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01

MICROECONOMICS

Theory of Consumer Behaviour: Cardinal Approach and Ordinal Approach; Consumer Preferences; Nature of the utility function; Marshallian and Hicksian demand functions; Duality Theorem

Difficulty: Easy | Reviewed practice | MCQ · 1 mark

Automobiles are normal goods, and buyers often finance purchases with loans. Holding other determinants fixed in each case, which change shifts the demand curve for automobiles to the left?

A. An increase in the automobiles' own selling price

B. An increase in the interest rate on loans used to buy automobiles

C. An increase in buyers' incomes

D. An increase in automobile producers' input costs

EXPLANATION

Correct answer: B

A demand curve relates the quantity buyers want to purchase to the automobile's own selling price, holding other influences fixed. A change in that selling price moves buyers along the curve. A change in a different determinant can change the quantity demanded at every selling price and therefore shift the curve.

Loan interest is part of the cost of financing a purchase. When that interest rate rises, a financed automobile becomes more expensive to buy even if its quoted selling price is unchanged. Some buyers postpone or reduce purchases. Thus demand is lower at a given selling price: the demand curve shifts left.

- **A:** A higher own selling price changes the quantity demanded along the existing demand curve. It does not, by itself, change the demand schedule relating prices to quantities.
- **C:** For a normal good, higher income raises demand at a given price. The normal-good assumption therefore makes this a rightward demand shift.
- **D:** Higher input costs make production less profitable at a given selling price and shift supply left. Any resulting price increase can reduce quantity demanded along the demand curve, but the production-cost change does not itself shift that curve.

KEYWORDS: demand shift | financing cost | normal good | movement along demand

02

MICROECONOMICS

Welfare Economics: Fundamental Theorems, Social Welfare Function

Difficulty: Easy | Reviewed practice | MCQ · 1 mark

A perfectly competitive market has no externalities, strictly downward-sloping demand and strictly upward-sloping supply meeting at an interior equilibrium. Quantities are allocated efficiently. Which statement about total consumer and producer surplus is NOT CORRECT?

A. Producing less than the competitive output lowers welfare.

B. Producing more than the competitive output lowers welfare.

C. Changing the transfer price at a fixed quantity and allocation only redistributes surplus between consumers and producers.

D. Producing an additional unit lowers welfare when buyers' willingness to pay for that unit exceeds its marginal production cost.

EXPLANATION

Correct answer: D

Total surplus measures the benefit consumers receive minus the resources used in production. For an additional unit, its change is marginal benefit minus marginal cost:

$$\Delta TS = MB - MC.$$

When willingness to pay exceeds marginal production cost, supplying that unit creates a positive net gain. D reverses this welfare comparison.

At the competitive equilibrium, demand and supply meet, so marginal benefit equals marginal cost. Strictly downward demand and upward supply imply positive net gains before this quantity and negative net gains beyond it.

- **A:** Underproduction leaves units with benefit greater than cost unproduced, sacrificing gains from trade. It therefore lowers total surplus.
- **B:** Overproduction adds units whose resource cost exceeds consumers' willingness to pay, so those units reduce welfare.
- **C:** With quantity and allocation fixed, the buyer's payment is the seller's receipt. A higher price reduces consumer surplus by exactly the amount it adds to producer surplus; the transfer cancels in their sum.

KEYWORDS: marginal social surplus | gains from trade | competitive efficiency

03

MICROECONOMICS

Theory of Consumer Behaviour: Cardinal Approach and Ordinal Approach; Consumer Preferences; Nature of the utility function; Marshallian and Hicksian demand functions; Duality Theorem

Difficulty: Medium | Reviewed practice | MCQ · 1 mark

Preferences are defined on the nonnegative two-good consumption set. A thick indifference set contains an open ball around an interior bundle, all of whose bundles are indifferent. Which is the weakest of the following standard conditions that rules out such a set?

A. Local nonsatiation.

B. Strong monotonicity.

C. Lexicographic preferences.

D. Completeness and transitivity alone.

EXPLANATION

Correct answer: A

Local nonsatiation means that, however small a neighbourhood around a consumption bundle is chosen, some feasible bundle in that neighbourhood is strictly preferred. It does not require that the improvement come from increasing a particular good.

Suppose an indifference set contained an open ball around an interior bundle. A sufficiently small neighbourhood would then lie entirely inside that ball. Every bundle in that neighbourhood would be indifferent to the centre, leaving no strictly preferred nearby bundle. This contradicts local nonsatiation, so local nonsatiation rules out such thickness.

- **B:** Strong monotonicity also excludes a thick indifference set: increasing a good slightly, without reducing the other, gives a strictly better nearby bundle. But it restricts the direction of improvement and is stronger than local nonsatiation, so it is not the weakest condition listed.
- **C:** Lexicographic preferences rank bundles first by one good and use the other good to break a tie. A small increase in the priority good produces a better nearby bundle. These preferences also rule out thickness, but their particular ranking rule imposes much more structure than local nonsatiation.
- **D:** Completeness allows every pair of bundles to be compared, and transitivity requires consistency of those comparisons. Neither requires a nearby improvement. A consumer indifferent between all bundles has complete, transitive preferences and a thick indifference set.

The distinction is between consistency of preferences and the absence of a locally flat region of indifference.

KEYWORDS: local nonsatiation | thick indifference set | strong monotonicity | weakest sufficient condition

04 MICROECONOMICS

The Cobweb Model

Difficulty: Easy | Reviewed practice | MCQ · 1 mark

Demand is $Q_t^d = 20 - p_t$ and supply is $Q_t^s = 2 + p_{t-1}$. The market clears each period and starts at its stationary equilibrium. After period-1 supply is set, the demand intercept permanently rises to 26. What are the price increases from the original equilibrium in period 1 and at the new stationary equilibrium, respectively?

A. 3 and 3

B. 3 and 6

C. 6 and 3

D. 6 and 6

EXPLANATION

Correct answer: C

At the original stationary equilibrium, the previous and current prices coincide. Hence $20 - p = 2 + p$, giving an initial price of 9 and quantity of 11.

Supply for period 1 has already been determined using that price of 9. It remains 11 when the demand intercept rises. The new demand curve clears this fixed supply at

$$26 - p_1 = 11 \quad \Rightarrow \quad p_1 = 15.$$

The immediate price increase is therefore $15 - 9 = 6$. For the new stationary equilibrium, supply must instead be evaluated at the same price as current demand:

$$26 - p^* = 2 + p^* \quad \Rightarrow \quad p^* = 12.$$

The stationary price increase is $12 - 9 = 3$, making the ordered pair of increases 6 and 3.

- **A:** It lets supply adjust immediately to the new stationary price, ignoring that period 1 production was fixed before the shock.
- **B:** It reverses the impact and stationary comparisons. The predetermined supply makes the immediate increase larger, not smaller.
- **D:** It treats the first-period price as stationary even though supply planned from a price of 15 would not clear at that same price.

The actual path can fail to converge to a stationary equilibrium. Here subsequent prices alternate between 15 and 9 around 12. The question asks for the new stationary price, so convergence to it is not required.

KEYWORDS: cobweb model | demand shock | predetermined supply | stationary equilibrium

05

MICROECONOMICS

Theory of Consumer Behaviour: Cardinal Approach and Ordinal Approach; Consumer Preferences; Nature of the utility function; Marshallian and Hicksian demand functions; Duality Theorem

Difficulty: Easy | Reviewed practice | MCQ · 1 mark

For $x, y > 0$, which utility representation has a marginal willingness to pay for good x in units of good y that rises with x when y is held fixed?

