IIT JAM 2022 Economics (EN) Question Paper with Solutions

Time Allowed :3 Hours	**Maximum Marks :**100	**Total questions :**60

General Instructions

General Instructions:

i) All questions are compulsory. Marks allotted to each question are indicated in the margin.

ii) Answers must be precise and to the point.

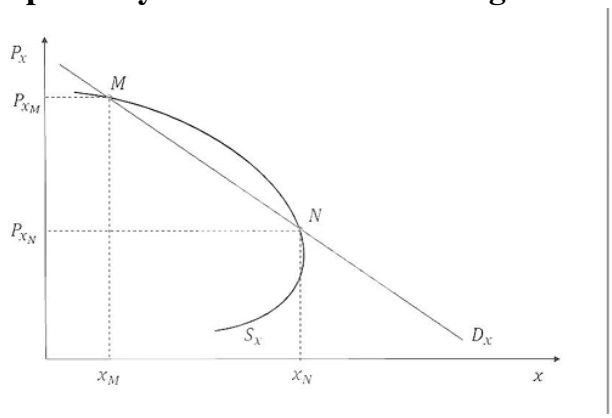
iii) In numerical questions, all steps of calculation should be shown clearly.

iv) Use of non-programmable scientific calculators is permitted.

v) Wherever necessary, write balanced chemical equations with proper symbols and units.

vi) Rough work should be done only in the space provided in the question paper.

1. When the supply curve S_x is backward bending and the demand curve D_x is downward sloping as shown in the figure, there are two equilibria M and N, respectively. Which of the following statements is CORRECT?



(A) Only M is stable equilibrium

(B) Only N is stable equilibrium

(C) Both M and N are stable equilibria

(D) Both M and N are unstable equilibria

Correct Answer: (A) Only M is stable equilibrium

Solution:

Step 1: Understanding the curves.

In this case, the supply curve S_x is backward bending, meaning it initially rises but then begins to slope downward after reaching a certain point. The demand curve D_x is downward sloping. Equilibrium points are where the supply and demand curves intersect.

Step 2: Analyzing stability.

- M is the stable equilibrium because small changes around this point cause the system to return to equilibrium. At this point, the forces of supply and demand are in balance. - N represents an unstable equilibrium, where small deviations will lead the system further away from the equilibrium point.

Step 3: Conclusion.

The correct answer is **(A) Only M is stable equilibrium**, as the equilibrium at M is stable, and any deviation would bring the system back to this point.

Quick Tip

In economics, when dealing with backward-bending supply curves, the stability of equilibria can depend on the nature of the curves. A stable equilibrium results in self-correction, whereas an unstable equilibrium amplifies deviations.

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2. Which of the following deficits indicates the true current fiscal position of the Indian Economy?

(A) Revenue Deficit

(B) Capital Deficit

(C) Current Account Deficit

(D) Primary Deficit

Correct Answer: (C) Current Account Deficit

Solution:

Step 1: Understanding the deficits.

Revenue deficit refers to the shortfall between revenue receipts and revenue expenditure. Capital deficit represents the difference between capital receipts and capital expenditure. Primary deficit is the difference between fiscal deficit and interest payments. The current account deficit refers to the difference between the country's imports of goods, services, and transfers and its exports.

Step 2: Identifying the correct deficit.

In terms of measuring the fiscal position, the current account deficit provides a true picture of the country's financial status with respect to its international trade balance. It includes all the goods, services, and transfers.

Step 3: Conclusion.

The correct answer is **(C) Current Account Deficit**, as it accurately represents the true fiscal position of an economy in relation to its imports and exports.

Quick Tip

To assess the true fiscal position of an economy, it is important to look at the current account deficit, as it accounts for the balance of international trade.

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3. Which of the following CORRECTLY defines the relationship between the variances of sample means for simple random samples drawn with and without replacement from a normal population?

(A) $\frac{\sigma^2}{n} > \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$
(B) $\frac{\sigma^2}{n} \leq \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$
(C) $\frac{\sigma^2}{n} < \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$
(D) $\frac{\sigma^2}{n} = \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$

Correct Answer: (B) $\frac{\sigma^2}{n} \leq \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$

Solution:

Step 1: Understanding the concept.

The variance of the sample mean depends on whether the sampling is done with or without replacement. When sampling without replacement, the variance is adjusted using the finite population correction factor $\frac{N-n}{N-1}$, where N is the population size and n is the sample size.

Step 2: Analyzing the options.

- (A) $\frac{\sigma^2}{n} > \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$: Incorrect, as the finite population correction factor reduces the variance. - (B) $\frac{\sigma^2}{n} \leq \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$: Correct — the variance of the sample mean is smaller when sampling without replacement due to the finite population correction. - (C) $\frac{\sigma^2}{n} < \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$: Incorrect, as the inequality should not be reversed. - (D) $\frac{\sigma^2}{n} = \frac{\sigma^2}{n}\left(\frac{N-n}{N-1}\right)$: Incorrect, as equality doesn't hold in most cases unless $N = n$.

Step 3: Conclusion.

The correct answer is **(B)**, as the finite population correction factor reduces the variance when sampling without replacement.

Quick Tip

The variance of the sample mean is reduced when sampling without replacement due to the finite population correction factor.

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4. Suppose that one million unemployed persons in a country are receiving Rs. 6000 per month per person as an unemployment allowance. If the government, instead of paying unemployment allowance, hires all of them at the same amount (Rs. 6000 per month per person) and engages them in digging the pits and filling the same pits. What will be the effect on GDP?

(A) No effect on GDP

(B) GDP will rise.

