Perfectly Competitive Market

- Many firms. Each firm is small in size. It means each firm can serve only small fraction of the market.
- Each firm is a price taker. Each firm take the market price as given.
- Each firm produces homogeneous product. The characteristic of the output does not change from firm to firm. Each firm produces perfect substitute. So does not make difference from which firm a buyer buys.
- Complete information:
  Each firm knows the market demand and market price. Each firm knows the cost function of all other firms. Buyers know the nature of the product.

- Since each firm take market price as given. So the demand curve faced by each firm is a horizontal line as shown in figure.
- The market demand is downward sloping but the demand curve faced by each firm is a flat horizontal line.

- The objective of each firm is to maximize profit.
- Each firm chooses output y_i to maximize profit taking market price as given.
- The profit function of a firm i is
  $\pi_i = py_i - c(y_i)$ where p is the market price, y_i output of firm i.
- py_i is the total revenue received by firm i.
- $c(y_i)$ is the total cost of producing y_i units of output.
- Each firm i maximizes profit π_i with respect to y_i.
- The profit function is differentiable with respect y_i.

- $\frac{d\pi_i}{dy_i} = p - c'(y_i)$
  First order condition gives that
  $\frac{d\pi_i}{dy_i} = p - c'(y_i) = 0$, at profit maximizing point.
  $\Rightarrow p = c'(y_i)$.
  $c'(y_i)$ is marginal cost when the output is y_i. First order condition gives that price must be equal to marginal cost. A firm must choose to produce that output where price is equal to marginal cost.
- Second order condition gives
  $\frac{d^2\pi_i}{dy_i^2} = -c''(y_i) < 0$ at $y_i = y_i^*$. It means that marginal cost must be positive at the profit maximising level of output.

- When the profit function is differentiable, we get that for the profit maximising output to exist, the cost function must be such that marginal cost is increasing in output.
- This implies that the cost function must exhibits decreasing returns to scale.

- Suppose the cost function is of the following type; $c(y_i) = c_v(y_i) + F$. We assume there is a fixed cost. From the profit maximising condition we get that, $c_v(y_i)$ must have $c_v''(y_i) < 0$ at the profit maximising output y_i^*.
- Another requirement to produce positive unit of output is $\pi_i = py_i - c_v(y_i) - F > -F$

  It implies $p > \frac{c_v(y_i)}{y_i}$. The price must be above the average variable cost.
- If price is below average variable cost, the firm shut down its production in the short run.

Derivation of the supply curve of a firm

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- Thus, the supply curve of a firm is inverse of this function, $p = c_v'(y_i)$ given that $p > \dfrac{c_v(y_i)}{y_i}$.
- The marginal cost curve above the minimum of the average variable cost is the supply curve of a firm.

- If production function is CRS. The cost function is $c(y_i) = cy_i + F$. if it has a fixed cost component.
- $\pi_i = py_i - cy_i - F$.
  $\Rightarrow \pi_i = (p - c)y_i - F$.
  If $p > c$, as we go on increasing y_i, profit increases so no profit maximising output.
  If $p < c$, profit is negative, and as output increases, loss increases. So better not to produce.
  If $p = c$, still y_i is indeterminate. Because profit is zero always.

Increasing returns to scale

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