A. $u = x^2 + y$

B. $u = \ln x + \ln y$

C. $u = x + y$

D. $u = \min\{x, y\}$

EXPLANATION

Correct answer: A

Marginal willingness to pay for an extra unit of x, measured in units of y, is the amount of y the consumer can give up while keeping utility unchanged. Where utility is differentiable and $MU_y > 0$, its magnitude is the marginal rate of substitution

$$\text{MRS}_{xy} = \frac{MU_x}{MU_y} = \frac{\partial u/\partial x}{\partial u/\partial y}.$$

For $u = x^2 + y$, the marginal utilities are $MU_x = 2x$ and $MU_y = 1$, giving $\text{MRS}_{xy} = 2x$. This rises strictly with x. Because the question holds y fixed, the relevant comparison is how this ratio varies across bundles with the same y.

- **B:** For $u = \ln x + \ln y$, marginal utilities are $1/x$ and $1/y$. Their ratio is y/x, which falls as x increases at fixed positive y.
- **C:** For $u = x + y$, both marginal utilities equal 1. The consumer's marginal willingness to exchange the goods stays at 1.
- **D:** For $u = \min\{x, y\}$, utility is limited by the smaller quantity. When $x < y$, extra y has zero marginal utility; when $x > y$, extra x has zero marginal utility; at $x = y$ the function has a kink. There is no smoothly defined marginal-utility ratio that rises with x across the positive domain.

A utility level by itself does not measure willingness to pay. The ratio of marginal utilities expresses the local trade-off between goods.

KEYWORDS: marginal rate of substitution | marginal willingness to pay | increasing marginal utility

06

MICROECONOMICS

Theory of Consumer Behaviour: Cardinal Approach and Ordinal Approach; Consumer Preferences; Nature of the utility function; Marshallian and Hicksian demand functions; Duality Theorem

Difficulty: Easy | Reviewed practice | MCQ · 1 mark

A firm finds that for the product that it produces, its (own) price elasticity of demand is 4. Currently, the firm is selling 2000 units per month at ₹ 5 per unit. If it wishes to increase its sales by 10%, it must

A. lower its price by 4%

B. lower its price by 2%

C. lower its price by 2.5%

D. increase its price by 2%

EXPLANATION

Correct answer: C

Own-price elasticity measures how strongly quantity demanded responds to a change in the good's own price. For an ordinary downward-sloping demand curve, the signed elasticity is negative. The value 4 here is its magnitude: a 1% price reduction produces approximately a 4% increase in sales.

Using the standard percentage-change calculation,

$$\varepsilon = \frac{\%\Delta Q}{\%\Delta P} = -4, \qquad \%\Delta P = \frac{10\%}{-4} = -2.5\%.$$

Thus the price should fall by 2.5%. At the initial price of ₹5, the reduction is ₹0.125, giving a new price of ₹4.875. The intended sales increase is 200 units, from 2,000 to 2,200 per month.

This is a local approximation. The elasticity at the original price does not tell us exactly how demand behaves over the whole price change.

- **A:** A 4% price reduction would give an approximately 16% sales increase under this calculation, exceeding the 10% target.
- **B:** A 2% reduction would raise quantity by approximately 8%, falling short of the desired increase.
- **D:** A price increase moves sales in the opposite direction: a 2% rise would reduce quantity by approximately 8%.

To find the required price change, divide the desired quantity change by the signed elasticity; do not use the elasticity itself as the percentage reduction.

KEYWORDS: own price elasticity | percentage change | price reduction

07

MICROECONOMICS

Theory of Production and Costs: Short-run and Long-run Analysis

Difficulty: Medium | Reviewed practice | MCQ · 1 mark

For the production function $Q = F(K, L) = \sqrt{KL}$ with $P_K = 4$ and $P_L = 2$, find the values of K and L that will minimize the cost of producing 2 units of output.

A. $K = 2\sqrt{3};\ L = 3\sqrt{2}$

B. $K = 2\sqrt{2};\ L = \sqrt{2}$

C. $K = \sqrt{2};\ L = 2\sqrt{2}$

D. $K = 2;\ L = 2$

EXPLANATION

Correct answer: C

Cost minimisation asks for the cheapest input combination that produces the required output, not simply a combination with equal inputs. The firm must minimise $4K + 2L$ subject to $\sqrt{KL} = 2$, or $KL = 4$.

At an interior optimum, the last rupee spent on either input should add the same output. The marginal products are

$$MP_K = \frac{1}{2}\sqrt{\frac{L}{K}}, \qquad MP_L = \frac{1}{2}\sqrt{\frac{K}{L}}.$$

Equating $MP_K/4$ and $MP_L/2$ gives $L = 2K$. Capital is more expensive, so the optimal bundle uses twice as much labour as capital. Substitution into the output constraint yields

$$K(2K) = 4 \quad \Rightarrow \quad K = \sqrt{2}, \qquad L = 2\sqrt{2}.$$

The minimum cost is $4\sqrt{2} + 4\sqrt{2} = 8\sqrt{2}$. One can also substitute $L = 4/K$ directly into cost: $C(K) = 4K + 8/K$ has a positive second derivative for $K > 0$, confirming the minimum.

- **A:** The input product is $6\sqrt{6} > 4$, so this bundle produces more than the required two units. Reducing both inputs can meet the target at lower cost.
- **B:** This produces two units but reverses the cost-minimising input ratio. Its cost is $10\sqrt{2}$, exceeding $8\sqrt{2}$.
- **D:** Equal inputs also produce two units, but cost 12. This exceeds $8\sqrt{2} \approx 11.31$ because the allocation does not account for capital's higher price.

KEYWORDS: cost minimization | marginal product per rupee | conditional factor demand | cobb douglas production

08

MICROECONOMICS

Efficiency Criteria: Pareto-Optimality

Difficulty: Easy | Reviewed practice | MCQ · 1 mark

In a two-person exchange economy with fixed preferences and free disposal, an allocation is Pareto efficient relative to the initial aggregate resources. Keeping that consumption allocation fixed, which change can make it Pareto inefficient?

A. Redistributing initial ownership while leaving aggregate resources unchanged.

B. Adding usable resources to the aggregate endowment.

C. Applying a strictly increasing transformation to one utility representation.

D. Relabelling the two goods without changing preferences or resources.

EXPLANATION

Correct answer: B

Pareto efficiency compares a consumption allocation with all feasible alternatives using the individuals' preference rankings. It therefore depends on the aggregate resources and preferences, rather than on the names of goods or a particular numerical representation of utility.

Adding usable resources can enlarge the feasible set and create a Pareto improvement over the unchanged original allocation. For example, if both people prefer more of a single good, a division exhausting 10 units is efficient when only 10 exist. If an eleventh unit becomes available, someone can receive it without taking anything from the other person. The old division is then inefficient.

- **A:** Changing who initially owns the same resources can change budgets and the market outcome. It does not change which consumption allocations are physically feasible. With preferences and the tested allocation fixed, it cannot create a new Pareto improvement.
- **C:** A strictly increasing transformation preserves every preference comparison, including indifference. It cannot change whether a feasible alternative makes someone better off without harming another.
- **D:** A consistent relabelling changes notation only; the feasible allocations and preferences remain the same economic objects.

