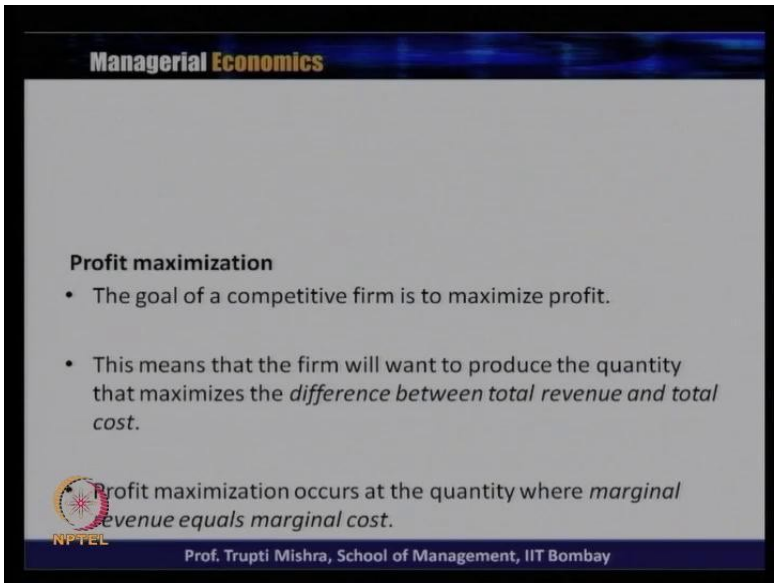
Managerial Economics
Prof. Trupti Mishra
S.J.M School of Management
Indian Institute of Technology, Bombay

Lecture - 50
Perfect Competition - II

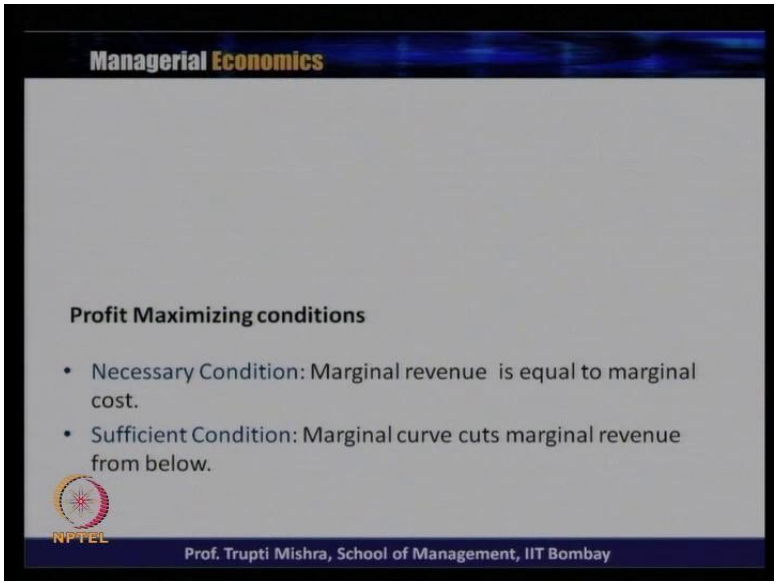
(Refer Slide Time: 24:17)



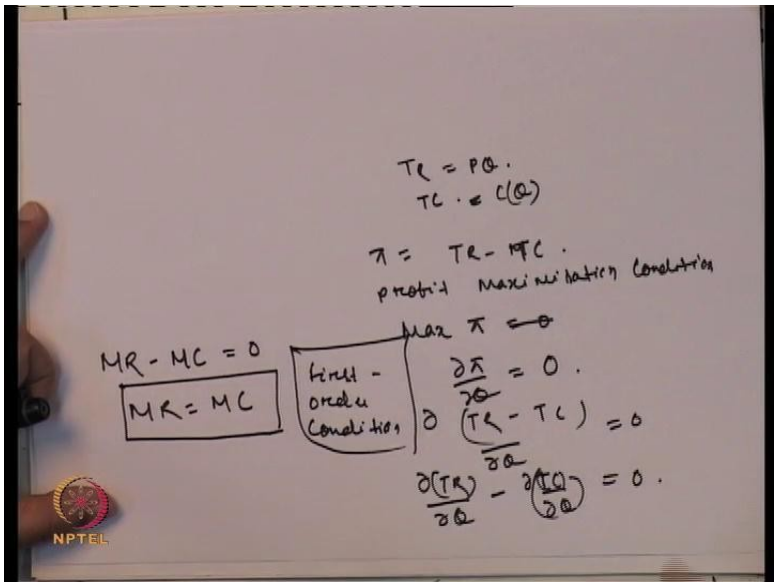
Then we will talk about the profit maximization. Now, why this profit maximization comes into picture; because the goal of the competitive firm is to maximize profit, the optimization problem for a firm is to always they maximize the profit with a minimum of cost. This means that the firm will want to produce the quantity that maximize the difference between the total revenue and total cost or may be the profit maximization occurs at the quantity where marginal revenue equal to marginal cost.

So, in the previous class if you remember we talked about two way, how the equilibrium can be achieved with the total cost and total revenue; or how the profit maximization can takes place with the help of total cost, total revenue, marginal cost and marginal revenue. And using the total cost and total revenue approach, the maximum at which the difference is total cost and total revenue, that is, maximum that is the point the level of output the producer or the firm should produce. And secondly, the marginal cost and marginal revenue where it is equalization of the marginal cost and marginal revenue that is the point the profit maximization should take place.

(Refer Slide Time: 25:30)



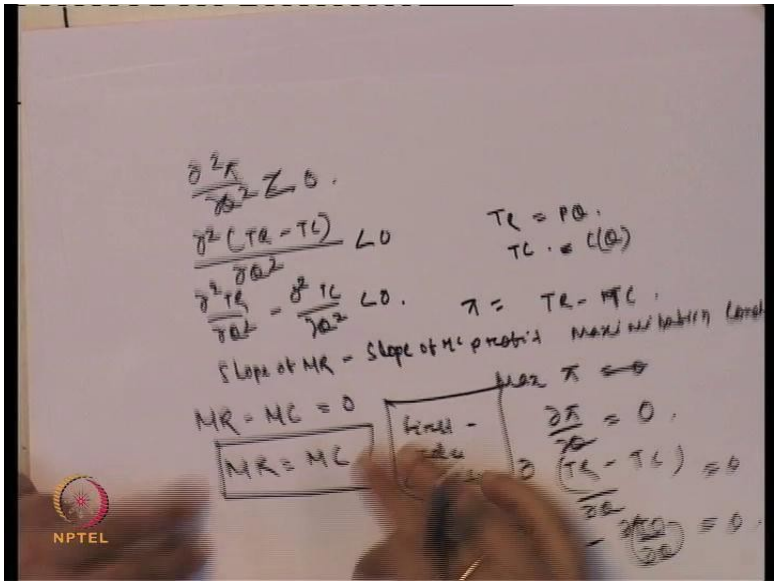
(Refer Slide Time: 26:05)



Now, from there actually two condition comes from the profit maximization condition; one that is necessary condition, marginal revenue is equal to marginal cost; and two is the sufficient condition, that is marginal curve cuts the marginal revenue from the below. So, we will look for the detail that how we get this equation marginal cost equal to marginal revenue and marginal cost should cut from the below at the point of equilibrium. So, if you look at now, what is our total revenue total revenue is P Q and total cost is maybe that is again it is a function of Q.

