

Break-even Price: $p^{MES} = ATC^{MES}$

There are two ways to find y^{MES} ; (1) $\frac{\partial ATC}{\partial y} = 0$; (2) $MC=ATC$ at y^{MES}

Competitive Equilibrium with Free Entry:

$$\pi = 0, p = p^{MES}, y = y^{MES},$$

$$\text{aggregate supply } S(p^{MES}) = N * y^{MES} = D(p^{MES})$$

Problem 1: Cost and Supply Functions

Johnny wants to start a lemonade stand business. The fixed cost of the investment (the lemonade machine) is \$200. After he obtains the machine, Johnny will be able to produce y lemonades at the variable cost $c(y) = 0.5y^2$.

- Does the production technology exhibit increasing, constant, or decreasing returns to scale?
- Derive Johnny's total cost (TC) curve, both analytically and graphically. Decompose it into variable (VC) and fixed cost (FC).
- Find the average fixed cost (AFC), average variable cost (AVC), average total cost (ATC), and marginal cost (MC) curves. Plot the ATC and MC on the same graph and comment on the shape of the curves and their relationship.
- Find the minimal efficient scale (MES), i.e. y^{MES} and ATC^{MES} . Relate to your graph from c) and d).
- Suppose the price of a lemonade is p . Find the optimal (i.e., profit-maximizing) level of y if $p = 10$, $p = 20$, and $p = 30$ and the corresponding profit.
- Find Johnny's lemonade supply function, $y(p)$. Provide a graph that contains both the (inverse) supply function and the ATC curve.

Problem 2: Equilibrium with N Firms (Perfect Competition)

Imagine an economy that is regulated and only 5 firms are allowed to operate in the market. These firms are identical price-takers with fixed costs equal to \$100 and variable costs equal to $5y + y^2$. The market demand for the good is given by $D(p) = 1000 - 10p$, where p is the price of the good.

- Find the supply curve of an individual firm in this market.
- Find the aggregate (market) supply curve.
- Find the equilibrium price and quantity, the individual production of each firm, and the profit of each firm in the market.

- (d) Now suppose the market is deregulated—that is, other firms are allowed free entry into the market. Find the new equilibrium price and quantity, the equilibrium number of firms in the market, and the profit of each firm.
- (e) Following from (d), suppose the market has free entry. Let fixed cost be F , derive the equilibrium number of firms, N , as a function of F .
- (f) Find the number of firms given different level of fixed cost F

F	1444	351	100
N			

Problem 3 (short question)

Give an example of a Cobb-Douglas production function that is associated with increasing returns to scale, increasing MPK and decreasing MPL (give a function). Without any calculations, sketch the average total cost function (ATC) associated with your production function.