KEYWORDS pareto efficiency | feasible set expansion | aggregate resources | ordinal preferences

09

MICROECONOMICS

Theory of Consumer Behaviour: Cardinal Approach and Ordinal Approach; Consumer Preferences; Nature of the utility function; Marshallian and Hicksian demand functions; Duality Theorem

Difficulty: Easy | Reviewed practice | MCQ · 1 mark

The demand function is given as $\log Q = \log A + 0.5 \log P$, where Q is quantity, P is the unit price of the good and A is a positive real number. The own price elasticity of demand is

A. Perfectly elastic

B. Perfectly inelastic

C. Elastic

D. Inelastic

EXPLANATION

Correct answer: D

In a log–log demand equation, the coefficient on log price is the price elasticity. To see why, exponentiate the equation:

$$Q = AP^{0.5}.$$

With positive price and $A > 0$, differentiate and multiply by the price-to-quantity ratio:

$$\frac{dQ}{dP} = 0.5AP^{-0.5}, \qquad \varepsilon = \frac{dQ}{dP}\frac{P}{Q} = 0.5AP^{-0.5}\frac{P}{AP^{0.5}} = 0.5.$$

Elastic versus inelastic demand is classified by the magnitude of the elasticity. Since $|\varepsilon| = 0.5 < 1$, the quantity response is less than proportionate to the price change, making it **inelastic**.

The positive sign is important: this particular equation describes quantity increasing with price. One should not insert a minus sign merely because many familiar demand curves slope downward. The direction of the response and the size of the response are separate features.

- **A:** Perfect elasticity would require an unbounded quantity response at a given price. The coefficient here is the finite number 0.5.
- **B:** Perfect inelasticity means quantity does not respond to price, which would require elasticity zero rather than 0.5.
- **C:** Elastic demand requires an elasticity magnitude greater than one. The magnitude here is only one-half, despite its positive sign.

For a power function, the exponent gives elasticity; the slope itself still depends on price.

KEYWORDS: log log demand | constant price elasticity | inelastic demand | elasticity sign

10

MICROECONOMICS

Theory of Production and Costs: Short-run and Long-run Analysis

Difficulty: Medium | Reviewed practice | MSQ · 1 mark

Consider aggregate production $Y = \alpha K + \beta L$, with $\alpha, \beta > 0$. Which properties are compatible with this technology?

A. Constant returns to scale.

B. Diminishing marginal product of each input when the other is fixed.

C. The possibility of competitive factor prices equal to marginal products.

D. Substitutability between capital and labour.

EXPLANATION

Correct answer: A, C, D

The linear production function adds the separate contributions of capital and labour. Increasing capital by one unit adds α units of output, regardless of the existing input amounts; increasing labour by one unit adds β.

- **A:** Constant returns to scale hold. Multiplying both inputs by $t > 0$ gives $\alpha(tK) + \beta(tL) = t(\alpha K + \beta L)$, so output increases in the same proportion.
- **B:** Marginal products do not diminish. They are $MP_K = \alpha$ and $MP_L = \beta$, both constant. Holding the other input fixed does not make successive units less productive.
- **C:** Competitive factor prices can equal the marginal products. Taking the output price as 1, a capital rental rate α and wage β make total factor payments $\alpha K + \beta L = Y$. The firm earns zero profit at those prices, so marginal-product remuneration is compatible with the technology.
- **D:** The inputs are perfect substitutes in production. Reducing capital by one unit loses α units of output; adding α/β units of labour replaces that loss. On an isoquant, $L = (Y - \alpha K)/\beta$ wherever both inputs remain nonnegative.

KEYWORDS: linear production | constant returns to scale | constant marginal product | factor exhaustion

11

MICROECONOMICS

Theory of Consumer Behaviour: Cardinal Approach and Ordinal Approach; Consumer Preferences; Nature of the utility function; Marshallian and Hicksian demand functions; Duality Theorem

Difficulty: Medium | Reviewed practice | MSQ · 1 mark

A Constant Elasticity of Substitution (CES) utility function is given as:

$U_{CES}(z_1, z_2) = \frac{1}{\delta}(z_1^{\delta} + z_2^{\delta})$

where z_1 and z_2 are two goods, and $\delta \leq 1, \delta \neq 0$.

A Quasi-linear (QL) utility function is given as:

$U_{QL}(z_1, z_2) = 2z_1 + \log z_2$

where z_1 and z_2 are two goods.

Which of the following statements is/are NOT CORRECT?

A. The CES utility function is homothetic but the QL utility function is non-homothetic.

B. For $\delta = 1$, the CES utility function is not strictly convex.

C. The Marginal Rate of Substitution $(MRS_{z_1 z_2})$ for the CES utility function and the QL utility function are dependent on both z_1 and z_2.

D. If $z_1 = z_2$, the Marginal Rate of Substitution $(MRS_{z_1 z_2})$ is 2 for both the CES and the QL utility functions.

EXPLANATION

Correct answer: C, D

The question asks for the statements that are not correct. Start with the marginal rate of substitution, defined here as the marginal utility of the first good divided by that of the second. It measures the willingness to give up the second good for an additional unit of the first while maintaining utility.

For positive quantities, differentiating the CES function gives

$$MU_1 = z_1^{\delta-1}, \qquad MU_2 = z_2^{\delta-1}, \qquad MRS_{12} = \left(\frac{z_1}{z_2}\right)^{\delta-1}.$$

The CES MRS stays the same when both quantities are scaled by the same factor. For any common scale $\lambda > 0$, $U_{CES}(\lambda z) = \lambda^{\delta} U_{CES}(z)$. The multiplier λ^{δ} is positive and preserves the ranking of any two bundles scaled by the same factor. This establishes homothetic preferences. When $\delta = 1$, utility becomes $z_1 + z_2$, a linear perfect-substitutes function.

For the quasi-linear function, using the natural-log convention,

$$MU_1 = 2, \qquad MU_2 = \frac{1}{z_2}, \qquad MRS_{12} = 2z_2.$$

This MRS depends only on the second good. Scaling both quantities changes it, so these preferences are not homothetic.

- **A:** This statement is correct and should not be selected. The CES preferences are homothetic, whereas the quasi-linear preferences here are not.
- **B:** This is also correct. At $\delta = 1$, the CES function is linear, so it is not strictly convex; its indifference curves are straight lines.
- **C:** This is incorrect because the quasi-linear MRS is independent of z_1. At $\delta = 1$ the CES MRS is constant at 1.
- **D:** Equal quantities give a CES MRS of 1, not 2. The quasi-linear MRS is $2z_2$, which equals 2 only at the particular quantity $z_2 = 1$.

KEYWORDS: ces utility | quasilinear utility | homothetic preferences | marginal rate of substitution

12

MICROECONOMICS

Theory of Firm: Market Structures — Competitive and Non-competitive equilibria and their efficiency properties

Difficulty: Easy | Reviewed practice | NAT · 1 mark

Along an unchanged supply curve, a price-taking firm earns revenue 50 at price 10, then revenue 150 at price 15. Using the initial values as percentage-change bases, calculate its finite-change supply elasticity.

_____ (in integer).

Accepted answer: **2**

EXPLANATION

Correct answer: 2

Revenue equals price multiplied by quantity. Recover the two quantities before applying the elasticity formula:

$$q_0 = \frac{50}{10} = 5, \qquad q_1 = \frac{150}{15} = 10.$$

Using the initial quantities and prices as bases, the quantity increase is $(10 - 5)/5 = 1$, or 100 percent. The price increase is $(15 - 10)/10 = 1/2$, or 50 percent. Hence

$$e_s = \frac{1}{1/2} = 2.$$

Enter **2**, a dimensionless elasticity. Revenue increased from 50 to 150, but that 200 percent increase combines price and quantity changes and cannot replace the quantity change in the formula.

The initial-base convention is part of the question. Using midpoint bases would compute a different finite-change measure; neither measure is a point elasticity inferred from an unspecified continuous supply function.

KEYWORDS: supply elasticity | initial base percentage change | revenue quantity conversion

13

MICROECONOMICS

Slutsky equation and Comparative Statics

Difficulty: Easy | Reviewed practice | NAT · 1 mark

A consumer maximises $U(X, Y) = \min\{X, Y\}$ over nonnegative quantities. Initially $p_X = p_Y = 1$ and income is 12. The price of X rises to 2 while p_Y is unchanged. What is the Hicksian substitution effect on X, in units?