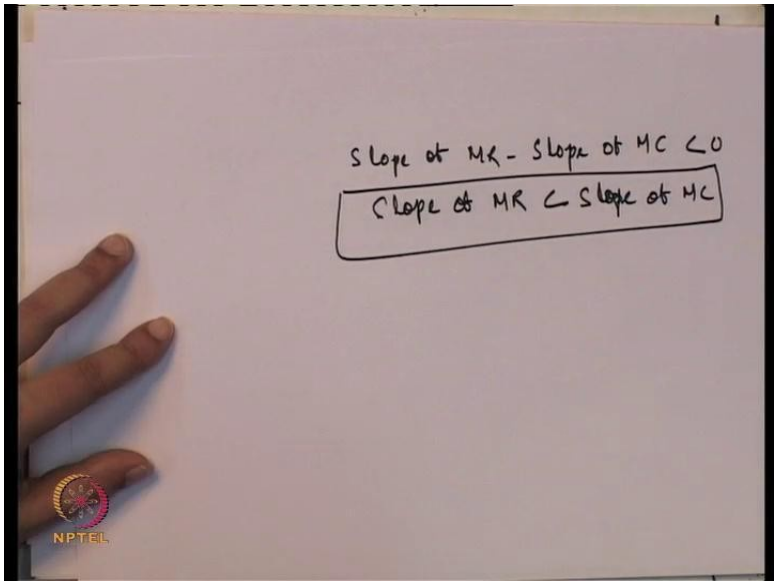
Now, how to, what is the profit;$(\pi = TR - TC)$ profit is total revenue minus total cost. Now, what is the profit maximization condition, the profit maximization condition is when you maximize P, maximize the profit it has to be equal to 0 or may when you, to maximize the profit this derivative has to be equal to 0 first order derivative $\frac{\partial \pi}{\partial Q} = 0$. So, in this case this is $\frac{\partial (TR - TC)}{\partial Q} = 0$. So, this is $\frac{\partial (TR)}{\partial Q} - \frac{\partial (TC)}{\partial Q} = 0$, and what is the first order derivative of the total revenue function, that gives us the marginal revenue. What is the first order derivative of the total cost function, that gives us the marginal cost.

(Refer Slide Time: 28:04)



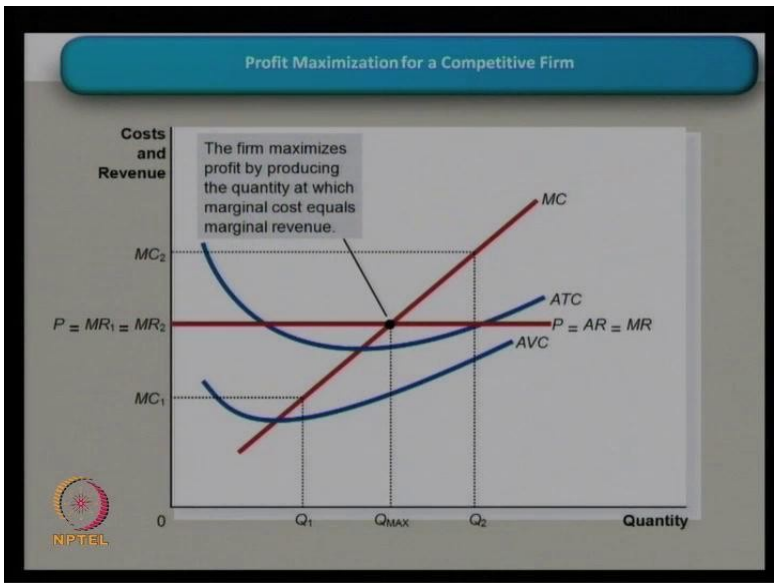
So, this has to be equal to 0 or marginal revenue has to be equal to 0, if marginal revenue is equal to marginal cost that is the first order condition. This is the first order condition for the profit maximization. Similarly, how we derive the second order condition this, that is first order or the necessary condition and second order condition is the marginal curve cuts should, marginal curve cuts marginal revenue from below. So, if you took that in a algebraically solution than it should be that the slope of the marginal cost should be greater than the slope of the marginal revenue curve at the point of the equilibrium or at the point of profit maximization. To check this how we have to do we have to take a second order derivative of the profit function. So, that has to be less than 0 $\frac{\partial^2 \pi}{\partial Q^2} < 0$.

(Refer Slide Time: 28:47)



So, this is total revenue minus total cost. So, this is $\frac{\partial^2(TR-TC)}{\partial Q^2}<0$ then $\frac{\partial^2 TR}{\partial Q^2}-\frac{\partial^2 TC}{\partial Q^2}<0$. So, this gives us the slope of marginal revenue, this gives us the slope of M C marginal cost. So, if you look at then the slope of marginal revenue minus slope of marginal cost has to be less than 0. And slope of if you simplify again, this slope of marginal revenue has to be the slope of marginal cost. Slope of marginal revenue is equal to less than the slope of marginal cost.

