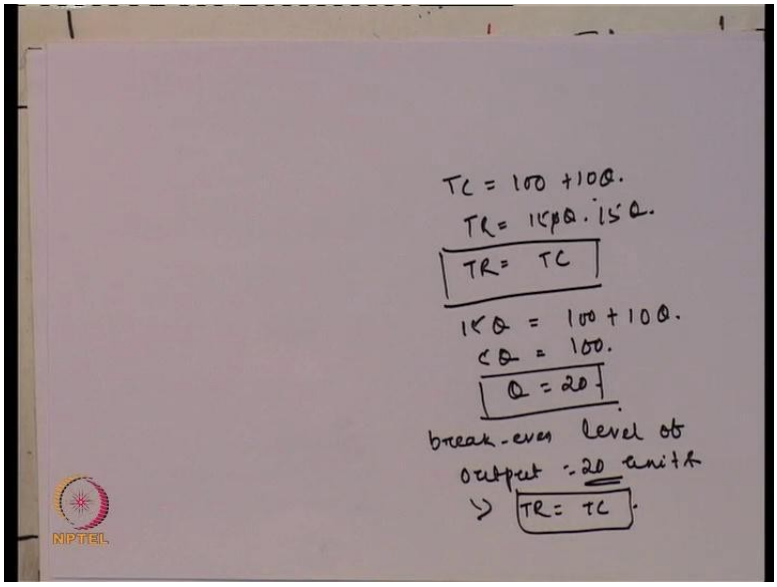

We have known as the total cost that is $TC = 100 + 10Q$ and we know the total revenue that is $TR = 150Q$. So, total revenue should be equal to total cost. So, this is actually 15; this is if you take this as 15 Q, then at the breakeven level total revenue has to be equal to the total cost. So, in this example if we look at this total revenue is $15Q = 100 + 10Q$ and if you simplify this that this is $5Q = 100, Q = 20$.

So this Q is equal to 20, what is the implication for this? It follows that the breakeven analysis or the breakeven level of output is equal to 20 units. So, these 20 units is what; 20 units can be achieved at total revenue is equal to total cost. So, breakeven achieved at a point when total revenue is equal to total cost and break even output level is 20 units, because this is achieved through the equalization of the breakeven condition; that is total revenue is equal to total cost

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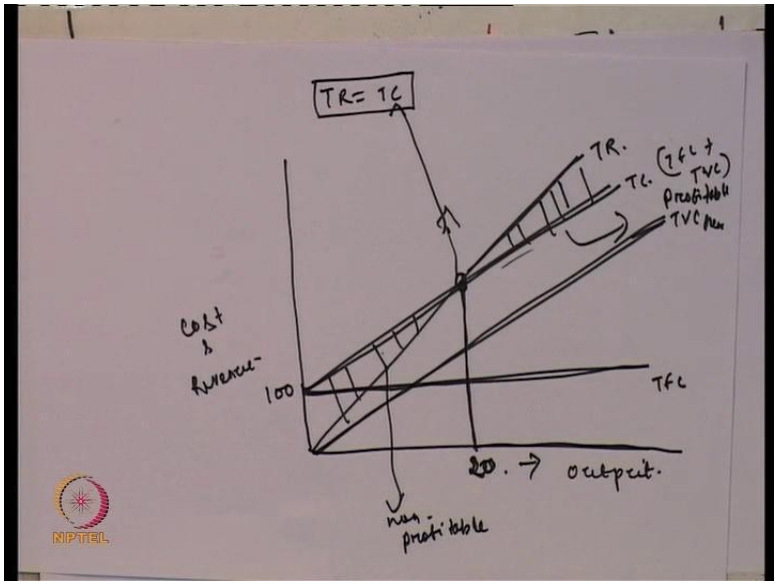

