Review Notes for Chapter 5

1. **Optimal decision making by anyone**
   Engage in an activity up to the point where the marginal benefit = marginal cost

   **Sunk costs** are costs which must be borne regardless of future actions
   → These should not affect decisions.

   **Opportunity costs** do affect decisions.

2. **Optimal Decision making by a firm**
   Maximizing profits is a firm’s main objective
   
   \[ \text{Profit} = \Pi = \text{Total Revenue} - \text{Total Costs} \]

   The profit maximizing point is where **marginal revenue = marginal cost**
   
   This is true for any type of firm
   
   \[ \text{MR: The additional revenue from selling one more unit.} \]
   \[ \text{MC: The additional costs from producing one more unit.} \]

   **Total costs = fixed costs + variable costs**

   **Fixed costs** are costs that must be borne regardless of how many units are produced.
   
   Fixed costs come from factors that cannot be adjusted in the short run.
   
   These costs can be adjusted in the long run.

   → Changes in fixed costs do not affect behavior in the **short run**
   
   Why not? They do not change the point where MR = MC

   → Changes in fixed costs do affect behavior in the **long run**.
   
   Why? Changes in fixed costs change profits,
   
   This could cause entry into or exit from the industry.
   
   This could affect the demand for the other firms.

   **Variable costs** are costs that change depending on the amount of output produced

   → Changes in variable costs affect the marginal cost.

   → Changes in variable costs affect behavior in both **short and long run**
   
   Why? They change the point where MR = MC
Costs come from inputs (also called factors of production)
  \( P_K = \) rental rate of capital (physical assets like machines)
  \( P_L = \) wage rate for labor
Costs include opportunity costs—the value of inputs in their alternative use
(Even if I own a machine or a building, I need to include what I could make by renting it out.)

**What costs are relevant to the decision depends on timing**

- **Short run:** Some inputs are fixed.
  These are the fixed factors that generate fixed costs.
- **Long run:** All factors are variable

**A Typical Pattern of Production and Costs in the Short Run**

- **Marginal product:** The additional output (total product) from using one more input.
- **Average product:** Output divided by inputs

- **Initially, marginal product rises** as additional inputs make other inputs more productive
  This often occurs because of specialization.
  When marginal product rises, average product is also rising.

- **Eventually, marginal product falls.**
  Diminishing marginal returns set in because some factors are fixed,
  causing MP to fall.
  When marginal product falls by enough that it is below average product,
  average product also begins falling.

  \( \rightarrow \) MP and AP are hump shaped, with MP crossing AP at its peak.

- This pattern implies **U-shaped short run marginal and average cost** functions

  Marginal cost crosses average cost at its minimum point.
Production and Costs in the Long Run

To minimize costs of production, compare relative productivity with relative cost

- **Isoquants**: combinations of inputs that produce the same level of output
  - Downward sloping, fill the plane
  - Slope = Marginal Rate of Technical Substitution
    \[ \text{MRTS} = \frac{\text{MP}_L}{\text{MP}_K} \] — the ratio of the marginal products
  - MRTS can change along an isoquant.
    - If labor gets relatively less productive as it increases relative to K, the MRTS will get smaller moving along an isoquant.
    - \( \rightarrow \) isoquants are convex

- **Isocost lines** represent combinations of inputs that produce the same level of costs
  - Slope = wage ratio = \( \frac{P_L}{P_K} \)

- Minimum cost method of production \( \rightarrow \) isoquant and isocost are tangent
  \[ \frac{\text{MP}_L}{\text{MP}_K} = \frac{P_L}{P_K} \] — ratio of marginal products = ratio of input prices
  Or
  \[ \frac{\text{MP}_L}{P_L} = \frac{\text{MP}_K}{P_K} \] — “bang for buck” is the same

**Shape of long run average cost curve depends on returns to scale**

If inputs increase by 1% and production takes place under
- **Increasing Returns to Scale**: \( \rightarrow \) output goes up by more than 1%
  \( \rightarrow \) LRAC slopes down
- **Decreasing Returns to Scale**: \( \rightarrow \) output goes up by less than 1%
  \( \rightarrow \) LRAC slopes up
- **Constant Returns to Scale**: \( \rightarrow \) output goes up by 1%

**Some relationships to use when solving problems:**

- Marginal cost: \( \text{MC} = \frac{\Delta \text{TC}}{\Delta Q} \)
- When labor is the only variable input: \( \text{MC} = \frac{P_L}{\text{MP}_L} \)
- Average cost: \( \text{AC} = \frac{\text{TC}}{Q} \)
- Marginal Product of labor: \( \text{MP}_L = \frac{\Delta Q}{\Delta L} \)
- Average product of labor: \( \text{AP}_L = \frac{Q}{L} \)
- Total cost: \( \text{TC} = \text{fixed costs (FC)} + \text{variable costs (VC)} \)
- When capital and labor are the only inputs: \( \text{TC} = P_LL + P_KK \)
- Average variable cost \( \text{AVC} = \frac{\text{VC}}{Q} \)
A firm is perfectly competitive if it is a price taker. This means:
- It can sell as many units as it wants at a given price
- It faces a horizontal demand curve
- Marginal Revenue = Price

A firm’s short run supply curve is the part of the SRMC curve above the AVC curve
- In the short run, some costs are fixed. This means that they are not relevant to decision making in the short run.
- If a competitive firm does not shut down, it will supply the quantity where P = MC
- If the firm cannot cover its variable costs, it will shut down in the short run
  Stay open if Total revenue > total variable costs
  This means P > Average variable cost

Industry Supply in the short run
- Horizontally sum firms’ individual supply curves
- Adjust for the factor price effect: expanding the industry may bid up the prices of inputs, raising marginal costs
- Elasticity of supply = % change in quantity/% change in price

A firm’s long run supply curve is the part of the LRMC curve above the LRAC curve
- In the long run, all inputs are variable. Their costs are relevant to decisions.
- A firm will exit the industry if it cannot earn a positive economic profit.
  Economic profits include opportunity costs
  A firm will exit even if accounting profits are positive if it can earn higher profits in another activity
  The break even price is the price where profits are zero
- In the long run Total Revenue must exceed Total Cost or the firm will exit
  Or equivalently, P > AC

Industry supply in the long run
- In the long run firms exit if economic profits are < 0
  This reduces supply in these industries, bidding up prices
- In industries where profits are positive, firms enter, driving down prices
- In constant cost industries, the long run supply curve is horizontal
- In increasing cost industries, the long run supply curve has a positive slope
  An increasing cost industry: the break even price rises as more firms enter
  (Why? Entrants are less efficient or input prices rise.)

In equilibrium, firms earn zero (economic) profits
ASSUMING that all firms are identical
Equilibrium in a constant cost industry

1. Increase in fixed costs
   Marginal cost unaffected
   Average cost rises $\rightarrow$ break even price rises
   $\rightarrow$ LR supply shifts back (up)
   Some firms exit
   All remaining firms produce a higher quantity
   Industry quantity falls

2. Increase in Variable costs
   Both MC and AC rise $\rightarrow$ break even price rises
   $\rightarrow$ LR supply shifts back (up)
   Some firms exit
   What happens to individual firm quantity depends on how variable costs change
   If VC changes by same amount for all Q, firm quantity stays the same
   Industry quantity falls

3. Increase in demand
   No change to LR supply
   No change to price
   Entry by some firms $\rightarrow$ industry quantity rises