Long Run

- In the long run, the firms can freely exit the market and also freely enter the market.
- If at the market price p, the firms are making super normal profit, new firms are going to enter the market. so N increases.
- When N increase, the market supply curve shifts rightward. Because market supply curve is $Y = \sum_{i=1}^{N} y_i(p)$ at each price p.
- Since the market demand curve remains as it is. The rightward shift of market supply curve leads to fall in equilibrium price. It is shown in figure.

- The fall in equilibrium prices leads to fall in the super normal profit.
- The entry of new firms will continue as long as there are positive super normal profit.
- It may happen that the numbers are so many that price falls by greater margin. So firms start making losses.
- In short run, if the amount of loss is less the fixed cost, the firms are going to produce positive amount of output.
- If the amount of loss is more than equal to the fixed cost, the firms are not going produce any output in the short run. It is the shut down condition.
- In the long run firms are not produce or stay in the market, if they are making loss.

- If the price is below average cost but above the average variable cost. It means firms are making losses but the amount of loss is less than fixed cost. If this price persists over a period of time. Some of the firms will leave the market.
- when some firms exit the market, N decreases.
- When some of the firms exit the market or N decreases, the market supply curve shifts leftward. Because $Y = \sum_{i=1}^{N} y_i(p)$.
- When the market supply curve shits leftward. The equilibrium price increases. If at the new equilibrium price firms are still making loss.
- Some more firms will leave the market. So N will further decrease.

- This go on till price is equal to average cost that is $p = AC$. At this price firms are making normal profit.
- In the long run, the equilibrium price p must satisfy the condition; $p = MC(y_i) = AC(y_i)$ for each firm.
- The first order condition of profit maximization gives; $p = MC(y_i)$ for each firm i.
- If this price is above average cost, the firms are making super normal profit so new entry of firms. If this price is below average cost, there is going to be exit of firms.
- So in the long run, we need additional condition that is $p = MC(y_i) = AC(y_i)$

- We know that average cost curve and marginal cost curve intersects at the minimum of the average cost curve.
- So the long run market price is given by the minimum of the average cost curve of the firms provided that the cost function of each firm is similar.
- We can also determine the number of firms going to be there in the long run.

Example: Suppose the market demand curve is $A - p = Y$, where p is the price and Y market demand. Suppose there are N firms. The cost function of each firm is similar. It is $c(y_i) = cy_i^2 + F$.
Each firm maximizes profit taking price as p. It is
$\pi_i = py_i - cy_i^2 - F$, $i = 1, 2, ...N$.
$\frac{d\pi_i}{dy_i} = p - 2cy_i$

First order condition gives, $\frac{d\pi_i}{dy_i} = p - 2cy_i = 0$.

$\Rightarrow y_i = \frac{p}{2c}$. This the optimal or profit maximizing output of each firm i.

There are N firms and each firm is similar. So the market supply at price p is $Y = \sum_{i=1}^{N} y_i = \frac{Np}{2c}$.

The equilibrium market price is such that quantity demanded is equal to quantity supplied. $A - p = \frac{Np}{2c}$

$\Rightarrow p = \frac{2Ac}{N + 2c}$.

Note that equilibrium price is a function of number of firms present in the market.

In the short run, the equilibrium market price of this good is $p = \frac{2Ac}{N + 2c}$ when there are N firms.

The profit maximizing output of each firm is $y_i = \frac{p}{2c} = \frac{A}{N+2c}$.

At this market price, the firms may make super normal profit, normal profit or loss.

$\pi_i = py_i - cy_i^2 - F$, substituting the optimal output and equilibrium market price we get

$$\pi_i = (\frac{2Ac}{N+2c})(\frac{A}{N+2c}) - c(\frac{A}{N+2c})^2 - F.$$

$$\pi_i = \left(\frac{A}{N+2c}\right)^2 c - F.$$

At $p = \dfrac{2Ac}{N+2c}$, average cost

$$AC = cy_i + \frac{f}{y_i} = c\left(\frac{A}{N+2c}\right) + \frac{F(N+2c)}{A}.$$

The firms make super normal profit, if $p > AC$ at $p = \dfrac{2Ac}{N+2c}$.

It means $p > AC = c\left(\dfrac{A}{N+2c}\right) + \dfrac{F(N+2c)}{A}$. This implies that $\left(\dfrac{A}{N+2c}\right)^2 c > F$.

The firms are going to make normal profit, if $\left(\dfrac{A}{N+2c}\right)^2 c = F$

The firms are going to make loss, if $\left(\dfrac{A}{N+2c}\right)^2 c < F$.