_____ (in integer).

Accepted answer: **0**

EXPLANATION

Correct answer: 0

Perfect complements provide utility through matched quantities. Since $U = \min\{X, Y\}$ and both prices are positive, extra units of only one good waste expenditure. Initially the consumer chooses $X = Y$, and the budget gives

$$X + Y = 12 \quad \Longrightarrow \quad X_0 = Y_0 = 6.$$

Initial utility is therefore 6. Hicksian compensation holds that utility fixed after the price change and finds the cheapest bundle that achieves it.

At the new prices, reaching utility 6 requires both $X \geq 6$ and $Y \geq 6$. The least-cost bundle is still $(6, 6)$, now costing $2(6) + 1(6) = 18$. Thus compensated demand for X is 6, exactly its original level. The substitution effect is

$$\text{substitution effect} = X_{\text{compensated}} - X_0 = 6 - 6 = 0.$$

Enter the exact integer 0 units. The increase in the relative price of X cannot induce substitution toward Y while preserving utility, because unmatched extra Y does not replace missing X.

With actual income left at 12, the new ordinary optimum would satisfy $X = Y = 12/(2 + 1) = 4$. The fall of 2 units is the total demand change, not the substitution effect. Here it comes entirely from the loss of purchasing power.

KEYWORDS perfect complements | hicksian substitution effect | fixed proportions

14

MICROECONOMICS

Decision making under uncertainty and risk

Difficulty: Easy | Reviewed practice | NAT · 1 mark

Consider a lottery with three possible outcomes:

Outcomes	Probability	Reward/Win (in INR)
I	0.2	25
II	0.3	50
III	0.5	100

The maximum amount that a risk-neutral person would be willing to pay to play the above lottery is INR _____ (in integer)

Accepted answer: **70**

EXPLANATION

Correct answer: 70

Risk neutrality means the monetary value assigned to a gamble equals its probability-weighted payoff. Larger outcomes matter more only to the extent that their values and probabilities contribute to that average; the uncertainty does not create a separate risk premium.

The three contributions to expected winnings are

$$0.2(25) = 5, \qquad 0.3(50) = 15, \qquad 0.5(100) = 50.$$

Adding them gives

$$E[X] = 5 + 15 + 50 = 70.$$

Suppose the person must pay an entry charge c. The expected net return from playing is $70 - c$. Paying ₹70 leaves an expected net return of zero, making the person indifferent between entering and keeping that amount. Any charge above ₹70 produces a negative expected net return, so it exceeds the maximum willingness to pay.

The answer is therefore **₹70**. It is not the unweighted mean of 25, 50 and 100: the ₹100 outcome has probability one-half, while the two smaller outcomes together have the remaining half. A quick check is to combine those smaller outcomes first: their conditional mean is $(5 + 15)/0.5 = 40$, so the overall lottery is worth $0.5(40) + 0.5(100) = 70$ to a risk-neutral buyer.

KEYWORDS: risk neutrality | expected payoff | lottery valuation

15

MICROECONOMICS

Existence, Uniqueness and Stability of Market Equilibrium: Walrasian and Marshallian Stability Analysis

Difficulty: Medium | Reviewed practice | MCQ · 2 marks

Demand is $P = Q^2 - 12Q + 35$ and supply is $4P - 3Q = 0$. Under continuous-time Marshallian quantity adjustment, which price–quantity equilibrium is locally stable?

A. $(P^*, Q^*) = (3, 4)$

B. $(P^*, Q^*) = (\frac{105}{16}, \frac{70}{8})$

C. $(P^*, Q^*) = (6, 8)$

D. $(P^*, Q^*) = (14, 3)$

EXPLANATION

Correct answer: A

Equilibrium requires the demand price and supply price to agree at the same quantity. Since supply gives $P_S = 3Q/4$, solve

$$Q^2 - 12Q + 35 = \frac{3}{4}Q \quad \Rightarrow \quad 4Q^2 - 51Q + 140 = (Q - 4)(4Q - 35) = 0.$$

There are two intersections: $(P, Q) = (3, 4)$ and $(105/16, 35/4)$. Finding an intersection alone does not establish stability; one must specify how the market responds to a disturbance.

Under Marshallian quantity adjustment, production expands when demand price exceeds supply price and contracts when it falls below supply price. Define the excess demand price

$$E(Q) = P_D(Q) - P_S(Q) = Q^2 - \frac{51}{4}Q + 35.$$

A locally stable intersection has $E'(Q) < 0$: a small increase in quantity then creates pressure to reduce it, while a small decrease creates pressure to expand it. Here $E'(Q) = 2Q - 51/4$, which equals $-19/4$ at $Q = 4$ and $19/4$ at $Q = 35/4$. Only the first intersection is stable under this rule.

- **B:** This is a genuine equilibrium, but its excess demand price increases with quantity. Small disturbances are amplified under quantity adjustment.
- **C:** At $Q = 8$, supply price is 6 but demand price is 3, so the market does not clear.
- **D:** At $Q = 3$, supply price is $9/4$ and demand price is 8. Neither equals the proposed price of 14.

KEYWORDS: marshallian quantity adjustment | market equilibrium | local stability | excess demand price

16

MICROECONOMICS

General Equilibrium Analysis

Difficulty: Medium | Reviewed practice | MCQ · 2 marks

Consider a two good economy where a denotes consumption of apricots and b denotes consumption of bananas. Anu's utility function is $U^{Anu}(a,b) = a + 2b$, and Binu's utility function is $U^{Binu}(a,b) = \min\{a, 2b\}$. Anu initially has no apricots and 12 bananas. Binu initially has 12 apricots and no bananas. In the competitive equilibrium, which one of the following will be Anu's optimal consumption bundle?

A. 6 apricots and 9 bananas

B. 9 apricots and 9 bananas

C. 4 apricots and 10 bananas

D. 0 apricots and 12 bananas

EXPLANATION

Correct answer: A

Anu regards the goods as perfect substitutes, while Binu wants them in the fixed proportion $a = 2b$. Equilibrium must make both consumers choose optimal bundles and make their combined purchases equal the available 12 apricots and 12 bananas.

Normalise the banana price to 1 and denote the apricot price by p. Anu's marginal utility per unit of expenditure is $1/p$ for apricots and 2 for bananas. A market-clearing allocation requires $p = 1/2$, where she is willing to consume both goods.

If $p < 1/2$, Anu spends all her banana-endowment income of 12 on apricots and demands more than the 12 available. If $p > 1/2$, she keeps all 12 bananas, leaving none for Binu, who has positive income and wants some of both goods. Neither case clears both markets.

At $p = 1/2$, Binu's 12 apricots are worth 6. Combining his budget with $a_B = 2b_B$ gives

$$\frac{1}{2}a_B + b_B = 6 \quad \Rightarrow \quad 2b_B = 6, \qquad (a_B, b_B) = (6, 3).$$

Anu receives the remaining $(12 - 6, 12 - 3) = (6, 9)$, which costs 12 and is optimal for her at these prices.

- **B:** Nine apricots and nine bananas cost 13.5 at the equilibrium prices, exceeding Anu's income of 12.
- **C:** Although affordable and optimal for Anu alone, this leaves Binu eight apricots and two bananas. That bundle fails Binu's preferred ratio and gives less utility than his affordable choice of six apricots and three bananas.
- **D:** Keeping all bananas leaves Binu none. His resulting zero utility cannot be optimal when trade allows a positive amount of both goods.