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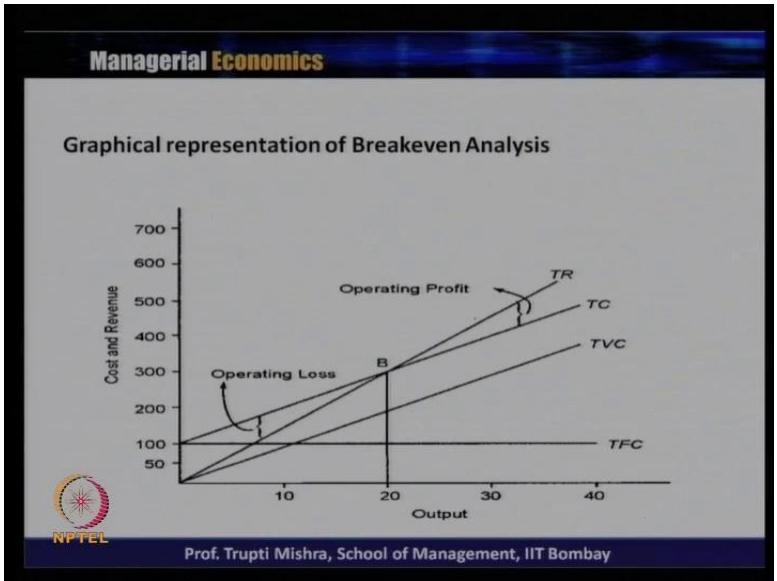

Now when you look at the graphical analysis of this, look at the total revenue, total cost, total variable cost, total fixed cost. So output is in the x-axis, cost and revenue are in the y-axis. So this is the total revenue, this is the total fixed cost, this is the total cost, and this is the total variable cost. This is 100 and this is 20. Now to understand this relationship or the breakeven analysis with the help of the graphical representation what is the breakeven condition? The breakeven condition is total revenue is equal to total cost.

So this is the total revenue which starts from origin because any level beyond 0 level of output, the firm is incurring the total revenue. Total fixed cost is fixed at 100. Total variable cost starts from origin, whenever there is a Q, their corresponding variable cost is there. Total cost is summation of total fixed cost plus total variable cost. That is the reason it starts from 100. Because up to this, it is the total fixed cost plus the total variable cost. Now what is the breakeven point? Breakeven point corresponding to this is the total revenue is equal to the total cost.

So corresponding to this, we get the level of output as 20. Now assuming 100 as the fixed cost, the output will be 20. Breakeven output level will be 20, because at this point the total revenue is equal to the total cost. So, breakeven analysis generally tells us the relationship between the total revenue and total cost. Now what happens if it is the output level is below 20 or output level is more than 20. If it is below 20, the cost is more than the revenue; it is not profitable for the firm.

If it is the produce beyond 20, then the total revenue is greater than total cost. So, this is the profitable level of output. The firm is going to get profit if it is a higher level of output and that is the reason if you look at, this is known as the profitable range of output and this is known as the non-profit range of output. Because if the firm is operating at output beyond 20, the total revenue is more than total cost and if the firm is operating before 20, the total cost is

more than total revenue. So, this is known as the non-profitable range of output and this is known as the profitable range of output.

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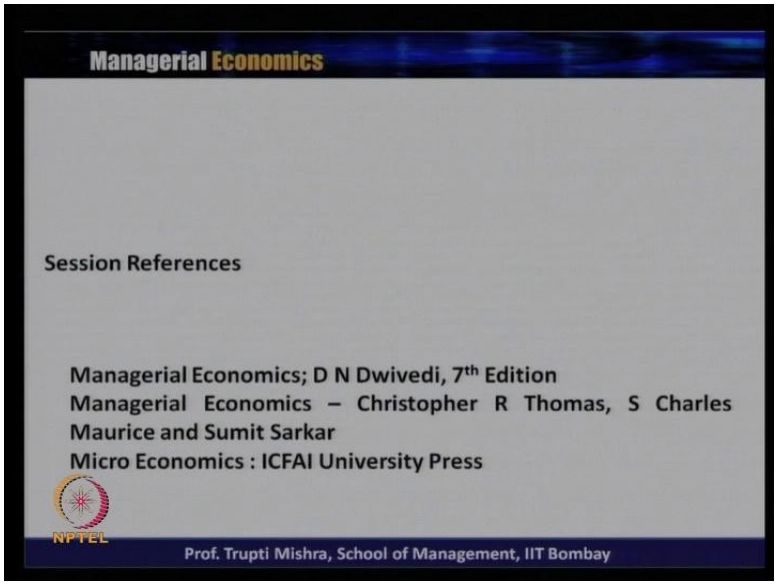

So, we will talk about the algebra behind this breakeven analysis, and how the breakeven analysis works before in case of non-linear cost function in the next session. So, these are the session references that is being followed exclusively for preparing this session.