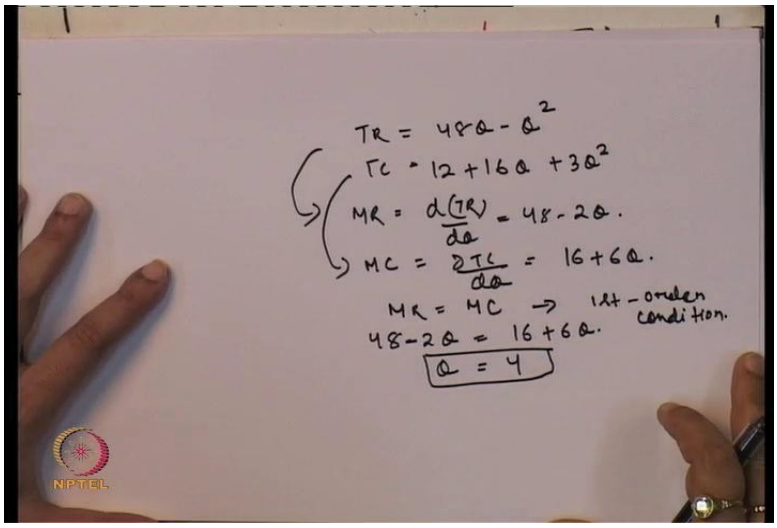
(Refer Slide Time: 29:28)



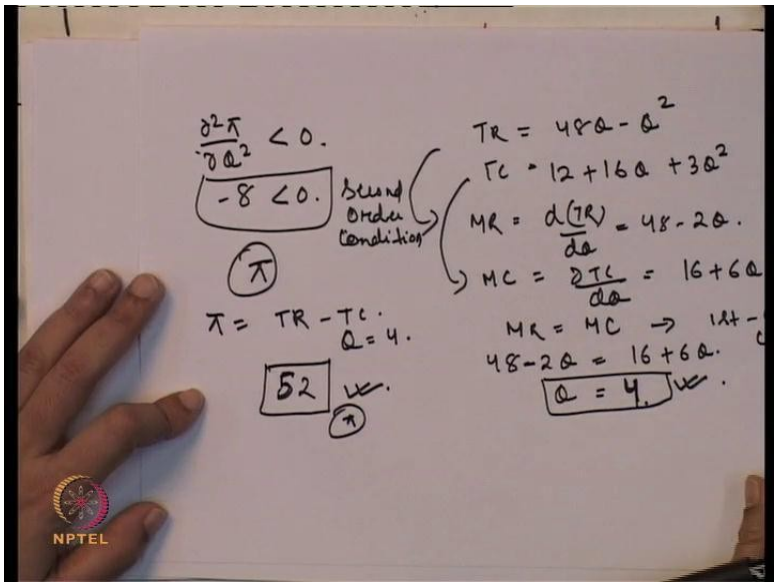
So, the necessary conditions talks about the marginal revenue has to be equal to the marginal cost and sufficient condition says that the marginal curve cuts the marginal revenue from the below. So, graphically if you look at than here; P is equal to AR is equal to MR, this is the demand curve, than ATC is the average total cost, AVC is the average variable cost and marginal cost curve intersect the average total cost curve and average variable cost at its minimum point. The firm maximizes the profit by producing the quantity at which the marginal cost is equal to the marginal revenue.

So, corresponding to that if you look at the both the condition gets fulfilled, that is, condition one the marginal revenue is equal to marginal cost, and condition two that this point the slope of the MC is greater than the slope of MR. Now, we will just take a numerical function in order to understand how the profit maximization is done using this both this condition. So, we will take a TR function, we will take a TC function and then from there we will try to maximize the profit using the sufficient condition and the necessity condition and see what is the profit level.

(Refer Slide Time: 30:35)



(Refer Slide Time: 30:35)



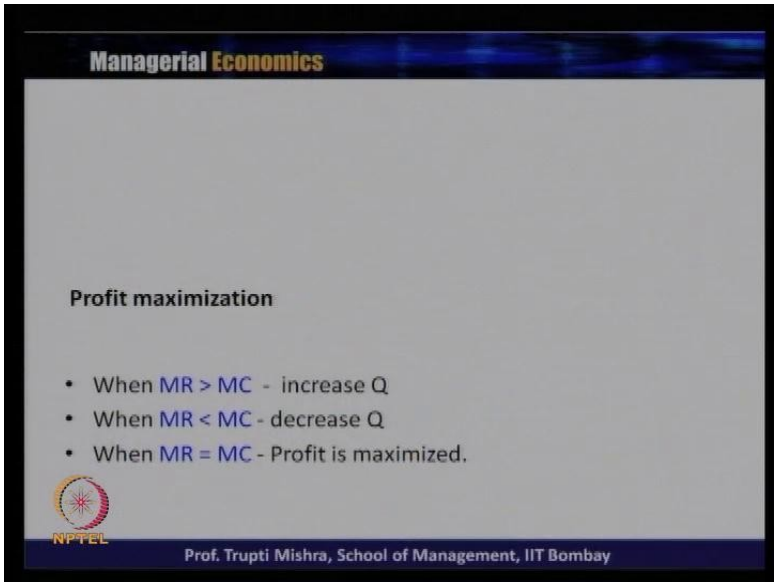
So, if you look at this total revenue and total cost. So, total revenue is $TR = 48Q - Q^2$, total cost is $TC = 12 + 16Q + 3Q^2$, we need to calculate the output that maximize the profit and the amount of maximum profit. What we require now, we require the marginal revenue. So, marginal revenue is $MR = \frac{d(TR)}{dQ} = 48 - 2Q$ and from total cost we will find out the marginal cost, that is $MC = \frac{d(TC)}{dQ} = 16 + 6Q$. First order condition says that marginal revenue should be equal to the marginal cost.

So, marginal revenue if it is equal to marginal cost $MR = MC$ then $48 - 2Q = 16 + 6Q$ and if you simplify this then it comes to so, this comes to Q is equal to 4. So, this is the quantity of output where the profit level is maximum. Now, in this case only the first to till now we have only checked about the first order condition for the profit maximization. Then we will check for the second order condition for the profit maximization, and what the second order condition says, the second order condition says that the $\frac{\partial^2 \pi}{\partial Q^2} < 0$.

So, if you take this $\frac{\partial^2 \pi}{\partial Q^2} < 0$ then that comes to -8 and which is less than 0, so the second order condition also gets fulfilled. Here the next task is once we fulfill both the profit maximization condition, the next task is to find out what is the amount of profit when the output level is this, and how we will find out, that as we know that profit is equal to total revenue minus total cost we will find out the value of the total revenue. So, total revenue is substituting the value which is Q is equal to 4 and there we get a value that is profit that is equal to 52.

