UNIT 3: AP MICRO REVIEW

AP Microeconomics Unit 3: Production, Cost, and the Perfect Competition Model Study Guide 📝

Unit 3 accounts for a significant portion of the AP Microeconomics exam (22–25%). It focuses on how firms make decisions regarding production, costs, and profit maximization, primarily in the context of a perfectly competitive market structure.

I. Production and Costs

The Production Function (Short-Run)

Concept	Definition	Formula/Key Idea	Graph Analysis
Short Run	A period where at least one input (usually **capital**) is **fixed**, while others (usually **labor**) are **variable**.	Capital (K) is fixed, Labor (L) is variable.	-
Total Product (TP)	The total quantity of output produced.	$TP = Q$	S-shaped curve, initially increases at an increasing rate, then at a decreasing rate.
Marginal Product (MP_L)	The additional output produced when one additional unit of a **variable input** (labor) is employed.	$MP_L = \Delta Q / \Delta L$	Intersects Average Product (AP_L) at AP_L's maximum.
Average Product (AP_L)	The output produced per unit of labor.	$AP_L = Q / L$	Increases when $MP_L > AP_L$, decreases when $MP_L < AP_L$.

Law of Diminishing Marginal Returns	As successive units of a variable input are added to a fixed input, the **marginal product** of the variable input will eventually **decrease**.	This law is the reason MP_L and TP curves eventually flatten/decrease.	Occurs when MP_L begins to fall.

Short-Run Production Costs

Concept	Definition	Formula/Key Idea	Curve Shape
Total Fixed Cost (TFC)	Costs that **do not vary** with the quantity of output produced. (e.g., rent, insurance)	$TFC = \text{Constant}$	Horizontal line.
Total Variable Cost (TVC)	Costs that **do vary** with the quantity of output produced. (e.g., raw materials, hourly wages)	TVC increases as Q increases.	Upward sloping, usually an inverse S-shape.
Total Cost (TC)	The sum of total fixed and total variable costs.	$TC = TFC + TVC$	Parallel to TVC, starts at TFC value.
Marginal Cost (MC)	The **additional cost** of producing one more unit of output.	$MC = \Delta TC / \Delta Q = \Delta TVC / \Delta Q$	**U-shaped**. Due to diminishing marginal returns, MC eventually rises.
Average Fixed Cost (AFC)	Fixed cost per unit of output.	$AFC = TFC / Q$	**Always decreases** as Q increases (spreading the overhead).

Average Variable Cost (AVC)	Variable cost per unit of output.	$AVC = TVC / Q$	**U-shaped**.
Average Total Cost (ATC)	Total cost per unit of output.	$ATC = TC / Q = AFC + AVC$	**U-shaped**. MC intersects ATC and AVC at their **minimum points**.

Long-Run Production Costs

Concept	Definition	Graph Analysis
Long Run	A period where **all inputs are variable**. Firms can change their plant size.	-
Long-Run Average Total Cost (LRATC) Curve	Shows the lowest average cost at which any given output can be produced in the long run. It's an **envelope** of all possible short-run ATC curves.	**U-shaped**.
Economies of Scale	$LRATC$ **decreases** as output increases (downward-sloping portion of $LRATC$). Occurs due to specialization, bulk discounts, etc.	-
Diseconomies of Scale	$LRATC$ **increases** as output increases (upward-sloping portion of $LRATC$). Occurs due to coordination problems, bureaucracy, etc.	-
Constant Returns to Scale	$LRATC$ **remains constant** as output increases (flat portion of $LRATC$).	-

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II. Types of Profit and Maximization

Types of Profit

Concept	Definition	Calculation
Explicit Costs	Direct, out-of-pocket expenses (payments for wages, raw materials, rent).	-
Implicit Costs	The **opportunity cost** of using resources the firm already owns (e.g., owner's time, forgone interest on capital).	-
Accounting Profit	Total Revenue minus Explicit Costs.	$TR - \text{Explicit Costs}$
Economic Profit	Total Revenue minus (Explicit Costs + Implicit Costs).	$TR - \text{Total Costs}$ (including implicit)
Normal Profit (Zero Economic Profit)	The level of accounting profit that covers all explicit and implicit costs. Firms are earning just enough to stay in business and have no incentive to exit.	$\text{Economic Profit} = 0$

Profit Maximization Rule

- A firm maximizes profit or minimizes loss by producing at the quantity where **Marginal Revenue (MR) equals Marginal Cost (MC)**.
    - If $MR > MC$, the firm should produce more.
    - If $MR < MC$, the firm should produce less.
- **Total Revenue (TR):** $TR = P \times Q$
- **Marginal Revenue (MR):** The additional revenue from selling one more unit. $MR = \Delta TR / \Delta Q$
- **Total Profit (π):** $\pi = TR - TC = (P - ATC) \times Q$

III. Perfect Competition

Characteristics of Perfect Competition

1. **Many Buyers and Sellers:** No single buyer or seller can influence the market price.
2. **Identical (Homogeneous) Products:** Products are perfect substitutes (e.g., a bushel of wheat).
3. **Easy Entry and Exit:** No significant barriers to entry or exit in the long run.
4. **Perfect Information:** Buyers and sellers know all relevant information.
5. **Firms are Price Takers:** Individual firms must accept the market price. **$P = MR = AR = D$**. The firm's demand curve is perfectly elastic (horizontal).

Short-Run Decisions

- **Profit Maximizing Output:** Produce where **$MR = MC$**.
- **Profit, Loss, or Break-Even:**
    - **Profit:** If $P > ATC$ at the profit-maximizing output.
    - **Break-Even/Normal Profit:** If $P = ATC$ at the profit-maximizing output.
    - **Loss:** If $P < ATC$ but $P \ge AVC$ at the profit-maximizing output.
- **Shutdown Rule:** A firm should **shut down** (produce $Q=0$) in the short run if the price is less than its **minimum Average Variable Cost ($P < \text{min } AVC$)**. If P is below AVC, the firm isn't even covering its variable costs, so shutting down minimizes losses to just the TFC.
- **Firm's Short-Run Supply Curve:** The portion of the **MC curve above the AVC curve**.

Long-Run Equilibrium in Perfect Competition

- **Adjustment Process:**
    - If firms are making **economic profit** ($P > ATC$), new firms will **enter** the market. This increases market supply ($S \uparrow$), driving the market price **down** ($P \downarrow$) until $P = ATC$.
    - If firms are incurring an **economic loss** ($P < ATC$), existing firms will **exit** the market. This decreases market supply ($S \downarrow$), driving the market price **up** ($P \uparrow$) until $P = ATC$.
- **Long-Run Equilibrium Condition: $P = MR = MC = \text{min } ATC$**.
    - Firms earn **zero economic profit** (a normal profit).
- **Long-Run Supply Curve:** Depends on industry cost structure:
    - **Constant-Cost Industry:** P returns to the original level. LR supply is **perfectly elastic** (horizontal).
    - **Increasing-Cost Industry:** P settles at a higher level. LR supply is **upward sloping**.
    - **Decreasing-Cost Industry:** P settles at a lower level. LR supply is **downward sloping** (rare).

Efficiency in Perfect Competition

- **Productive Efficiency:** Producing goods at the lowest possible cost. Achieved in the **long run** where **$P = \text{min } ATC$**.
- **Allocative Efficiency:** Producing the optimal mix of goods and services society desires. Achieved when the price consumers are willing to pay equals the cost of the last unit produced. Achieved in the **short and long run** where **$P = MC$**.