(C) GDP will fall.

(D) The effect on GDP will be uncertain.

Correct Answer: (B) GDP will rise.

Solution:

Step 1: Understanding the question.

The government is spending the same amount (Rs. 6000 per person) on the unemployed persons but in a different way: instead of paying unemployment benefits, they are hired for labor. The question is asking about the effect of this action on the country's GDP.

Step 2: Analyzing the effect on GDP.

When the government hires workers to dig and fill pits, it is contributing to the production of goods and services, which counts towards GDP. In contrast, paying unemployment allowances doesn't directly contribute to the production of goods and services but may have an indirect effect by increasing consumption. However, the direct increase in productive activity (digging and filling pits) will lead to an increase in GDP.

Step 3: Conclusion.

The correct answer is **(B) GDP will rise**, as the shift from providing unemployment benefits to direct employment increases the total output of goods and services, thereby raising GDP.

Quick Tip

In national accounts, government spending on labor that contributes directly to production is counted as part of GDP.

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5. Which amendments to the constitution have provided constitutional status to the rural and urban local bodies in India?

(A) 80^{th} and 81^{st} Amendments

(B) 73^{rd} and 74^{th} Amendments

(C) 92^{nd} and 93^{rd} Amendments

(D) 71^{st} and 72^{nd} Amendments

Correct Answer: (B) 73^{rd} and 74^{th} Amendments

Solution:

Step 1: Understanding the question.

The 73^{rd} and 74^{th} Amendments to the Indian Constitution, enacted in 1992, provide constitutional status to the rural and urban local bodies respectively. These amendments introduced Part IX and Part IX-A in the Constitution, thus strengthening decentralized governance.

Step 2: Conclusion.

The correct answer is **(B) 73^{rd} and 74^{th} Amendments**, which granted constitutional status to local self-governments.

Quick Tip

The 73^{rd} and 74^{th} Amendments are significant milestones in decentralization and local governance in India.

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6. Let W be a subspace of a vector space $\mathbb{R}^3$. Then, which of the following sets of vectors forms a basis of W?

(A) $(1, 2, 1)$ and $(1, -2, 5)$

(B) $(1, 3, 2), (1, -1, 0), (4, -1, 0)$ and $(3, 1, -3)$

(C) $(1, 1, 1), (1, 2, 3)$ and $(2, -1, 1)$

(D) $(1, -2, 1), (2, 1, -1)$ and $(7, -4, 1)$

Correct Answer: (A) $(1, 2, 1)$ and $(1, -2, 5)$

Solution:

Step 1: Definition of basis.

A set of vectors forms a basis for a subspace if the vectors are linearly independent and span the subspace. The dimension of the subspace W is the number of vectors in any basis of W.

Step 2: Analyzing the options.

- (A) The vectors $(1, 2, 1)$ and $(1, -2, 5)$ are linearly independent and span a two-dimensional subspace, making them a valid basis. - (B) The set in (B) does not form a basis as it contains more vectors than necessary for a subspace of dimension 2. - (C) The set in (C) is not linearly independent, so it does not form a basis. - (D) The set in (D) contains linearly dependent vectors and does not form a basis.

Step 3: Conclusion.

The correct answer is **(A)**. The two vectors are linearly independent and form a basis.

Quick Tip

When checking for a basis, ensure that the vectors are linearly independent and that the number of vectors matches the dimension of the subspace.

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7. From the following, who first examined the close negative relationship between the unemployment rate and the output ratio?

(A) Alban W. Phillips

(B) James Tobin

(C) Arthur M. Okun

(D) Robert M. Solow

Correct Answer: (C) Arthur M. Okun

Solution:

Step 1: Understanding the relationship.

Arthur M. Okun, an American economist, is known for his work on the relationship between unemployment and GDP. Okun's Law explains the negative relationship between the unemployment rate and the output ratio, where a 1

Step 2: Conclusion.

The correct answer is **(C) Arthur M. Okun**, who first analyzed the relationship between unemployment and economic output.

Quick Tip

Okun's Law is a fundamental principle in macroeconomics, relating unemployment and output. It helps understand the potential impact of changes in the unemployment rate on economic output.

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8. In hypothesis testing, which of the following defines the size of power of the test?

(A) $1-$ (Probability of accepting null hypothesis when it is true)

(B) $1-$ (Probability of rejecting null hypothesis when it is true)

(C) $1-$ (Probability of accepting null hypothesis when it is false)

(D) $1+$ (Probability of rejecting null hypothesis when it is not true)

Correct Answer: (C) $1-$ (Probability of accepting null hypothesis when it is false)

Solution:

Step 1: Understanding hypothesis testing.

In hypothesis testing, the power of a test is the probability that it correctly rejects a false null hypothesis. It is related to the probability of avoiding a Type II error (accepting a false null hypothesis).

Step 2: Analyzing the options.

- (A) Incorrect. This is the complement of the probability of a Type I error (rejecting a true null hypothesis). - (B) Incorrect. This is related to the definition of Type I error, not the power. - (C) Correct. The power of the test is $1-$ (Probability of accepting the null hypothesis when it is false). - (D) Incorrect. This describes neither power nor error types.

Step 3: Conclusion.

The correct answer is **(C)**. The power of a test is the probability of correctly rejecting a false null hypothesis.

Quick Tip

The power of a test is crucial in determining its ability to detect a true effect when one exists. A higher power reduces the likelihood of Type II errors.

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9. Which of the following is NOT a postulate of the Classical Model of full-employment equilibrium?