KEYWORDS: exchange equilibrium | perfect substitutes | perfect complements | endowment income

17

MICROECONOMICS

Theory of Consumer Behaviour: Cardinal Approach and Ordinal Approach; Consumer Preferences; Nature of the utility function; Marshallian and Hicksian demand functions; Duality Theorem

Difficulty: Medium | Reviewed practice | MSQ · 2 marks

For nonnegative three-good bundles, define $a \succeq b$ exactly when $a_1 \geq b_1$, $a_1 + a_2 \geq b_1 + b_2$ and $a_1 + a_2 + a_3 \geq b_1 + b_2 + b_3$. Which properties does this relation satisfy?

A. Transitivity.

B. Weak monotonicity: adding nonnegative amounts to a bundle makes it weakly preferred.

C. Closed upper and lower contour sets.

D. Completeness: every pair of bundles is comparable.

EXPLANATION

Correct answer: A, B, C

This relation compares the first good, then the total of the first two goods, then the total of all three goods. For a to be weakly preferred to b, all three comparisons must point in the required direction. A gain in a later good cannot automatically compensate for a loss in an earlier cumulative comparison.

- **A:** Transitivity holds. If $a \succeq b$ and $b \succeq c$, then $a_1 \geq b_1 \geq c_1$. The same chaining works for the first-two-good sums and for the three-good sums. Thus all inequalities required for $a \succeq c$ hold.
- **B:** Weak monotonicity holds. Adding nonnegative amounts to a bundle cannot reduce its first coordinate, its first-two-good sum or its total. The larger bundle therefore satisfies every inequality needed to be weakly preferred to the original.
- **C:** Both contour sets are closed. Fix a reference bundle. Its upper contour set contains bundles whose three cumulative sums meet fixed lower bounds; its lower contour set uses fixed upper bounds. These are non-strict linear inequalities, so their bounds remain satisfied under convergence. Intersecting their solution sets with the nonnegative consumption set preserves closure.
- **D:** Completeness fails. Let $a = (1, 0, 0)$ and $b = (0, 2, 0)$. For $a \succeq b$, the first-two-good comparison would require $1 \geq 2$, which is false. For $b \succeq a$, the first-coordinate comparison would require $0 \geq 1$, also false. Neither bundle is weakly preferred to the other.

KEYWORDS: cumulative dominance | preference transitivity | closed contour sets | incomplete preferences

18

MICROECONOMICS

Homogeneous and Homothetic Utility Functions; Euler's Theorem

Difficulty: Easy | Reviewed practice | MSQ · 2 marks

A consumer has homothetic preferences over strictly positive bundles. Bundles a and b are indifferent, while c is strictly preferred to d. Which conclusions must hold? Here $t > 0$ is a scalar and z is any strictly positive bundle.

A. ta and tb are indifferent for every $t > 0$.

B. $a + z$ and $b + z$ are indifferent for every z.

C. tc is strictly preferred to td for every $t > 0$.

D. Every utility function u representing the preferences satisfies $u(ta) = t\,u(a)$.

EXPLANATION

Correct answer: A, C

Homothetic preferences preserve the ranking of any two bundles when both are multiplied by the same positive number. The property concerns comparisons, including indifference, rather than the numerical values assigned by every possible utility function.

- **A:** True. If $a \sim b$, common multiplication by $t > 0$ preserves the tie, so $ta \sim tb$. This holds for contractions as well as expansions.
- **B:** False. Adding the same bundle is a translation, not proportional scaling. For preferences represented by xy, take $a = (1, 4)$ and $b = (2, 2)$, which both give utility 4. With $z = (1, 1)$, the new utilities are $2 \times 5 = 10$ and $3 \times 3 = 9$. The translated bundles are no longer indifferent, even though the preferences are homothetic.
- **C:** True. A strict ranking is also preserved by common scaling. Were the scaled bundles tied or reversed, scaling them back by $1/t$ would contradict the original strict preference of c over d.
- **D:** False. Other degrees of homogeneity are possible. For example, $u(x, y) = xy$ represents homothetic preferences but satisfies $u(tx, ty) = t^2 u(x, y)$. At $t = 2$, the utility number quadruples.

The common proportional change is the decisive restriction. Homotheticity is compatible with many numerical utility scales and does not assert that a fixed additive gift preserves every comparison.

KEYWORDS: homothetic preferences | preference ordering | proportional scaling | additive translation

19

MICROECONOMICS

The Theory of Revealed Preference: Weak Axiom of Revealed Preference and Strong Axiom of Revealed Preference

Difficulty: Easy | Reviewed practice | MSQ · 2 marks

A consumer has the following two observations, with quantities ordered as (x, y):

Observation	Prices	Income	Chosen bundle
I	$(1, 1)$	4	$(1, 3)$
II	$(2, 1)$	4	$(1.5, 1)$

Which of the following statements is/are correct?

A. The observations violate WARP because the price and chosen quantity of x both rise.

B. The rise in the price and quantity of x does not by itself establish a WARP violation.

C. The bundle chosen in observation I is affordable in observation II.

D. The bundle chosen in observation II is strictly affordable in observation I.

EXPLANATION

Correct answer: B, D

WARP compares which alternatives were feasible when each choice was made. A price increase with a quantity increase does not by itself supply the two affordability comparisons required by this test.

At the first prices, the bundle chosen later costs $1.5 + 1 = 2.5$, below income 4. At the second prices, the original bundle costs $2(1) + 3 = 5$, above income 4. Therefore the original choice reveals a preference over the later bundle, but the later observation does not reverse that comparison: the original bundle is then unavailable.

- **A:** False. The rise in the price and quantity of x is an upward ordinary-demand response. It is not sufficient for WARP failure because the original bundle costs 5 in observation II and cannot be purchased with income 4.
- **B:** True. WARP is a cross-affordability restriction. Without the reverse affordability needed to complete a violation, the positive price-quantity association alone cannot establish inconsistency.
- **C:** False. Buying $(1, 3)$ at prices $(2, 1)$ requires 5, which exceeds the second budget by 1.
- **D:** True. Buying $(1.5, 1)$ at the initial unit prices costs only 2.5, leaving 1.5 of the first income unspent. It is strictly affordable in observation I.

The distinction reflects the income effect of a price change. Ordinary demand holds money income fixed; it does not hold the consumer's purchasing possibilities or utility fixed.

KEYWORDS: weak axiom of revealed preference | cross affordability | ordinary demand | income effect

20

MICROECONOMICS

Theory of Agency costs

Difficulty: Medium | Reviewed practice | MSQ · 2 marks

A worker already hired for one hour chooses nonnegative effort allocations x and y with $x + y = 1$. The worker's utility is $1 + bx - (x^2 + y^2)/2$, where only task X is measured and rewarded at bonus rate $b \geq 0$. The employer's gross value from the work is $V = x + 3y$. Compare $b = 0$ with $b = 0.5$. Which of the following statements is/are correct?

A. At $b = 0.5$, the worker chooses $x = 0.75$ and $y = 0.25$.

B. Increasing the bonus from 0 to 0.5 increases the total effort $x + y$.

C. The employer's gross value falls from 2 to 1.5.

D. Because task Y is not directly rewarded, changing the bonus for X cannot change effort on Y.

EXPLANATION

Correct answer: A, C

The worker's total available effort is fixed, so a stronger incentive for X changes its allocation between tasks. Substitute $y = 1 - x$ into utility:

$$U(x) = 1 + bx - \frac{x^2 + (1-x)^2}{2}, \qquad 0 \leq x \leq 1.$$

The first derivative is $U'(x) = b + 1 - 2x$ and the second derivative is -2. Hence any interior stationary point is the unique maximum. At $b = 0$, the worker chooses $x = y = 0.5$. At $b = 0.5$, the optimum is $x = 0.75, y = 0.25$, also within the feasible interval.