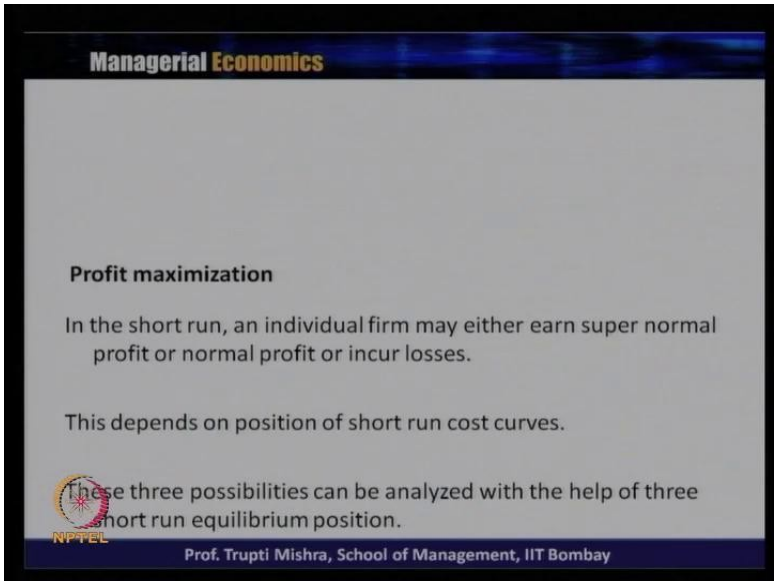
So, 52 is the profit, if Q is equal to 4 and in this case both the first order and the second order condition get fulfilled. So, for profit maximizing level at any point of time, we need to first check whether the profit maximization condition has been made fulfilled or not and after doing that then we need to find out that, what is the level of output, what is the total revenue, what is the total cost, and hence for the what is the total profit, or what is the profit the firm is getting.

(Refer Slide Time: 33:51)



So, what is the thumb rule for this profit maximization, if marginal revenue is greater than marginal cost we have to increase the quantity because the per unit increase in the Q brings more revenue than the cost. When marginal revenue is less than marginal cost, there should be decrease in the quantity because the per unit increase in the revenue is less than per unit increase in the cost when one more unit of output is added. And if marginal revenue is equal to marginal cost then the profit is maximized.

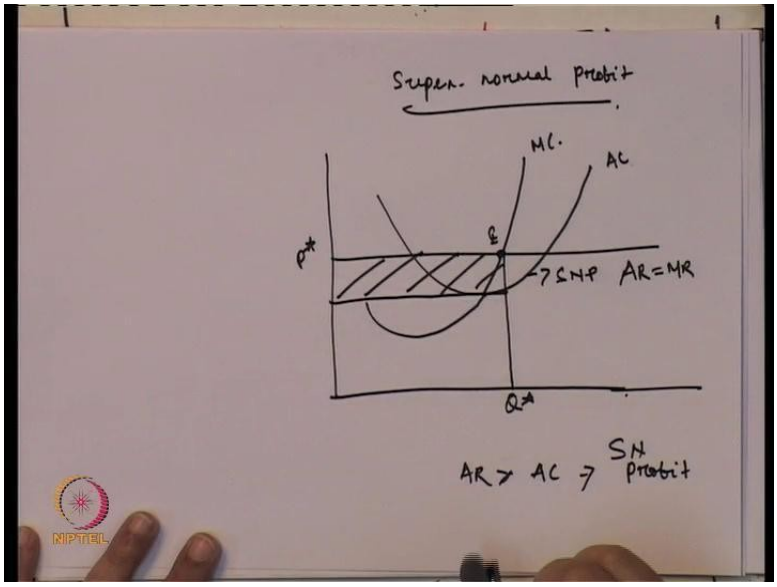
(Refer Slide Time: 34:24)



So, profit maximization in the short run if you are coming specifically to the short turn case an individual firm, may either earn super normal profit or earn normal profit or incur loss. So, either of these three situations can happen in case of short run individual firm, can either earn super normal profit. Let me tell you the super normal profit here is to the profit above the normal profit or just the normal profit or incur losses.

This depends on the position of the short run cost curve because what is the cost curve, on that basis it is going to be decided whether the individual firm is going to get the super normal profit going to get the normal profit or just incur the loss by producing that level of output. So, these three possibilities whether super normal profit, normal profit or loss that can be analyzed with the help of three short run equilibrium positions.

(Refer Slide Time: 35:40)

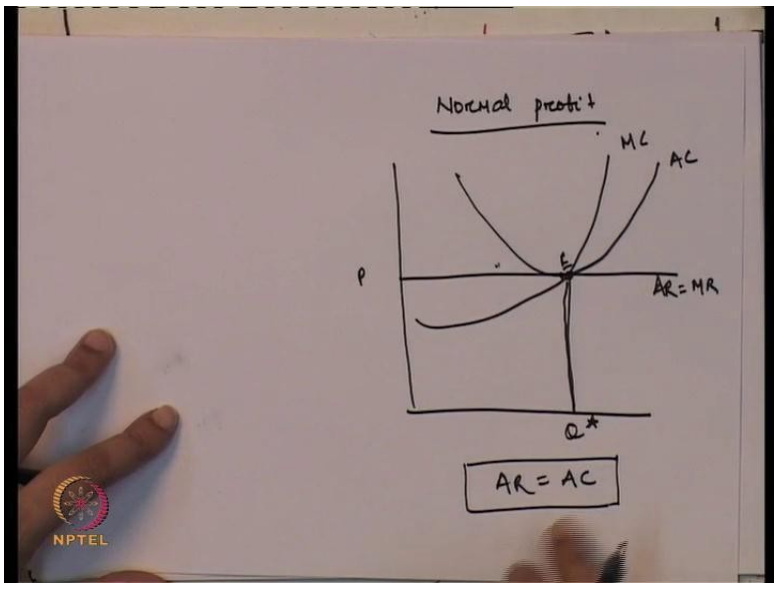


We will now see for all this three cases on the basis of the cost curve, how we can say which one is the super normal profit and which one is the normal profit. To start with we do with a super normal profit we will see in which case, generally the in the short run the individual firm gets the super normal profit. This is the demand curve, average revenue is equal to the marginal revenue, this is the average cost and this is the marginal cost. So, this is our price.

Now, how we will find whether in this case it is the super normal profit, normal profit or the loss. Now, what is the profit maximizing condition, the marginal revenue should be equal to the marginal cost and second the slope of M C should be greater than slope of marginal revenue curve. So, if we look at this point E, both the condition gets fulfilled and this is the profit maximizing level of the typical firm. Now, when this output is produced, suppose this is $Q^{¿}$now we need to check at $Q^{¿}$ level of output what the firm is getting.

So, now how to find out that corresponding to this level of output, we will find out what is the average cost and what is the average revenue. So, this is the average cost and this is the average revenue. Since, average revenue is greater than average cost the firm is getting profit, that is, super normal profit and what is the amount of the super normal profit the area between the average revenue and the average cost. So, this is the super normal profit the firm is getting, and how to reach to this super normal profit loss or the normal profit. First we need to look at the equilibrium point, the profit maximization condition where it gets fulfilled, corresponding to that we need to look for the average revenue, we need to look for the average cost and the difference between the average revenue and average cost that gives us the profit loss or the super normal profit.