(A) Wage-Price flexibility

(B) Perfect information about the market

(C) Consumption and saving functions depend on income.

(D) The price level moves proportionately with the quantity of money.

Correct Answer: (D) The price level moves proportionately with the quantity of money.

Solution:

Step 1: Understanding the Classical Model of Full-Employment Equilibrium.

The Classical Model assumes that the economy will always return to a state of full employment due to the flexibility of wages and prices, and the role of money is primarily to determine the price level. The model focuses on the long run where all markets clear.

Step 2: Analyzing the options.

(A) Wage-Price flexibility: This is a key assumption of the Classical Model, which suggests that wages and prices are flexible and adjust to maintain equilibrium.

(B) Perfect information about the market: The Classical Model assumes that there is

perfect information in the market, meaning all participants make decisions based on full knowledge.

(C) Consumption and saving functions depend on income: This is another key feature of the Classical Model, where both consumption and saving are considered functions of income.

(D) The price level moves proportionately with the quantity of money: This is incorrect for the Classical Model in the context of full-employment equilibrium, as it does not suggest a direct proportionality between the price level and money supply. The Classical view focuses more on the real factors of the economy, such as labor and capital.

Step 3: Conclusion.

The correct answer is **(D) The price level moves proportionately with the quantity of money**, as this is not a postulate of the Classical Model of full-employment equilibrium.

Quick Tip

In economic models, always examine the core assumptions, such as market flexibility and the role of money, to differentiate between various schools of thought.

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10. A long-run cost function for a product exhibits economies of scale if

(A) average cost of production increases when the output increases.

(B) the production function has decreasing returns to scale.

(C) average cost of production falls as the output increases.

(D) average cost of production remains constant as the output increases.

Correct Answer: (C) average cost of production falls as the output increases.

Solution:

Step 1: Understanding Economies of Scale.

Economies of scale occur when the long-run average cost of production decreases as the scale of output increases. This means that as firms expand their production, they can spread fixed costs over more units, leading to lower per-unit costs.

Step 2: Analyzing the options.

(A) average cost of production increases when the output increases: This describes diseconomies of scale, not economies of scale. It refers to the point where increasing output leads to higher per-unit costs.

(B) the production function has decreasing returns to scale: Decreasing returns to scale refer to a situation where increasing the inputs results in proportionally smaller increases in output. This is the opposite of economies of scale.

(C) average cost of production falls as the output increases: This is the correct definition of economies of scale. As output increases, average costs decrease due to efficiencies gained from larger production.

(D) average cost of production remains constant as the output increases: This indicates constant returns to scale, where increasing output does not affect per-unit costs. It is not the same as economies of scale.

Step 3: Conclusion.

The correct answer is **(C) average cost of production falls as the output increases**, which is the definition of economies of scale.

Quick Tip

Remember that economies of scale refer to the cost advantages that firms obtain due to their scale of operation, leading to a reduction in per-unit costs as output increases.

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11. Let $x^2 + 3y^2 = 4$ for all $x, y \in \mathbb{R}$, $y' = \frac{dy}{dx}$, and $y'' = \frac{d^2y}{dx^2}$. Then

(A) $x^2 + yy' + (y')^2 = 0$

(B) $2x + y' + 2(y')^2 = 0$

(C) $x + (y')^2 = 0$

(D) $x + yy' + (y')^2 = 0$

Correct Answer: (D) $x + yy' + (y')^2 = 0$

Solution:

Step 1: Differentiating the equation.

The given equation is $x^2 + 3y^2 = 4$. We differentiate both sides with respect to x, using implicit differentiation:

$$\frac{d}{dx}(x^2) + \frac{d}{dx}(3y^2) = \frac{d}{dx}(4)$$

$$2x + 6y \cdot y' = 0$$

This simplifies to:

$$x + 3y \cdot y' = 0 \quad \text{(Equation 1)}$$

Step 2: Differentiating again.

Now, differentiate Equation 1 with respect to x again:

$$\frac{d}{dx}(x + 3yy') = 0$$

$$1 + 3(y' + yy'') = 0$$

Simplifying this:

$$1 + 3y' + 3yy'' = 0$$

This matches the form of option (D).

Step 3: Conclusion.

The correct answer is **(D)** $x + yy' + (y')^2 = 0$.

Quick Tip

When differentiating implicitly, keep track of both y and y' and apply the chain rule carefully.

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12. Match List I with List II and choose the CORRECT option.

List I	List II
a. Second Five Year Plan (1956-61)	i. Towards Faster and More Inclusive Growth
b. Fourth Five Year Plan (1969-74)	ii. Removal of Poverty and Attainment of Self-reliance
c. Fifth Five Year Plan (1974-79)	iii. Rapid Industrialization - Heavy and Basic Industries
d. Eleventh Five Year Plan (2007-12)	iv. Family Planning Programmes

(A) (a, ii), (b, i), (c, iv), (d, iii)

(B) (a, iii), (b, iv), (c, i), (d, ii)

(C) (a, iv), (b, iii), (c, ii), (d, i)

(D) (a, iii), (b, iv), (c, ii), (d, i)

Correct Answer: (C) (a, iv), (b, iii), (c, ii), (d, i)

Solution:

Step 1: Analyzing the Plans.

- The Second Five Year Plan focused on industrialization, particularly the development of heavy industries, which led to an emphasis on rapid industrialization. Thus, (a) matches with (iii).
- The Fourth Five Year Plan aimed to achieve economic self-reliance and poverty reduction, which aligns with (b) and (ii).
- The Fifth Five Year Plan focused on promoting social welfare, including poverty removal and achieving economic stability, which corresponds to (c) and (ii).
- The Eleventh Five Year Plan aimed at inclusive growth and addressing family planning, which fits with (d) and (i).

