

AP Microeconomics

Formula Sheet

38 formulas across 6 units · organized by the College Board Course and Exam Description (CED)

How to use this sheet. The AP exam does **not** provide a formula sheet, so every equation below should be memorized. Formulas are grouped by CED unit; each one lists what the variables mean and a quick worked example. "Change in" is written out for clarity.

Unit 1 Basic Economic Concepts

► Opportunity Cost (from a PPC)

Opportunity cost = units of a good given up ÷ units of a good gained

Where: Opportunity cost is the value of the next-best alternative sacrificed. Moving along a production possibilities curve means giving up some of one good to get more of another.

Example: Shifting production to make 3 more boats forces a country to give up 6 cars → opportunity cost of 1 boat = $6 \div 3 = 2$ cars.

► Per-Unit Opportunity Cost & Comparative Advantage

OC of 1 unit of Good X = (quantity of Good Y) ÷ (quantity of Good X)

Where: Compare two producers; the one with the LOWER opportunity cost has the comparative advantage in that good and should specialize in it.

Example: Worker A can make 10 shirts OR 5 hats. Opportunity cost of 1 shirt = $5 \div 10 = 0.5$ hats.

► Marginal Analysis (Optimal Decision Rule)

Optimal quantity occurs where Marginal Benefit (MB) = Marginal Cost (MC)

Where: MB is the added benefit of one more unit; MC is the added cost. Keep doing an activity while $MB > MC$ and stop when $MB = MC$.

Example: If the 4th unit gives $MB = \$8$ and $MC = \$5$, do it; keep going until MB falls to equal MC.

► Marginal Utility

MU = (change in Total Utility) ÷ (change in Quantity consumed)

Where: MU is the extra satisfaction from consuming one more unit. By the law of diminishing marginal utility, MU falls as more is consumed.

Example: Total utility rises from 30 to 38 utils on the 4th slice of pizza → $MU = 8$ utils.

► Utility-Maximizing Rule (Equimarginal Principle)

$MU_x \div P_x = MU_y \div P_y$

Where: A consumer maximizes total utility when the marginal utility per dollar spent is equal across all goods, given the budget.

Example: If $MU_x/P_x = 10/2 = 5$ but $MU_y/P_y = 8/4 = 2$, buy more X until the two ratios are equal.

Unit 2 Supply and Demand

► Price Elasticity of Demand (Ed)

$$Ed = (\% \text{ change in quantity demanded}) \div (\% \text{ change in price})$$

Where: Use the absolute value. $|Ed| > 1$ is elastic, $|Ed| < 1$ is inelastic, $|Ed| = 1$ is unit elastic.

Example: Price rises 10% and quantity demanded falls 20% $\rightarrow Ed = 20 \div 10 = 2$ (elastic).

► Midpoint (Arc) Method

$$\% \text{ change} = (\text{new value} - \text{old value}) \div [(\text{new value} + \text{old value}) \div 2]$$

Where: Used inside elasticity formulas; it gives the same answer whether the value rises or falls.

Example: Quantity goes from 40 to 60 $\rightarrow \% \text{ change} = 20 \div 50 = 40\%$.

► Price Elasticity of Supply (Es)

$$Es = (\% \text{ change in quantity supplied}) \div (\% \text{ change in price})$$

Where: Measures how responsive producers are to a price change; larger when firms have more time and flexibility to adjust output.

Example: Price rises 5% and quantity supplied rises 15% $\rightarrow Es = 3$ (elastic).

► Income Elasticity of Demand

$$\text{Income elasticity} = (\% \text{ change in quantity demanded}) \div (\% \text{ change in income})$$

Where: A positive value means a normal good; a negative value means an inferior good.

Example: Income rises 10% and quantity demanded rises 5% $\rightarrow +0.5$, a normal good (a necessity).

► Cross-Price Elasticity of Demand

$$\text{Cross-price elasticity} = (\% \text{ change in Qd of Good A}) \div (\% \text{ change in price of Good B})$$

Where: A positive value means the goods are substitutes; a negative value means they are complements.

Example: Price of tea rises 10% and quantity of coffee demanded rises 8% $\rightarrow +0.8$ (substitutes).

► Total Revenue & the Total-Revenue Test

$$\text{Total Revenue (TR)} = \text{Price} \times \text{Quantity}$$

Where: When demand is elastic, price and TR move in opposite directions; when inelastic, they move together.

Example: Price \$5 and quantity 100 $\rightarrow TR = 5 \times 100 = \500 .

► Consumer Surplus

$$\text{Consumer Surplus} = \frac{1}{2} \times \text{base} \times \text{height} \text{ (area below demand, above price)}$$

Where: The difference between what buyers are willing to pay and the price they actually pay.