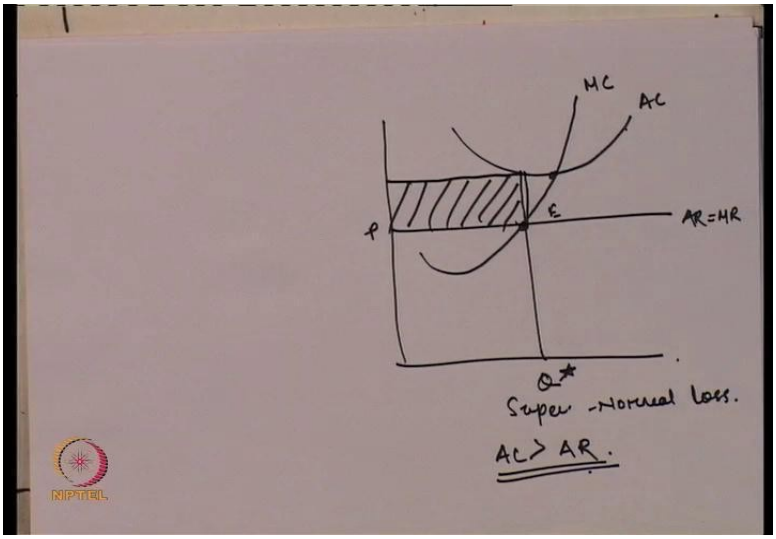
(Refer Slide Time: 38:10)



So, in this specific case since the average revenue is higher than the average cost the firm is getting the super normal profit. Then we will see the case of the normal profit and ideally normal profit is what, the revenue is just equal to the cost. So, this is the our P which is also equal to the average revenue and the marginal revenue, this is our average cost, this is our

marginal cost, this is point E where both the condition gets fulfilled; marginal revenue is equal to the marginal cost and the slope of the M C is greater than the slope of the M R curve, this is the equilibrium point or the profit maximization point $Q^{¿}$ is the level of output.

(Refer Slide Time: 39:29)



And now we need to check whether it is normal profit, super normal profit or loss. Corresponding to this if you find our average revenue is just equal to the average cost. So, there is no super nominal profit no loss rather this is the normal profit because average revenue is just equal to the average cost.

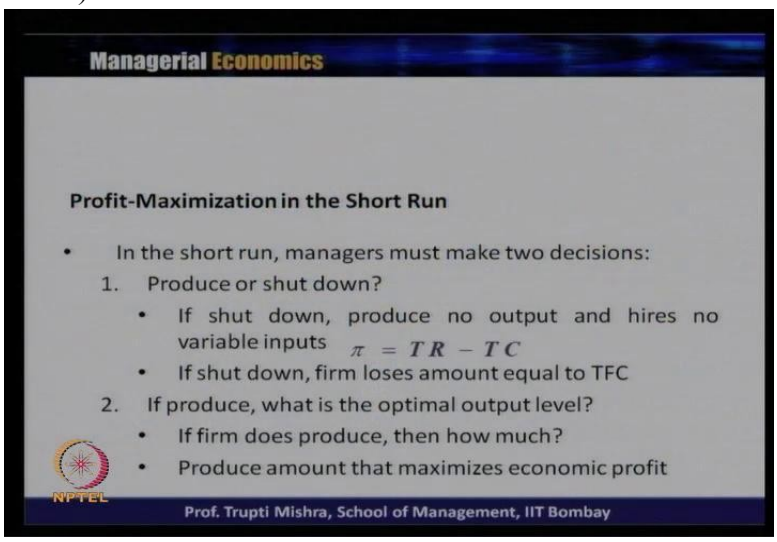
Then, we will see the third case that is the case of the loss, and in case of the loss ideally how it should happen, the loss should be where the cost is higher than the revenue. So, again we will follow the same process; we will identify the demand curve, that is average revenue is equal to the marginal revenue, we will take the average cost we will take the marginal cost, we will find the equilibrium point, that is point E where marginal revenue is equal to the marginal cost and the slope of the mc is greater than the slope of the M R curve, corresponding to that we will find the level of output and corresponding to that level of level of output now we will find out what is the profit loss or what is the outcome over here

So, corresponding to this if we look at our average cost is greater than the average revenue. So, this is and the difference between the average cost is average revenue is this much, that is between corresponding to the profit maximizing level of output and in this case, since the average cost is greater than average revenue the firm is incurring super normal loss. Okay!

Now, these are three situations where we think that either the firm is getting super normal profit or the firm is getting the normal profit or they are incurring loss. Is there any way where it all happens if the firm is producing, but there are some situations where the firm just gets the sub normal profit and they shut down the operation. Now, we will see and that generally happen in case of the short run when the shut down takes place because the firm is

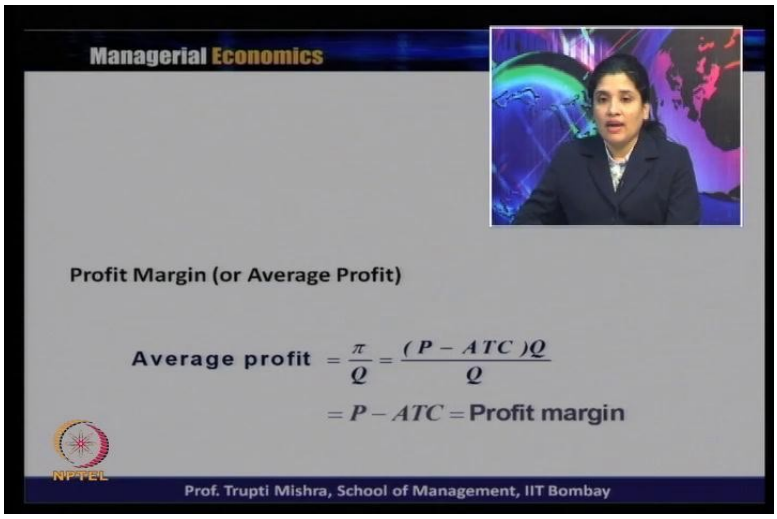
not able to cover the variable cost of production. Also now, we will take a special case where the firm is getting sub normal profit and they are getting into a shut down condition because the price is not getting price is the, variable cost is also not getting covered by the market price of the product.