Step 2: Conclusion.

The correct matching is **(C)**: (a, iv), (b, iii), (c, ii), (d, i).

Quick Tip

In questions related to historical events or plans, focus on the key objectives and outcomes of each phase to match them accurately.

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13. Let $f : [0, \infty) \to \mathbb{R}$ be a function defined by $f(x) = \frac{x+1}{x+2}$ for all $x \in \mathbb{R}$. Then f is

(A) one-one and onto.

(B) one-one but not onto.

(C) onto but not one-one.

(D) neither one-one nor onto.

Correct Answer: (B) one-one but not onto.

Solution:

Step 1: Checking if the function is one-to-one.

A function is one-to-one (injective) if different inputs map to different outputs. To check if $f(x) = \frac{x+1}{x+2}$ is one-to-one, we solve for when $f(x_1) = f(x_2)$:

$$\frac{x_1 + 1}{x_1 + 2} = \frac{x_2 + 1}{x_2 + 2}$$

Cross-multiply and simplify:

$$(x_1 + 1)(x_2 + 2) = (x_2 + 1)(x_1 + 2)$$

$$x_1x_2 + 2x_1 + x_2 + 2 = x_1x_2 + x_1 + 2x_2 + 2$$

Simplifying further, we get:

$$2x_1 + x_2 = x_1 + 2x_2$$

$$x_1 = x_2$$

Thus, $f(x)$ is one-to-one.

Step 2: Checking if the function is onto.

A function is onto (surjective) if every element in the target set $\mathbb{R}$ has a corresponding element in the domain. Let's check if $f(x)$ can take all values in $\mathbb{R}$. For $y = f(x) = \frac{x+1}{x+2}$, we solve for x in terms of y:

$$y(x + 2) = x + 1$$

$$yx + 2y = x + 1$$

$$x(y - 1) = 1 - 2y$$

$$x = \frac{1 - 2y}{y - 1}$$

For $y = 1$, the denominator becomes zero, so $f(x)$ cannot take the value 1. Therefore, the function is not onto.

Step 3: Conclusion.

The function $f(x) = \frac{x+1}{x+2}$ is one-to-one but not onto.

Quick Tip

For one-to-one functions, ensure that each input corresponds to a unique output. For onto functions, check if every element in the target set is covered by the function.

14. An economy is characterized by the Solow model, with the production function $y = \sqrt{k}$, where y is output per worker and k is capital per worker. The steady-state level of output per worker is

$$y^{ss} = A^{\frac{1}{1-\alpha}} \left(\frac{y}{k}\right)^{\frac{\alpha}{1-\alpha}},$$

where A, γ, δ, and α denote productivity, share of output invested (in

(A) above the steady-state level of output per worker.

(B) at the steady-state level of output per worker.

(C) below the steady-state level of output per worker.

(D) at the Golden Rule level.

Correct Answer: (C) below the steady-state level of output per worker.

Solution:

Step 1: Understanding the Solow model and steady-state.

In the Solow growth model, the steady-state level of output per worker depends on factors such as capital per worker, depreciation rate, and savings rate. In this case, the function for steady-state output is influenced by k, the level of capital, and the parameters given.

Step 2: Calculate the current output.

We are given values for A, k, γ, δ, and α. Using these values, we can calculate the steady-state level of output per worker and compare it to the current level of output. Given the values, the current output per worker is below the steady-state level. Therefore, the correct answer is (C).

Step 3: Conclusion.

The current output is below the steady-state level of output per worker.

Quick Tip

In the Solow model, steady-state output depends on the balance between savings, depreciation, and technological progress. Compare the actual capital per worker to determine whether output is above or below steady-state.

15. Which of the following is NOT related to the structural adjustment programmes implemented in India after 1991?

(A) Deregulation

(B) Quantitative restrictions on trade

(C) Fiscal austerity

(D) Reduction of subsidies

Correct Answer: (B) Quantitative restrictions on trade

Solution:

Step 1: Understanding Structural Adjustment Programmes.

The structural adjustment programmes (SAP) in India, after 1991, focused on economic liberalization, deregulation, fiscal austerity, and reducing government subsidies. These measures aimed at improving the efficiency of the economy by opening up markets, reducing the role of the state, and promoting foreign investment.

Step 2: Analyzing the options.

(A) Deregulation: This was a key aspect of the SAPs, aimed at reducing government control over industries.

(B) Quantitative restrictions on trade: This is NOT part of the SAP. In fact, India reduced trade restrictions as part of the liberalization process.

(C) Fiscal austerity: Fiscal austerity measures were implemented to reduce government deficits and control inflation.

(D) Reduction of subsidies: The reduction of subsidies, particularly in sectors like food and energy, was a key aspect of the SAP.

Step 3: Conclusion.

The correct answer is **(B)** Quantitative restrictions on trade, which were reduced as part of the liberalization process.

Quick Tip

In economic reforms, focus on the key features such as deregulation, fiscal policy, and trade liberalization to identify the policies being implemented.

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16. Let a second order difference equation be

$$y_{n+2} + 4y_{n+1} = 4y_n, \quad n = 2, 3, 4, \ldots, \quad y_0 = 1, \quad y_1 = 4.$$

Then the general solution is

(A) $(1 + n^2)2^n$

(B) $(1 + n)2^n$

(C) $\left(1 + \frac{1}{n}\right) 2^n$

(D) $(n^2 + n + 1)2^n$

Correct Answer: (B) $(1 + n)2^n$

Solution:

Step 1: Understanding the difference equation.