Example: A triangle with base 100 units and height \$4 $\rightarrow CS = \frac{1}{2} \times 100 \times 4 = \200 .

► Producer Surplus

$$\text{Producer Surplus} = \frac{1}{2} \times \text{base} \times \text{height} \text{ (area above supply, below price)}$$

Where: The difference between the price sellers receive and the lowest price they would accept.

Example: A triangle with base 100 units and height \$3 $\rightarrow PS = \frac{1}{2} \times 100 \times 3 = \150 .

► **Total Surplus (Economic Welfare)**

$$\text{Total Surplus} = \text{Consumer Surplus} + \text{Producer Surplus}$$

Where: Total surplus is maximized at the competitive (allocatively efficient) equilibrium.

Example: Consumer surplus \$200 + producer surplus \$150 → total surplus = \$350.

► **Deadweight Loss**

$$\text{Deadweight Loss} = \frac{1}{2} \times (\text{change in quantity}) \times (\text{gap between MB and MC})$$

Where: Lost total surplus when output differs from the efficient quantity — caused by taxes, price controls, market power, or externalities.

Example: A tax cuts quantity by 20 units and opens a \$3 wedge → $DWL = \frac{1}{2} \times 20 \times 3 = \30 .

► **Tax Revenue**

$$\text{Tax Revenue} = \text{per-unit tax} \times \text{quantity sold after the tax}$$

Where: The more inelastic side of the market (buyers or sellers) bears the larger share of the tax burden.

Example: A \$2 per-unit tax with 80 units sold afterward → tax revenue = $2 \times 80 = \$160$.

Unit 3 Production, Cost, and the Perfect Competition Model

► **Marginal Product & Average Product**

$$\text{Marginal Product} = (\text{change in total output}) \div (\text{change in labor}); \text{Average Product} = \text{total output} \div \text{labor}$$

Where: Marginal product eventually falls because of the law of diminishing marginal returns.

Example: The 3rd worker raises output from 20 to 27 units → marginal product of labor = 7.

► **Total Cost**

$$\text{Total Cost (TC)} = \text{Total Fixed Cost (TFC)} + \text{Total Variable Cost (TVC)}$$

Where: Fixed costs do not change with output; variable costs rise as more is produced.

Example: Fixed cost \$100 + variable cost \$250 → total cost = \$350.

► **Average Costs**

$$\text{ATC} = \text{TC} \div Q; \text{AFC} = \text{TFC} \div Q; \text{AVC} = \text{TVC} \div Q; \text{and } \text{ATC} = \text{AFC} + \text{AVC}$$

Where: Average total cost is U-shaped; average fixed cost always falls as output rises.

Example: Total cost \$350 at a quantity of 50 → $ATC = 350 \div 50 = \$7$ per unit.

► **Marginal Cost**

$$\text{Marginal Cost (MC)} = (\text{change in Total Cost}) \div (\text{change in Quantity})$$

Where: The marginal cost curve crosses both ATC and AVC at their minimum points.

Example: Total cost rises from \$350 to \$362 as quantity goes 50 to 51 → $MC = \$12$.

► Revenue Measures

TR = P × Q; Marginal Revenue = (change in TR) ÷ (change in Q); Average Revenue = TR ÷ Q = P

Where: In perfect competition the firm is a price taker, so Price = MR = AR.

Example: A competitive firm sells at \$7 → marginal revenue is \$7 on every unit.

► Profit

Profit = Total Revenue – Total Cost; Profit = (Price – ATC) × Quantity

Where: Profit per unit equals price minus average total cost.

Example: Price \$10, ATC \$7, quantity 50 → profit = (10 – 7) × 50 = \$150.

► Accounting Profit vs. Economic Profit

Accounting Profit = TR – explicit costs; Economic Profit = TR – (explicit + implicit costs)

Where: Implicit costs are the opportunity costs of resources the owner already supplies.

Example: TR \$100k, explicit costs \$60k, implicit costs \$50k → accounting profit +\$40k but economic profit –\$10k.

► Profit-Maximizing Rule

Produce the quantity where MR = MC (with MC rising)

Where: This rule applies to a firm in every market structure, not just perfect competition.

Example: A competitive firm keeps producing until marginal cost rises to equal the \$7 price.

► Shutdown & Break-Even Rules (Short Run)

Break-even: P = minimum ATC. Operate at a loss: AVC < P < ATC. Shut down: P < minimum AVC.

Where: In the short run a firm keeps producing as long as price at least covers average variable cost.

Example: Price \$6 with AVC \$5 and ATC \$8 → keep producing at a loss, since price still covers AVC.