(Refer Slide Time: 41:37)



So, in the case of the profit maximizing in the short run, manager must take two decisions whether to produce or to shut down. If shut down, produce no output hires no variable inputs, and if shut down firm loosed the amount which is equal to the total fixed cost. If produce what is the optimal level of output and then if firm dose produce then how much and produce the amount that maximize the profit.

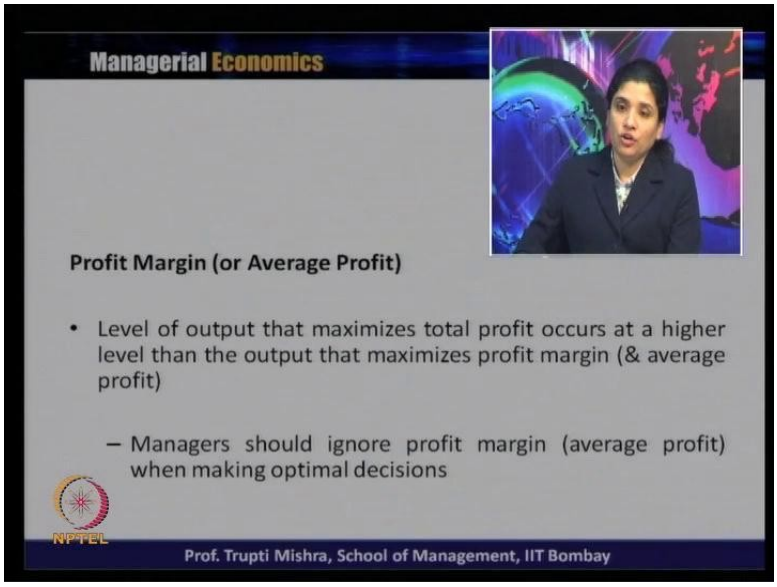
(Refer Slide Time: 42:04)



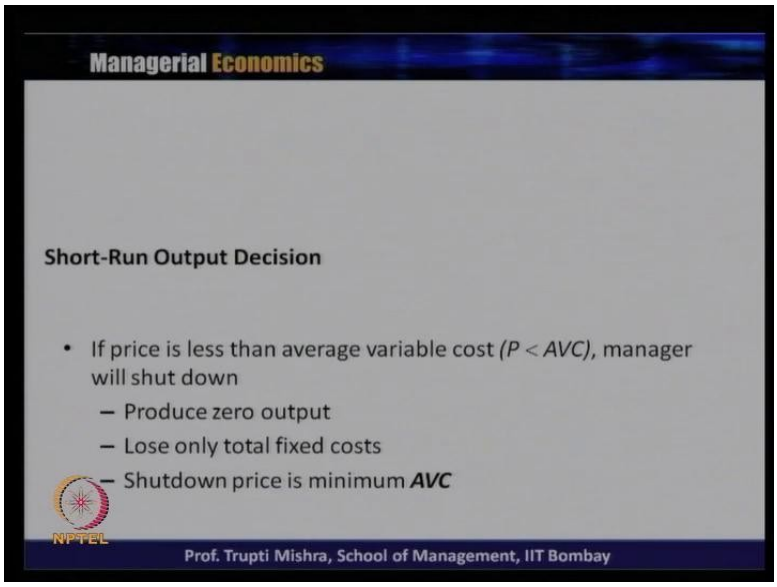
Now, here focus is more when the firm should shut down because we have already checked when they produce either they get profit loss or super normal profit. Now, if they shut then in this case we need to check how much they should produce, in which level they should just

shut down the operation. Now, what is profit margin, we need to understand this concept in order to understand the shut down condition. So, profit margin or the average profit is the $\frac{\pi}{Q} = \frac{(P - ATC)Q}{Q}$ or we can say $(P - ATC)$ is the profit margin.

(Refer Slide Time: 42:40)



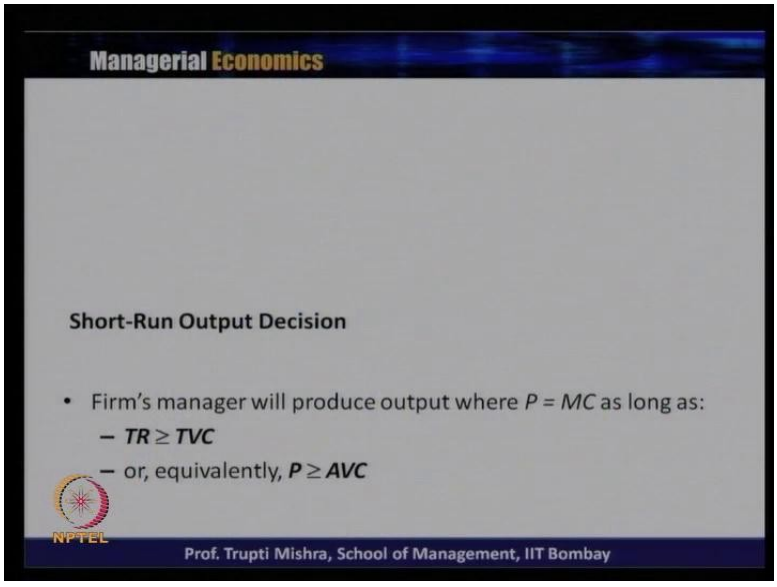
(Refer Slide Time: 42:54)



Level of output that maximize the total profit occurs at a higher level than the output that maximize the profit margin, and generally manager should ignore profit margin when making the optimal decision, and what is the short run output decision. If price less than average variable cost; manager will shut down, they produce 0 output, loose only total fixed cost and shut down price is generally the minimum of AVC. So, till the time the price is equal to or greater than minimum of average variable cost the firm will continue the production. The

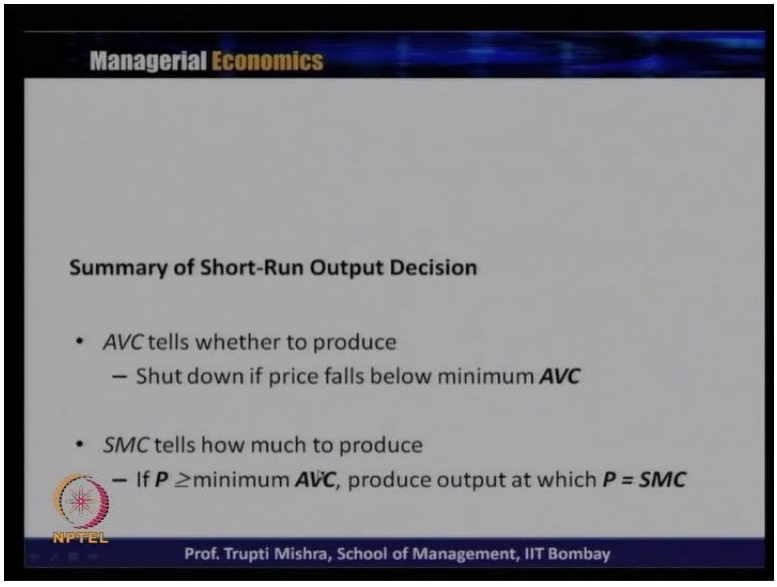
logic here is that at least they are covering the variable cost of production and if they continue in the same manner in the long run the possibility is there are they can they will get some amount of profit.