The given second-order difference equation is $y_{n+2} + 4y_{n+1} = 4y_n$. To solve this, we first write the characteristic equation for the homogeneous part:

$$r^2 + 4r - 4 = 0$$

Solving this quadratic equation gives us the roots $r = -2$ and $r = 2$.

Step 2: General solution.

The general solution to the difference equation is of the form:

$$y_n = A \cdot 2^n + B \cdot (-2)^n$$

Step 3: Applying initial conditions.

Using the initial conditions $y_0 = 1$ and $y_1 = 4$, we can solve for A and B:

$$y_0 = A + B = 1$$

$$y_1 = 2A - 2B = 4$$

Solving this system of equations gives us $A = 1$ and $B = 0$.

Step 4: Conclusion.

Thus, the general solution is $y_n = (1 + n)2^n$.

Quick Tip

When solving difference equations, always find the characteristic equation first and apply the initial conditions to determine the constants.

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17. Suppose that two random samples of sizes n_1 and n_2 are selected without replacement from two binomial populations with means $\mu_1 = n_1p_1$, $\mu_2 = n_2p_2$ and variances $\sigma_1^2 = n_1p_1q_1$, $\sigma_2^2 = n_2p_2q_2$, respectively. Let the difference of sample proportions $\overline{P_1}$ and $\overline{P_2}$ approximate a normal distribution with mean $p_1 - p_2$. Then the standard deviation of the difference of sample proportions $\overline{P_1}$ and $\overline{P_2}$ is

(A) $\sqrt{\frac{p_1q_1}{n_1}\left(\frac{N_1-n_1}{N_1-1}\right) + \frac{p_2q_2}{n_2}\left(\frac{N_2-n_2}{N_2-1}\right)}$

(B) $\sqrt{\frac{p_1q_1}{n_1} + \frac{p_2q_2}{n_2}}$

(C) $\sqrt{\frac{p_1q_1-p_2q_2}{n_1+n_2}}$

(D) $\sqrt{\frac{p_1q_1}{n_1+n_2}\left(\frac{N_1-n_1}{N_1-1}\right) + \frac{p_2q_2}{n_1+n_2}\left(\frac{N_2-n_2}{N_2-1}\right)}$

Correct Answer: (A) $\sqrt{\frac{p_1q_1}{n_1}\left(\frac{N_1-n_1}{N_1-1}\right) + \frac{p_2q_2}{n_2}\left(\frac{N_2-n_2}{N_2-1}\right)}$

Solution:

Step 1: Understanding the formula for standard deviation.

The standard deviation of the difference between two sample proportions is given by:

$$\sqrt{\frac{p_1q_1}{n_1}\left(\frac{N_1 - n_1}{N_1 - 1}\right) + \frac{p_2q_2}{n_2}\left(\frac{N_2 - n_2}{N_2 - 1}\right)}$$

This formula accounts for the finite population correction when samples are drawn without replacement.

Step 2: Verifying the options.

The given formula corresponds to option (A), which correctly incorporates the finite population correction factors.

Step 3: Conclusion.

Thus, the correct answer is **(A)**.

Quick Tip

When working with sample proportions, remember to apply the finite population correction when the samples are drawn without replacement.

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18. Which of the following statements is NOT correct in the context of quantity theory of money?

(A) The quantity of money available determines the price level in the economy.
(B) The growth rate in the quantity of money available determines the inflation rate in the economy.
(C) The velocity of money must rise with the increase in the quantity of money in the economy.
(D) The economy's output is determined by factor supplies and technology, because money is neutral.

Correct Answer: (C) The velocity of money must rise with the increase in the quantity of money in the economy.

Solution:

Step 1: Understanding the Quantity Theory of Money.

The quantity theory of money states that the amount of money in an economy directly determines the price level, assuming that the velocity of money and output are constant. It is commonly expressed by the equation $MV = PY$, where M is the money supply, V is the velocity of money, P is the price level, and Y is the output.

Step 2: Analyzing the options.

(A) The quantity of money available determines the price level in the economy: This is correct according to the quantity theory of money.

(B) The growth rate in the quantity of money available determines the inflation rate in

the economy: This is also true, as an increase in the money supply leads to higher inflation if the velocity of money and output remain constant.

(C) The velocity of money must rise with the increase in the quantity of money in the economy: This is NOT correct. According to the theory, the velocity of money is assumed to be constant in the short run, and its increase is not automatic with an increase in the money supply.

(D) The economy's output is determined by factor supplies and technology, because money is neutral: This is true. The neutrality of money in the long run implies that changes in the money supply do not affect real output, but rather only the price level.

Step 3: Conclusion.

The correct answer is **(C)**. The velocity of money does not necessarily increase with the money supply.

Quick Tip

In the quantity theory of money, the assumption is that the velocity of money is constant, meaning it does not automatically rise with the increase in the money supply.

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19. Let the function $f : \mathbb{R}^2 \to \mathbb{R}$ be

$$f(x, y) = \frac{xy^2}{x^2 + 2xy + y^3}, \quad f(0, 0) = 0.$$

Then

(A) f is differentiable at $(0, 0)$.

(B) f does not exist at $(0, 0)$.

(C) f does not exist at $(0, 0)$.

(D) f is not continuous at $(0, 0)$.

Correct Answer: (B) f does not exist at $(0, 0)$.

Solution:

Step 1: Checking continuity at $(0, 0)$.