- **A:** True. The positive bonus shifts one quarter of the hour from Y to X, giving the allocation.
- **B:** False. The constraint remains $x + y = 1$. More measured effort means less unmeasured effort, not a longer total working time.
- **C:** True. Gross value is initially $0.5 + 3(0.5) = 2$. After the bonus rises, it is $0.75 + 3(0.25) = 1.5$. The employer values Y more highly, so the reallocation reduces gross value even as measured X performance improves.
- **D:** False. The tasks share a fixed time resource. Rewarding X changes the opportunity cost of spending that resource on Y, reducing Y effort despite its absence from the payment formula.

This is a multitasking agency problem: the rewarded measure does not capture the employer's full objective. The value comparison is before subtracting bonus payments, so the reduction is already present in the work produced.

KEYWORDS: multitask agency | performance measure | incentive distortion | effort allocation

21

MICROECONOMICS

Decision making under uncertainty and risk

Difficulty: Medium | Reviewed practice | NAT · 2 marks

An investor puts fraction $s \in [0, 1]$ of wealth 100 in a risky asset with equiprobable gross returns 2 and 0.5; the remainder earns gross return 1. With no other assets or income, the investor maximizes expected log terminal wealth. The optimal risky investment as an integer percentage of initial wealth is _____.

Accepted answer: **50**

EXPLANATION

Correct answer: 50

The safe part of wealth remains unchanged, while the risky part is multiplied by its state-dependent gross return. Terminal wealth is therefore $100(1 - s) + 200s = 100(1 + s)$ in the high-return state and $100(1 - s) + 50s = 100(1 - s/2)$ in the low-return state.

Both amounts are positive throughout $0 \le s \le 1$. Expected log wealth is

$$\ln 100 + \tfrac{1}{2}\ln(1 + s) + \tfrac{1}{2}\ln(1 - s/2).$$

Combining the logarithms shows that maximizing this expression is equivalent to maximizing

$$(1 + s)(1 - s/2) = 1 + \tfrac{s}{2} - \tfrac{s^2}{2}.$$

This strictly concave quadratic has derivative $1/2 - s$, so its unique maximum on the permitted interval is at $s = 1/2$. The optimal investment is therefore **50 percent** of initial wealth. Terminal wealth is then 150 or 75, and the chosen share lies strictly between the two boundaries.

Maximizing expected wealth alone would put everything into the risky asset, which has mean gross return 1.25. Minimizing wealth variance alone would choose no risky investment. Expected log utility balances the gain in the high state against the loss in the low state, giving the interior share found above.

KEYWORDS: expected utility | portfolio choice | log utility | risky asset share

22

MICROECONOMICS

Non-Cooperative games: Constant sum game, Mixed Strategy & Pure Strategy, Bayesian Nash Equilibrium, SPNE, Perfect Bayesian Equilibria

Difficulty: Medium | Reviewed practice | NAT · 2 marks

Two players simultaneously choose Enter or Out (zero payoff). Entry earns revenue minus own cost: revenue is 6 alone, 2 if both enter. Player 1 privately knows its cost, 0 or 4 with equal probabilities; player 2's cost is 3. This is common knowledge. In a Bayesian Nash equilibrium where player 1's cost-4 type and player 2 both mix, what is player 1's unconditional entry probability?

_____ (rounded off to two decimal places).

Accepted answer: **0.75**

EXPLANATION

Correct answer: 0.75

Player 1's cost-0 type strictly prefers Enter: its payoff is 6 when alone and 2 when both enter, both exceeding zero. The high-cost type may instead mix.

Let r be player 1's unconditional entry probability. Player 2 earns $6-3=3$ from entering alone and $2-3=-1$ from entering when player 1 also enters. Because player 2 mixes in this equilibrium, these expected entry returns must equal the zero payoff from staying out:

$$3(1-r)-r=0 \quad \Rightarrow \quad r=\tfrac{3}{4}.$$

To verify that this is feasible, let z be the entry probability of player 1's cost-4 type. Then $r=(1/2)1+(1/2)z$, so $z=1/2$. Let q be player 2's entry probability. The high-cost type gets 2 when entering alone and -2 when both enter, so indifference requires $2(1-q)-2q=0$, giving $q=1/2$. Both requested randomizations are therefore interior.

The answer is the unconditional probability **0.75**, averaging over player 1's private type. The high-cost type's own entry probability is 0.5; reporting that would omit the low-cost type, which always enters.

KEYWORDS: bayesian nash equilibrium | private cost | entry game | conditional probability

23

MICROECONOMICS

Factor Pricing: Marginal productivity Theory of Distribution in Perfectly Competitive markets; Theory of Employment in Imperfectly Competitive Markets — Monopolistic Exploitation

Difficulty: Medium | Reviewed practice | NAT · 2 marks

In an economy, the effort level of a worker in firm i is denoted by e_i and depends on the wage W_i received by the worker from the firm, and the minimum wage W_0 is set by the government. The effort function is given by

$$e_i(W_i, W_o) = \sqrt{W_i - W_0}$$

If the firm employs N_i unit of workers, then the efficiency unit of labour employed by the firm is $e_i N_i$. The production is based on only the efficiency unit of labour, and the production function is given by

$$F(e_i N_i) = \log_e(e_i N_i)$$

If the minimum wage set by the government is 10, and the profit maximizing firms sell the good in a competitive market at price P by choosing W_i and N_i, then the profit maximizing wage set by the firm will be _____ (rounded off to one decimal place).

Accepted answer: **18.0 to 22.0 (inclusive)**

EXPLANATION

Correct answer: 20.0

The firm pays for workers but obtains effective labour equal to the number of workers multiplied by effort. A higher wage raises both the wage bill and effort, so the cheapest effective labour need not come from paying the legal minimum.

If the firm wants E units of effective labour, it needs $N = E/e(W)$ workers. Its wage bill is therefore $WE/e(W)$. For any chosen E, minimising this bill means minimising the wage cost per effective unit:

$$c(W) = \frac{W}{\sqrt{W - 10}}, \qquad W > 10.$$

The strict inequality is necessary because effort is zero at the minimum wage. Differentiate:

$$c'(W) = \frac{1}{\sqrt{W - 10}} - \frac{W}{2(W - 10)^{3/2}} = \frac{W - 20}{2(W - 10)^{3/2}}.$$

Cost per effective unit falls for $10 < W < 20$ and rises for $W > 20$. Thus the optimal wage is 20, reported as **20.0**.

The same condition can be expressed as $We'(W)/e(W) = 1$: a 1% wage rise must produce exactly a 1% effort rise at the cost-minimising wage. Below that point, the extra effort more than compensates for the wage increase; above it, the wage bill grows faster than effort.

The output price affects the chosen amount of effective labour and employment. It does not change this wage–effort cost trade-off for the effort function.

KEYWORDS: efficiency wage | effort elasticity | cost per effective worker

24

MICROECONOMICS

The Theory of Search

Difficulty: Medium | Reviewed practice | NAT · 2 marks

A risk-neutral searcher draws independent one-time offers of 10, 20 or 30, equiprobably. Each draw costs 2 before its offer is observed. Draws are unlimited, recall is free and there is no discounting. The searcher may stop and take the best available offer, including a current outside offer. Find the stationary reservation reward.

_____ (in integer, monetary units).

Accepted answer: **24**

EXPLANATION

Correct answer: 24

At the reservation reward r, stopping and buying another draw have equal value. If $20 < r < 30$, offers of 10 and 20 do not improve the current best offer, while an offer of 30 improves it by $30 - r$. The expected improvement from one draw is therefore $(30 - r)/3$.