(Refer Slide Time: 43:50)



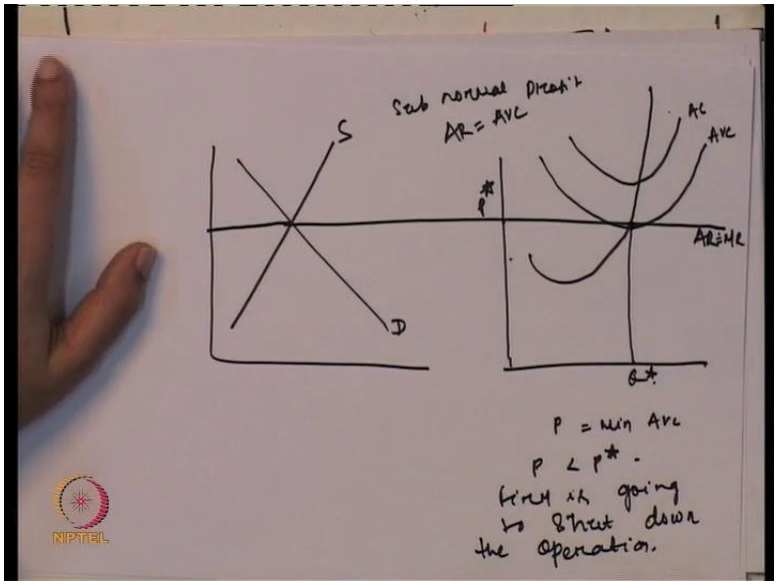
But in case of price if it is less than minimum AVC even they are not covering the variable cost for them, its profitable to shut down the production operation as a whole, and they will produce the output if they are producing, they will produce the output where P is equal to M C as long as total revenue is greater than total variable cost or P is greater than the average variable cost. So, this P greater than average variable cost generally this is known as the shut down point or this is known as the shut down condition for the firm in the short run.

(Refer Slide Time: 44:09)



Now, if you summarize this short run output decision or may be before summarizing this let us take a look on the graphical analysis of this specific situation or the special case, where the firm is not producing they are evaluating the option, whether to produce if they are covering the just variable cost and not when not covering the variable cost of production they are thinking to shut down the operation.

(Refer Slide Time: 44:58)

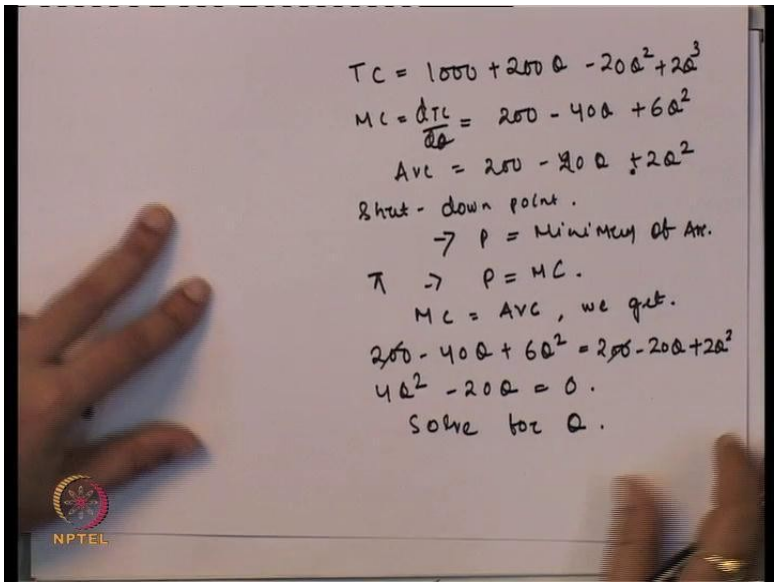


So, before that we will see what is the exit what is the shut down point, graphically we will just take a numerical to understand; what the price is, or how the price is decided to find out the shut down point, or to find out the level of output whether firm should go for the shut down. So, generally we call this is the case of a sub normal profit. So, the first part is; that is supply, this is demand, this from demand supply equation we get the price and that is generally accepted by the firm, and this is $P^{\dot{c}}$here the cost functions are bit different. Here we will, so we are representing the average variable cost we are representing the average cost and marginal cost curve intersect the average variable cost and average cost at its minimum point, this is the level of output. Okay.

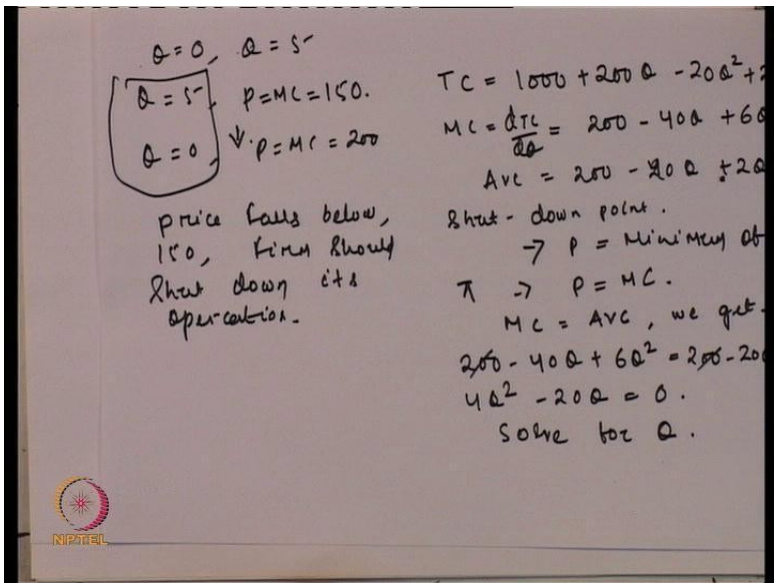
Now, what is this $P^{\dot{c}}$. So, if we look at here P is equal to minimum point of average variable cost. This is the level of output and here if you look at they are not getting any profit, any profit rather you can call it a sub normal profit because here the average revenue just equal to the average variable cost not the entire average total cost. So, here the average revenue is equal to the average variable cost. So, this is average revenue, this is marginal revenue and at this point. So, any price if it is less than $P^{\dot{c}}$then the firm is going to shut down the operation,

because after this it will not also cover the variable cost. So, any price which is less than P^{i} the firm is going to shut down the operation.