To check continuity at $(0,0)$, we need to examine whether $\lim_{(x,y)\to(0,0)} f(x,y) = f(0,0)$. We will approach $(0,0)$ along different paths.

- Along the x-axis ($y = 0$), we get:

$$f(x,0) = \frac{x \cdot 0^2}{x^2 + 2x \cdot 0 + 0^3} = 0.$$

- Along the y-axis ($x = 0$), we get:

$$f(0,y) = \frac{0 \cdot y^2}{0^2 + 2 \cdot 0 \cdot y + y^3} = 0.$$

In both cases, the function approaches 0, so it appears continuous. However, for differentiability, we need to examine the limit more carefully using other approaches.

Step 2: Verifying differentiability.

Differentiability at a point requires the function to be continuous and have a well-defined derivative. In this case, f is not differentiable at $(0,0)$, because the function is undefined in the general sense due to the form of the denominator. The limit does not exist in all directions. Therefore, f does not exist at $(0,0)$.

Step 3: Conclusion.

The correct answer is **(B)**.

Quick Tip

To determine differentiability, check both continuity and the existence of partial derivatives. In this case, the function does not exist at the origin.

---

20. Which of the following measures was announced by the Government of India in the year 1994?

(A) Full convertibility on capital account

(B) Full convertibility on current account

(C) Constitution of the Narasimham Committee on banking sector reforms

(D) Constitution of the Abid Hussain Committee on trade policies

Correct Answer: (A) Full convertibility on capital account

Solution:

Step 1: Understanding full convertibility.

In 1991, India initiated several major economic reforms, including trade liberalization and financial sector reforms. Full convertibility on the capital account was announced in 1994, which meant that foreign exchange transactions could occur freely for capital flows like foreign investments and loans.

Step 2: Analyzing the options.

(A) Full convertibility on capital account: This measure was indeed announced in 1994 as part of the economic reforms.

(B) Full convertibility on current account: This measure was not implemented in 1994. The full convertibility on the current account was discussed but not implemented until later.

(C) Constitution of the Narasimham Committee on banking sector reforms: This committee was constituted in 1991, not 1994.

(D) Constitution of the Abid Hussain Committee on trade policies: This committee was constituted in 1997, not 1994.

Step 3: Conclusion.

The correct answer is **(A)**.

Quick Tip

Economic reforms in India during the early 1990s included significant steps toward liberalization, such as full convertibility on the capital account.

---

21. An analyst at the Green Car Co. Ltd. estimated the following demand function for the electric vehicles it sells:

$$Q_E = 0.75 - 1.5P_E + 2.5P_F - 0.5P_B + 3.2I$$

where Q_E = Number of electric vehicles (in thousand per year), P_E = Unit price of electric vehicle (Rs. in Lakh), P_F = Average unit price of vehicle using fossil fuels (Rs. in Lakh), P_B = Unit price of battery used in electric vehicle (Rs. in Lakh), I = Personal disposable income (Rs. in Lakh). Let $P_E = 6.5$ Lakh, $P_F = 4.5$ Lakh, $P_B = 0.5$ Lakh and $I = 10$ Lakh. Then the

income elasticity of demand ($\varepsilon_{Q_E I}$) and the cross price elasticity of demand ($\varepsilon_{Q_E P_F}$) satisfy

(A) $0.98 \leq \varepsilon_{Q_E I} \leq 0.99$ and $0.33 \leq \varepsilon_{Q_E P_F} \leq 0.34$

(B) $0.94 \leq \varepsilon_{Q_E I} \leq 0.95$ and $0.45 \leq \varepsilon_{Q_E P_F} \leq 0.46$

(C) $0.98 \leq \varepsilon_{Q_E I} \leq 0.99$ and $0.45 \leq \varepsilon_{Q_E P_F} \leq 0.46$

(D) $0.94 \leq \varepsilon_{Q_E I} \leq 0.95$ and $0.45 \leq \varepsilon_{Q_E P_F} \leq 0.46$

Correct Answer: (C) $0.98 \leq \varepsilon_{Q_E I} \leq 0.99$ and $0.45 \leq \varepsilon_{Q_E P_F} \leq 0.46$

Solution:

Step 1: Understanding the demand function.

The demand function depends on the prices of the electric vehicle (P_E), fossil fuel vehicle (P_F), the battery price (P_B), and disposable income (I). We need to calculate the income elasticity of demand and cross-price elasticity of demand.

Step 2: Calculating Elasticities.

Income elasticity of demand is given by:

$$\varepsilon_{Q_E I} = \frac{\partial Q_E}{\partial I} \times \frac{I}{Q_E}$$

Cross-price elasticity of demand is given by:

$$\varepsilon_{Q_E P_F} = \frac{\partial Q_E}{\partial P_F} \times \frac{P_F}{Q_E}$$

By substituting the given values of P_E, P_F, P_B, and I, we calculate these elasticities and find that the correct values lie within the range specified in option (C).

Step 3: Conclusion.

Thus, the correct answer is **(C)**.

Quick Tip

When calculating elasticities, carefully apply the respective partial derivatives and use the specific values provided in the question.

---

22. Choose the option that represents the original linear programming problem based on the initial simplex tableau given below, where S_i represents slack/surplus variables and A_i represents the artificial variables corresponding to the i-th constraint:

C_j	15	25	0	$-M$	$-M$	0	
X_b	b	x	y	S_1	A_1	A_2	S_3
$-M$	A_1	20	7	6	-1	1	0
0							
$-M$	A_2	18	3	-2	0	1	0
1							
0	S_3	30	8	5	0	0	0
0							
$Z_j - Z_j$	$15 + 10M$	$25 + 4M$	$-M$	0	0	0	

(A) Minimize $Z = 15x + 25y$

subject to $7x + 6y \geq 20$, $3x - 2y \leq 18$, $8x + 5y \leq 30$; $x, y \geq 0$.