Equating this improvement to the cost of 2 gives

$\frac{30-r}{3} = 2 \quad \Rightarrow \quad r = 24.$

The solution lies in the assumed interval, so the relevant outcomes were identified correctly. At a current reward of 24, another draw gives a best available offer of 24 with probability two thirds and 30 with probability one third. Its expected value after the draw cost is $-2 + (2/3)24 + (1/3)30 = 24$, confirming indifference.

Repeated search is consistent with this rule. Below the threshold, a searcher rejects offers of 10 and 20 and continues until 30 appears. The probability of 30 on each independent draw is one third, so the expected number of draws is 3. The expected reward net of those draw costs is $30 - 3(2) = 24$. Above 24, the available reward exceeds this continuation value and should be accepted.

The reservation reward is thus **24 monetary units**. It is the value of a current outside offer that makes further search just worthwhile.

KEYWORDS: reservation reward | stationary search | search cost | optimal stopping

25

MICROECONOMICS

Non-Cooperative games: Constant sum game, Mixed Strategy & Pure Strategy, Bayesian Nash Equilibrium, SPNE, Perfect Bayesian Equilibria

Difficulty: Hard | Reviewed practice | NAT · 2 marks

There are two firms in an industry producing a homogeneous product. The market demand function is given by $P = 1 - (q_1 + q_2)$, where q_1 and q_2 are the output levels of Firm 1 and Firm 2, respectively.

Firm 1's cost function is common knowledge and equals zero. Firm 2's cost function is private information. Firm 1 believes that Firm 2's cost function is $0.5q_2$ with probability 0.5 and that Firm 2's cost function is $0.25q_2$ with probability 0.5. The firms choose their quantities simultaneously.

Let q_1^* denote the quantity produced by Firm 1 in the Bayesian Nash equilibrium of this game. Then, the value of $24q_1^*$ is _____ (round off to one decimal place)

Accepted answer: **10.5 to 11.5 (inclusive)**

EXPLANATION

Correct answer: 11.0

Firm 2 knows its own cost, so its quantity can differ across its two types. Firm 1 chooses one quantity using the probabilities of those types. Each firm takes the other firm's strategy as given when choosing its quantity.

For a type of firm 2 with marginal cost c, profit is $(1 - q_1 - q_2 - c)q_2$. Its best response is

$$q_2(c) = \frac{1 - c - q_1}{2},$$

when this expression is positive, and zero otherwise. Firm 1 cannot optimally produce more than $1/2$ because Firm 2's output is nonnegative. At $q_1 = 1/2$, the low-cost type produces $1/8$, so Firm 1's best response is strictly below $1/2$. Both Firm 2 responses are therefore positive at any equilibrium. Thus the high-cost and low-cost quantities are $1/4 - q_1/2$ and $3/8 - q_1/2$. Their equally weighted expectation is

$$E[q_2] = \frac{1}{2}\left(\frac{1}{4} - \frac{q_1}{2}\right) + \frac{1}{2}\left(\frac{3}{8} - \frac{q_1}{2}\right) = \frac{5}{16} - \frac{q_1}{2}.$$

This expectation is at most $5/16$, so Firm 1 also has a positive best response. Its condition is $q_1 = (1 - E[q_2])/2$. Substituting the type responses into this equilibrium condition gives

$$2q_1 = 1 - \frac{5}{16} + \frac{q_1}{2} \quad \Rightarrow \quad q_1^* = \frac{11}{24}.$$

Both type quantities are positive: $q_2(0.5) = 1/48$ and $q_2(0.25) = 7/48$. The interior response formulas are therefore valid.

Finally, $24q_1^* = 11$, reported to one decimal place as **11.0**. The type responses are substituted after deriving firm 1's simultaneous-move best response; treating them as responses to an observed commitment by firm 1 would instead introduce a leadership game.

KEYWORDS: bayesian nash equilibrium | cournot competition | private cost information | type contingent best response

26

MICROECONOMICS

Theory of Production and Costs: Short-run and Long-run Analysis

Difficulty: Medium | Reviewed practice | NAT · 2 marks

Outputs and costs per unit of each process:

Process	X output	Y output	Cost
A	2	1	3
B	1	2	3

Process amounts are nonnegative and divisible; surplus output may be discarded free. Find minimum cost to supply at least 8 units of X and 7 of Y.

_____ (in integer, monetary units).

Accepted answer: **15**

EXPLANATION

Correct answer: 15

Let a and b be the amounts of processes A and B used. The two output requirements give

$$2a + b \geq 8, \qquad a + 2b \geq 7, \qquad a, b \geq 0.$$

Total cost is $3a + 3b$. Adding the output inequalities shows that every feasible production plan must satisfy

$$3a + 3b \geq 15.$$

Thus 15 is a lower bound on cost. To establish that it is the minimum, a feasible plan must attain it. Choose $a = 3$ and $b = 2$. Then output is $2(3) + 2 = 8$ units of X and $3 + 2(2) = 7$ units of Y. Both requirements are met exactly, and cost is $3(3) + 3(2) = 15$.

Consequently the lower bound is attainable and the minimum cost is 15 monetary units. Allowing free disposal does not lower the bound: any plan with surplus output must still satisfy the same two inequalities. Using only one process would overlook the saving available from combining their different output proportions.

KEYWORDS joint production | cost minimization | activity analysis

27

MICROECONOMICS

Structure-Conduct-Performance Paradigm

Difficulty: Easy | Reviewed practice | NAT · 2 marks

Consider an industry with six firms. An analyst collated the data for this industry as given below. The Herfindahl-Hirschman Index (HHI) for this industry will be _____ (in integer).

Firm	Market Share
F1	30%
F2	20%
F3	15%
F4	15%
F5	10%
F6	10%

Accepted answer: **1950**

EXPLANATION

Correct answer: 1950

The Herfindahl–Hirschman Index measures market concentration by summing the squared market shares of all firms. Squaring gives a larger weight to a given share held by a large firm than to the same total share divided among smaller firms.

Using shares expressed as percentages, the formula is

$$HHI = \sum_{i=1}^{6} s_i^2.$$

The listed shares sum to 100%, so they cover the whole industry. Their squared contributions are

$$30^2 = 900, \quad 20^2 = 400, \quad 15^2 = 225, \quad 15^2 = 225, \quad 10^2 = 100, \quad 10^2 = 100.$$

Therefore

$$HHI = 900 + 400 + 225 + 225 + 100 + 100 = 1950.$$

The requested integer is **1950**. On this percentage-share scale, a single firm with the entire market would have an index of $100^2 = 10000$. If shares were instead entered as fractions, the same concentration would be reported as 0.195; the numerical difference is only a scaling convention.

As a check, six equal-sized firms would have $HHI = 10000/6 \approx 1666.67$. The unequal shares here produce a higher value, as expected. Simply adding the shares would always give 100 and would reveal nothing about whether the market was evenly distributed or dominated by a few firms.

KEYWORDS: herfindahl hirschman index | market concentration | squared market shares

28

MICROECONOMICS

Non-Cooperative games: Constant sum game, Mixed Strategy & Pure Strategy, Bayesian Nash Equilibrium, SPNE, Perfect Bayesian Equilibria

Difficulty: Medium | Reviewed practice | NAT · 2 marks

Payoffs sum to 12. The row player's payoffs are:

	Left	Right
Top	10	-2
Bottom	-2	10

The column player chooses secretly, possibly randomly. Its action is independently revealed with probability $1/4$ before the row player acts; otherwise no information arrives. Both maximize expected payoffs. Find the row player's equilibrium expected payoff.