(Refer Slide Time: 46:50)



(Refer Slide Time: 49:01)



Now, we will just take a numerical to understand this short run condition. So, here we will take a cost function that is total cost which is equal to $TC = 1000 + 200Q - 20Q^2 + 2Q^3$. Now, we need to find out below what price the produce the product may the, or may be the firm decide to shut down its operation. Now, what is the marginal cost marginal cost will take a first order derivative of total cost with respective to Q, $MC = \frac{dTC}{dQ} = 200 - 40Q + 6Q^2$, average variable cost is $AVC = 200 - 20Q + 2Q^2$, and to find out the shut down point, and what is the

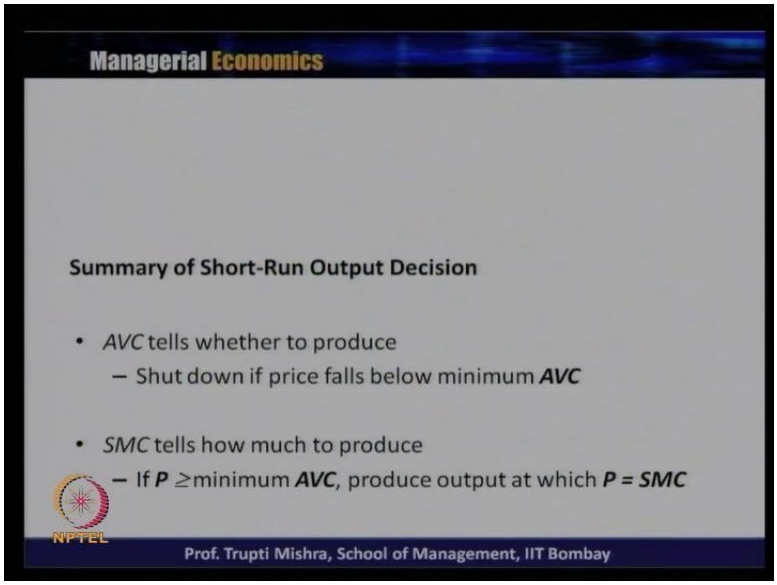
shut down point, we have to find out the price where it is equal to the minimum of average variable cost.

But before that if you know the profit maximization always requires the equality of price is equal to the marginal cost. So, in this case what we can do we can set the marginal cost which is equal to the AVC, and we get if we set the marginal cost equal to the average variable cost we get that, that is, $200-40Q+6Q^2=200-20Q+2Q^2$. So, that comes to $2Q^2-20Q=0$. And if you solve for Q solve for Q we will get 2 value of Q may be that, Q is equal to 0 and Q is equal to 5 and if we find if you take Q is equal to 5. Then what is the profit maximizing condition say, the profit maximizing condition say P is equal to marginal cost which is equal to 150 because if you put the value of P in the marginal cost equation and that gives you the 150.

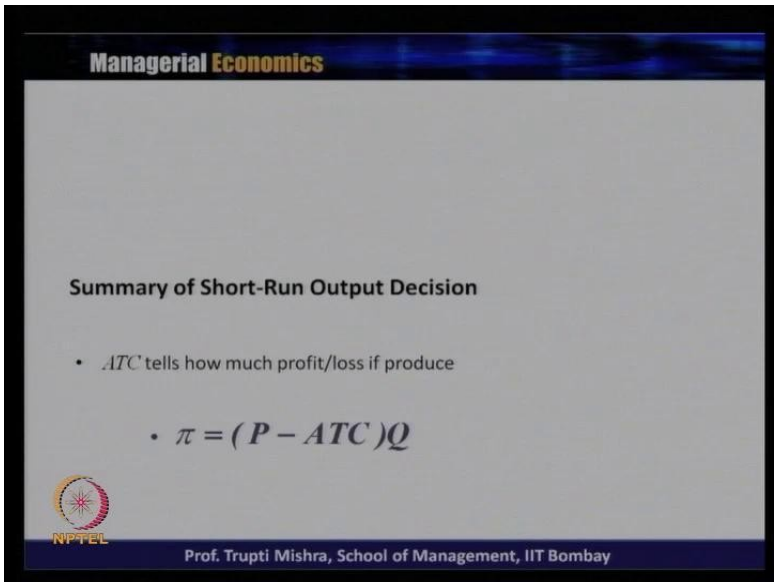
Now, what is the interpretation here or when you put the Q is equal to 0 then P is equal to M C which equal to two hundred. Now, how we can interpret from this two value of Q, if price falls below 150, firm should shut down its operation. So, any price if it is less than 150, than the firm should shut down the operation. So, this is not a specific case where we are talking about the normal profits, super normal profit or loss. This is the point where we talk about the case where till the time the firm is at least covering their variable cost or the variable expenses from the market price, they will continue the production, but once they are not covering that they will prefer to shut down the operation, in that case at least they are just taking care of the fixed cost not the variable cost.

So, whatever we have discussed today like whether it is the equilibrium of the firm, the equilibrium condition the different kind of situation what the firm generally gets in case of short run, that is profit loss, or super normal profit loss, or normal profit. And this typical case where the shut down condition, where we have analyzed the shut down condition if you summarize this short run output decision. Then generally if you look at the average variable cost always tell us whether to produce and it tells us that if we can shut down if price falls below the minimum of the average variable cost.

(Refer Slide Time: 51:21)



(Refer Slide Time: 51:33)



Short run marginal cost tells how much to produce and that tells us if P is greater than minimum of AVC produce the output where P is equal to SMC because that is the equilibrium condition, and the or the profit maximizing condition. And average total cost tells how much profit or loss it produce, because that depends upon that profit margin, and if $\pi = (P - ATC)Q$ if it is generally positive, then we get it a profit and if it is negative generally we get it a loss.

So, today basically we covered about the characteristic of the perfect competition and what is their applicability in the real world in a brief. Then we talked about the demand and revenue of a competitive firm in the short run, their equilibrium position, their profit maximization

situation in the different cases and finally, the shut down condition. So, in the next class we will talk about the supply curve and the supply behavior of the firm in the short run. We will talk about the price and output decision in the long run typical by a competitive firm and also we will talk about the long run supply in case of a cost and cost industry, in case of decreasing cost industry, and in case of a increasing cost industry.

(Refer Slide Time: 52:39)