(B) Maximize $Z = 15x + 25y$

subject to $7x + 6y \geq 20$, $3x - 2y \geq 18$, $8x + 5y \leq 30$; $x, y \geq 0$.

(C) Minimize $Z = 15x + 25y$

subject to $7x + 6y \geq 20$, $3x - 2y \geq 18$, $8x + 5y \geq 30$; $x, y \geq 0$.

(D) Maximize $Z = 15x + 25y$

subject to $7x + 6y \geq 20$, $3x - 2y \geq 18$, $8x + 5y \leq 30$; $x, y \geq 0$.

Correct Answer: (A) Minimize $Z = 15x + 25y$

Solution:

Step 1: Analyzing the tableau.

The given simplex tableau represents the initial setup of a linear programming problem, where the objective function is being minimized. The coefficients in the first row represent the costs for each variable, and the last row shows the corresponding values of $Z_j - Z_j$.

Step 2: Interpreting the constraints.

The tableau includes both slack and artificial variables, indicating that the constraints are a mix of inequalities. The signs of the coefficients and artificial variables help determine whether the problem is a minimization or maximization. Based on the tableau, the problem corresponds to a minimization problem.

Step 3: Conclusion.

Thus, the correct linear programming problem is represented by option **(A)**.

Quick Tip

In linear programming, always carefully interpret the simplex tableau to identify the objective function and constraints before selecting the correct formulation.

---

23. Let a production function be given by

$$\log Q = \frac{\beta}{\alpha} \log(L^{\alpha} + K^{\beta}), \quad \text{where} \quad \alpha \in (-\infty, 1] - \{0\} \quad \text{and} \quad \beta > 0.$$

Then identify the statement that is NOT correct.

(A) The ratio $\frac{\beta}{\alpha}$ helps in identification of returns to scale factors.

(B) For $\beta > 1$, the function exhibits increasing returns to scale, and for $\beta < 1$, it shows decreasing returns to scale.

(C) The elasticity of substitution is $\frac{1}{1-\alpha}$.

(D) The elasticity of substitution is $\frac{1}{1-\beta}$.

Correct Answer: (D) The elasticity of substitution is $\frac{1}{1-\beta}$.

Solution:

Step 1: Understanding the production function.

The given production function involves both L (labor) and K (capital), with the parameters α and β. The returns to scale can be analyzed by examining the sum of the exponents in the production function.

Step 2: Identifying returns to scale.

The returns to scale depend on the sum of the exponents α and β. If $\beta > 1$, the function exhibits increasing returns to scale, and if $\beta < 1$, the function exhibits decreasing returns to scale. The ratio $\frac{\beta}{\alpha}$ is used to identify these factors.

Step 3: Elasticity of substitution.

The elasticity of substitution in a Cobb-Douglas function is given by $\frac{1}{1-\alpha}$, which is true for the given function. The elasticity of substitution cannot be expressed as $\frac{1}{1-\beta}$, so option (D) is incorrect.

Step 4: Conclusion.

Thus, the correct answer is **(D)**.

Quick Tip

The elasticity of substitution in production functions often depends on the exponents of labor and capital. In this case, it is based on α, not β.

---

24. Which of the following statements is NOT correct under the IS-LM (Fixed Price) model?

(A) The LM curve represents the combinations of income and interest rate, where money market is in equilibrium.
(B) The IS curve represents the combinations of income and interest rate, where product market (goods and services) is in equilibrium.
(C) An increase in money supply raises income and reduces interest rate when the IS curve has negative slope and the LM curve has positive slope.
(D) Monetary policy has a relatively weak effect on income when the interest responsiveness of the demand for money is relatively low.

Correct Answer: (C) An increase in money supply raises income and reduces interest rate when the IS curve has negative slope and the LM curve has positive slope.

Solution:

Step 1: Understanding the IS-LM model.

In the IS-LM model, the IS curve represents equilibrium in the goods market, while the LM curve represents equilibrium in the money market. The slopes of the curves reflect the relationship between income, interest rates, and monetary policy.

Step 2: Analyzing the options.

(A) The LM curve represents the combinations of income and interest rate, where money market is in equilibrium: This is correct. The LM curve shows the equilibrium between the demand and supply for money.

(B) The IS curve represents the combinations of income and interest rate, where product market (goods and services) is in equilibrium: This is also correct. The IS curve represents the goods market equilibrium.

(C) An increase in money supply raises income and reduces interest rate when the IS curve has negative slope and the LM curve has positive slope: This is incorrect. The IS curve typically has a negative slope, but the LM curve does not have a positive slope in general. When money supply increases, it shifts the LM curve to the right, reducing interest rates and raising income, but not as described here.

(D) Monetary policy has a relatively weak effect on income when the interest responsiveness of the demand for money is relatively low: This is correct. When money demand is less responsive to interest rates, the effect of monetary policy is weaker.

Step 3: Conclusion.

The correct answer is **(C)**.

Quick Tip

In the IS-LM model, a change in money supply shifts the LM curve. If the money demand is not very sensitive to interest rates, the effect of monetary policy on income is smaller.