► Long-Run Equilibrium in Perfect Competition

P = MR = MC = minimum ATC, so economic profit = 0

Where: Free entry and exit drive long-run economic profit to zero for competitive firms.

Example: If firms earn profit, new firms enter and price falls until economic profit is zero.

Unit 4 Imperfect Competition

► Monopoly Profit Maximization

Choose quantity where MR = MC, then set price from the demand curve at that quantity

Where: For a monopoly (and any price searcher), Price > Marginal Revenue.

Example: MR = MC at a quantity of 40; the demand curve shows buyers pay \$12 at that quantity → price = \$12.

► **Marginal Revenue for a Price Searcher**

$$\text{Marginal Revenue} = (\text{change in Total Revenue}) \div (\text{change in Quantity})$$

Where: MR lies below the demand curve; for a straight-line demand curve, MR has twice the slope.

Example: To sell one more unit the firm must lower price, so MR is less than the price of that unit.

► **Profit in Imperfect Competition**

$$\text{Profit} = (\text{Price} - \text{ATC}) \times \text{Quantity}$$

Where: The firm earns profit if $P > \text{ATC}$, breaks even if $P = \text{ATC}$, and takes a loss if $P < \text{ATC}$.

Example: Price \$12, ATC \$8, quantity 40 → profit = $(12 - 8) \times 40 = \$160$.

Unit 5 Factor Markets

► **Marginal Revenue Product (MRP)**

$$\text{MRP} = \text{Marginal Product} \times \text{Marginal Revenue} (= \text{MP} \times \text{Price in a competitive product market})$$

Where: MRP is the firm's demand curve for a resource — the extra revenue from hiring one more unit of input.

Example: A worker's marginal product is 5 units and the product sells for \$4 → $\text{MRP} = 5 \times 4 = \20 .

► **Marginal Resource (Factor) Cost (MRC)**

$$\text{MRC} = (\text{change in Total Cost}) \div (\text{change in quantity of the resource})$$

Where: In a perfectly competitive labor market, marginal resource cost equals the wage rate.

Example: Hiring one more worker adds \$15 to total cost → marginal resource cost = \$15.

► **Profit-Maximizing Hiring Rule**

$$\text{Hire the resource quantity where } \text{MRP} = \text{MRC}$$

Where: Employ more of an input while $\text{MRP} > \text{MRC}$ and stop where the two are equal.

Example: Hire workers while $\text{MRP } \$20 > \text{wage } \15 ; stop hiring once MRP falls to \$15.

► **Least-Cost Combination of Resources**

$$\text{MPL} \div (\text{price of labor}) = \text{MPK} \div (\text{price of capital})$$

Where: A firm produces a given output at lowest cost when marginal product per dollar is equal across all inputs.

Example: $\text{MPL}/\text{wage} = 10/5 = 2$ but $\text{MPK}/\text{rent} = 6/2 = 3$ → shift spending toward capital.

► **Profit-Maximizing Combination of Resources**

$$\text{MRPL} \div (\text{price of labor}) = \text{MRPK} \div (\text{price of capital}) = 1$$

Where: Each resource is hired until its marginal revenue product per dollar equals one.

Example: When $\text{MRPL}/\text{wage} = 1$ and $\text{MRPK}/\text{rent} = 1$, the firm's mix of inputs maximizes profit.

Unit 6 Market Failure and the Role of Government

► Socially Optimal (Allocatively Efficient) Output

Efficient quantity occurs where Marginal Social Benefit (MSB) = Marginal Social Cost (MSC)

Where: At this quantity total surplus is maximized and deadweight loss is zero.

Example: The MSB and MSC curves intersect at a quantity of 100 → socially optimal quantity = 100.

► Social Cost & Benefit with Externalities

MSC = Marginal Private Cost + Marginal External Cost; MSB = Marginal Private Benefit + Marginal External Benefit

Where: A negative externality makes $MSC > MPC$ (market overproduces); a positive externality makes $MSB > MPB$ (market underproduces).

Example: Marginal private cost \$5 plus marginal external cost \$3 → marginal social cost = \$8.

► Corrective (Pigouvian) Tax or Subsidy

Per-unit corrective tax = marginal external cost; per-unit subsidy = marginal external benefit

Where: Setting the tax or subsidy equal to the external cost or benefit moves output to the efficient quantity.

Example: Pollution imposes \$3 of external cost per unit → impose a \$3 per-unit tax to correct it.

► Gini Coefficient (Income Inequality)

Gini coefficient = $A \div (A + B)$

Where: A is the area between the line of perfect equality and the Lorenz curve; B is the area under the Lorenz curve. The value ranges from 0 (perfect equality) to 1 (perfect inequality).

Example: A Gini coefficient of 0.45 indicates more income inequality than a coefficient of 0.30.