Long run outcome. In the long run, the entry and exit of firms are possible.
So, at the equilibrium price we have $p = MC = AC$. It is the minimum point of the average cost curve.
The minimum point of average cost is
$$\frac{dAC}{dy_i} = c - \frac{F}{y_i^2} = 0.$$
$$y_i = \left(\frac{F}{c}\right)^{\frac{1}{2}}.$$
So AC is $2\left(cF\right)^{\frac{1}{2}}$. So the equilibrium price in the long run is
$p = AC = MC$. So $p = 2\left(cF\right)^{\frac{1}{2}}$.

The market demand is $A - 2\left(cF\right)^{\frac{1}{2}} = Y$ at the long run equilibrium.

It is equal to market supply. The output of each firm is $y_i = \left(\frac{F}{c}\right)^{\frac{1}{2}}$.

So, $N = \frac{A - 2\left(cF\right)^{\frac{1}{2}}}{\left(\frac{F}{c}\right)^{\frac{1}{2}}}$.

This is the number of firms going to be there in the market in the long run.

They are going to earn normal profit.

Pareto Optimality: It is a state where no one can be made better-off without hurting some one else.
Example: 100 Rs should be be allocated between two persons. Suppose the division is $(50, 40)$. 10 Rs have not be allocated. If the distribution becomes $(60, 40)$ from $(50, 40)$, person 1 gets more but person 2 remains same. If the allocation is $(50, 50)$ from $(50, 40)$, person 2 is made better off and person remain same. So in the distribution $(50, 40)$, there is a possibility to make someone better-off without hurting someone else. Therefore, $(50, 40)$ distribution of 100 Rs is not Pareto optimal.

Take another example; suppose there are three persons 1, 2 and 3. There are three objects $\{a, b, c\}$. the preference ordering of the three persons over these three objects are following;
Person 1: $a\ P\ b\ P\ c$, Person 2: $b\ P\ c\ P\ a$, Person 3: $b\ P\ a\ P\ c$.
Suppose the allocation of these three objects between these three person is; Person 1 gets b, Person 2 gets c, and Person 3 gets a.
If we change the above allocation and give a to Person 1 and b to person 3. Both 1 and 3 are made better-off. Person 2 remains at same level of satisfaction. Therefore, Person 1 gets b, Person 2 gets c, and Person 3 gets a is not Pareto optimal allocation.

We show that equilibrium outcome in Perfectly Competitive market is always Pareto optimal and also maximizes social welfare

- At equilibrium price, quantity demanded is equal to quantity supplied.
- So no excess demand or excess supply at the equilibrium price.
- The market supply curve is horizontal summation of the supply curve of each firm. So each firm is producing profit maximising outputs at the equilibrium price. Firms are maximising profit at the equilibrium price.
- Demand curve has been derived from utility maximization of the consumers subject to their budget constraint .

Producer Surplus

- The supply curve of each firms shows the amount each firm is willing to sell at each price.
- Producer surplus is the difference between the current market price and the cost of production for the firm.
- The total producer surplus of a firm is the area $p \times y_i^*$ minus the total area below the marginal cost curve till y_i^* level of output. It is shown in figure below.
- For the industry, total producer surplus is the difference between $p \times Y^*$ and the area below the market supply curve. It is shown in figure below.

Consumer Surplus

- The demand curve is $10 - p = y$.
  If a consumer buys 2 units. The maximum amount the consumer is willing to pay is 9 for 1st unit and 8 for the second unit. We get it from the demand curve.
- Suppose the price is 4. In this case 2 units cost 8. For the 1st unit, consumer earns $9 - 4 = 5$ units of surplus. This is consumer surplus.
- For the second unit, it earn $8 - 4 = 4$ surplus. 4 is the consumer surplus.
- Total consumer surplus earned is $5 + 4 = 9$ or $9 + 8 - 8 = 9$. It is shown in figure.
- So each point in the demand curve show the amount a consumer is willing to pay for each unit of output.

- The equilibrium price in the competitive market is at the point of intersection of market demand and market supply curve. So, profit are also being maximized and utility of the consumers are also maximized at this price.
- At equilibrium price: the willingness to pay by the buyers for that quantity matches with what the firms are willing to supply at that price.
- We cannot make anyone better-off by deviating from this point. It is shown in figure below.

Social Welfare

- We can also define social welfare as the sum of consumer surplus and producer surplus.
- Perfectly Competitive equilibrium outcome always maximizes social welfare. See the class notes.