_____ (rounded off to one decimal place).

Accepted answer: **5.5**

EXPLANATION

Correct answer: 5.5

Since the sum of payoffs is always 12, maximizing the column player's payoff is equivalent to minimizing the row player's payoff. When the column action is revealed, the row player matches it and obtains 10.

For the unrevealed branch, let q be the probability of Left. Top gives expected payoff $10q - 2(1-q) = 12q - 2$, while Bottom gives $-2q + 10(1-q) = 10 - 12q$. The row player chooses whichever is larger. The column player minimizes that maximum by making the two values equal:

$$12q - 2 = 10 - 12q \quad \Rightarrow \quad q = \tfrac{1}{2}.$$

At this mixture, either row action gives 4 when no information arrives. The row player can also guarantee 4 on that branch by mixing equally, making the column player indifferent between its actions. Combined with matching every revealed action, these strategies support equilibrium.

The row player's overall expected payoff is consequently

$$\tfrac{1}{4}(10) + \tfrac{3}{4}(4) = 2.5 + 3 = 5.5.$$

The information probability is independent of the column action, so receiving no information does not change its equilibrium probability of Left. Using 4 for every branch would ignore the revealed action; using 10 for every branch would treat partial observation as complete observation.

KEYWORDS: constant sum game | value of information | mixed strategy | partial observation

29

MICROECONOMICS

Theory of Consumer Behaviour: Cardinal Approach and Ordinal Approach; Consumer Preferences; Nature of the utility function; Marshallian and Hicksian demand functions; Duality Theorem

Difficulty: Easy | Reviewed practice | NAT · 2 marks

Mr. Sharma's consumption preference for tea (denoted by x) and sugar (denoted by y) is given by the utility function

$$U(x, y) = \min\{x, 2y\}$$

The price per unit of tea is 10 and the price per unit of sugar is 10. Mr. Sharma's total income is 900.

The optimum quantity of tea purchased by Mr. Sharma equals _____ (in integer).

Accepted answer: **60**

EXPLANATION

Correct answer: 60

The minimum in the utility function makes tea and sugar perfect complements: utility is limited by whichever of x and $2y$ is smaller. Extra tea alone adds no utility when sugar is the limiting component, and extra sugar alone adds no utility when tea is limiting.

At an efficient consumption bundle the two components are balanced:

$$x = 2y.$$

Thus the preferred physical combination is two units of tea for one unit of sugar. This ratio comes from equating the expressions inside the minimum; it is not $x = y$.

Because the two prices are both 10 and buying more complete combinations raises utility, the entire income is spent:

$$10x + 10y = 900.$$

Substitute $x = 2y$ into the budget equation:

$$20y + 10y = 900 \quad \Rightarrow \quad y = 30, \qquad x = 60.$$

Mr. Sharma therefore purchases **60 units of tea** and 30 units of sugar. The bundle costs $10(60) + 10(30) = 900$ and gives utility $\min\{60, 60\} = 60$.

A useful check is to price one complete consumption combination: two tea units and one sugar unit cost 30. Income 900 buys 30 such combinations, each containing two tea units. Equal prices do not imply equal quantities when the goods must be combined in a fixed ratio.

KEYWORDS: perfect complements | leontief utility | fixed consumption ratio | budget constraint

30

MICROECONOMICS

Non-Cooperative games: Constant sum game, Mixed Strategy & Pure Strategy, Bayesian Nash Equilibrium, SPNE, Perfect Bayesian Equilibria

Difficulty: Medium | Reviewed practice | NAT · 2 marks

Types H and L are equiprobable and privately known to the sender. The sender chooses M or N. N ends play; after M, the receiver chooses Accept or Reject. Payoffs are ordered (sender, receiver):

Type	N	M, Accept	M, Reject
H	$(0, 0)$	$(2, 1)$	$(0, 0)$
L	$(1, 0)$	$(2, -2)$	$(0, 0)$

In a perfect Bayesian equilibrium, H always sends M, L mixes, and the receiver mixes after M. Find the unconditional probability of Accept.

_____ (rounded off to three decimal places).

Accepted answer: **0.375**

EXPLANATION

Correct answer: 0.375

Let x be the probability that type L sends M, and let a be the receiver's probability of Accept after M. Since H always sends M, Bayes' rule gives the posterior

$$\mu = \Pr(H \mid M) = \frac{1/2}{1/2+(1/2)x} = \frac{1}{1+x}.$$

The receiver mixes only if Accept and Reject give the same expected payoff. Reject gives zero, while Accept gives $\mu - 2(1-\mu) = 3\mu - 2$. Therefore $\mu = 2/3$, which implies $x = 1/2$.

Type L also mixes. Choosing N gives L a payoff of 1, while choosing M gives expected payoff $2a$. Indifference requires $2a = 1$, so $a = 1/2$. Type H then gets expected payoff 1 from M rather than zero from N, confirming that always choosing M is optimal for H.

Message M occurs with unconditional probability $(1/2)1 + (1/2)(1/2) = 3/4$. Acceptance can occur only after M, giving

$$\Pr(\text{Accept}) = \Pr(M)\Pr(\text{Accept} \mid M) = \tfrac{3}{4} \cdot \tfrac{1}{2} = \tfrac{3}{8} = 0.375.$$

The receiver's conditional acceptance probability is 0.5, but the question asks for the probability before the sender's type and message are known. Multiplying by the probability of reaching M accounts for that distinction.

KEYWORDS: perfect bayesian equilibrium | semi separating equilibrium | bayes rule | mixed strategy

Coverage at a glance.

30 questions · 90 practice minutes · Wrong MCQs lose one-third of their marks. MSQs and NATs have no negative marking; MSQs need all correct options and no others.

Subject	Questions
Microeconomics	30

Answer key

1 · B	2 · D	3 · A	4 · C	5 · A	6 · C	7 · C	8 · B	9 · D	10 · A, C, D
11 · C, D	12 · 2	13 · 0	14 · 70	15 · A	16 · A	17 · A, B, C	18 · A, C	19 · B, D	20 · A, C
21 · 50	22 · 0.75	23 · 18.0 to 22.0 (inclusive)	24 · 24	25 · 10.5 to 11.5 (inclusive)	26 · 15	27 · 1950	28 · 5.5	29 · 60	30 · 0.375

Selected from the reviewed GATE Economics question bank.

Topic breakdown.

Question counts in this practice resource, not predicted exam weightages.

Theory of Consumer Behaviour: Cardinal Approach and Ordinal Approach; Consumer Preferences; Nature of the utility function; Marshallian and Hicksian demand functions; Duality Theorem	8
The Cobweb Model	1
Efficiency Criteria: Pareto-Optimality	1
Slutsky equation and Comparative Statics	1
Existence, Uniqueness and Stability of Market Equilibrium: Walrasian and Marshallian Stability Analysis	1
Homogeneous and Homothetic Utility Functions; Euler's Theorem	1
Theory of Agency costs	1
Factor Pricing: Marginal productivity Theory of Distribution in Perfectly Competitive markets; Theory of Employment in Imperfectly Competitive Markets — Monopolistic Exploitation	1
Structure-Conduct-Performance Paradigm	1
Welfare Economics: Fundamental Theorems, Social Welfare Function	1
Theory of Production and Costs: Short-run and Long-run Analysis	3
Theory of Firm: Market Structures — Competitive and Non-competitive equilibria and their efficiency properties	1
Decision making under uncertainty and risk	2
General Equilibrium Analysis	1
The Theory of Revealed Preference: Weak Axiom of Revealed Preference and Strong Axiom of Revealed Preference	1
Non-Cooperative games: Constant sum game, Mixed Strategy & Pure Strategy, Bayesian Nash Equilibrium, SPNE, Perfect Bayesian Equilibria	4
The Theory of Search	1

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