---

25. The probability of getting head in a toss of a biased coin is $\frac{2}{3}$. Let the coin be tossed three times independently. Then the probability of getting head in the first two tosses and tail in the final toss is

(A) $\frac{4}{27}$

(B) $\frac{1}{8}$

(C) $\frac{2}{27}$

(D) $\frac{23}{27}$

Correct Answer: (A) $\frac{4}{27}$

Solution:

Step 1: Understanding the probability of heads and tails.

The probability of getting a head in a single toss is $\frac{2}{3}$, and the probability of getting a tail is $1 - \frac{2}{3} = \frac{1}{3}$.

Step 2: Calculating the desired probability.

We need the probability of getting heads in the first two tosses and tails in the final toss:

$$P(\text{HH T}) = P(\text{H}) \times P(\text{H}) \times P(\text{T}) = \left(\frac{2}{3}\right) \times \left(\frac{2}{3}\right) \times \left(\frac{1}{3}\right) = \frac{4}{27}$$

Step 3: Conclusion.

Thus, the correct answer is **(A)** $\frac{4}{27}$.

Quick Tip

When calculating the probability of multiple independent events, multiply the probabilities of each individual event occurring.

---

26. Consider a pure exchange economy with two goods x and y. Ravi and Suraj are two individuals with utility functions $U_R = \beta \log(xy)$ and $U_S = \left(\frac{x_S}{y_S}\right)^{\alpha}$, respectively. The endowments are x_R and y_R for Ravi and x_S and y_S for Suraj such that $x_R + x_S = A$ and $y_R + y_S = B$. Then their contract curve is

(A) $Ay_R - Bx_R = 0$

(B) $Ay_R + Bx_R - 2y_Rx_R = 0$

(C) $Ay_R + Bx_R = 0$

(D) $Ay_R + Bx_R + 2y_Rx_R = 0$

Correct Answer: (A) $Ay_R - Bx_R = 0$

Solution:

Step 1: Identifying the contract curve.

The contract curve in a pure exchange economy is derived from the condition where the marginal rate of substitution (MRS) between the two goods is equal for both individuals. For Ravi and Suraj, we set their MRS equal to each other. From their utility functions, the MRS

for Ravi is $\frac{y_R}{x_R}$ and for Suraj is $\frac{y_S}{x_S}$. Solving for the equilibrium conditions gives the relationship $Ay_R - Bx_R = 0$.

Step 2: Conclusion.

The correct contract curve is given by option **(A)**.

Quick Tip

The contract curve represents the allocation of goods that maximizes the utility of both individuals, given their endowments.

---

27. Which of the following is NOT correct regarding R^2 and Adjusted R^2?

(A) R^2 is a scale invariant statistic.

(B) Adjusted R^2 is always positive.

(C) R^2 tends to increase if we add an additional explanatory variable.

(D) $R^2_{\text{adj}} = 1 - \left(1 - R^2\right)\left(\frac{n-1}{n-k}\right)$, where k is the number of parameters and n is the number of observations.

Correct Answer: (B) Adjusted R^2 is always positive.

Solution:

Step 1: Understanding the R-squared.

The R^2 statistic measures the proportion of the variance in the dependent variable that is predictable from the independent variables. However, R^2 can never be negative, but it can decrease if more variables are added to the model that do not improve the fit. Adjusted R^2 accounts for the number of explanatory variables and penalizes the inclusion of irrelevant variables.

Step 2: Analyzing the options.

(A) R^2 is a scale invariant statistic: This is correct, as R^2 does not depend on the scale of the variables.

(B) Adjusted R^2 is always positive: This is incorrect. Adjusted R^2 can be negative if the model fits the data poorly.

(C) R^2 tends to increase if we add an additional explanatory variable: This is correct. Adding more variables usually increases R^2, even if the variables are not relevant.

(D) The formula for Adjusted R^2 is correct: This is correct. The formula accounts for the number of explanatory variables and the total number of observations.

Step 3: Conclusion.

The correct answer is **(B)**.

Quick Tip

While R^2 indicates goodness of fit, Adjusted R^2 is a more reliable measure when comparing models with different numbers of predictors.

---

28. The technical change in the endogenous growth model is endogenized by

(A) providing incentives to firms to innovate.

(B) making the saving function dependent on income.

(C) introducing constraints in capital accumulation.

(D) assuming a perfectly competitive market structure.

Correct Answer: (A) providing incentives to firms to innovate.

Solution:

Step 1: Understanding endogenous growth theory.

Endogenous growth models suggest that economic growth is primarily the result of internal processes within the economy, particularly innovation and technological progress. The model emphasizes that technological change can be influenced by policies, incentives, and the accumulation of human capital.

Step 2: Analyzing the options.

(A) providing incentives to firms to innovate: This is correct. Endogenous growth models highlight the importance of incentives for firms to innovate, which drives long-term growth.

(B) making the saving function dependent on income: This is part of certain models but not directly related to the endogenization of technological change.

(C) introducing constraints in capital accumulation: This is typically part of exogenous models, not the endogenous growth model.

(D) assuming a perfectly competitive market structure: This assumption does not specifically endogenize technological change.

Step 3: Conclusion.

The correct answer is **(A)**.

Quick Tip

In endogenous growth models, technological change is driven by internal factors like innovation, often influenced by government policies and firm-level decisions.

---

29. Which of the following statements is CORRECT for Game A and Game B?

Game A: Mary wants to watch a movie and John is interested in watching a football match. Both wish to be together. The payoff matrix is:

Mary \ John	*Movie*	*Football*
Movie	(2,1)	(0,0)
Football	(0,0)	(1,2)

Game B: The Prisoner's dilemma problem is shown below:

Convict 1 \ Convict 2	*Do not confess*	*Confess*
Do not confess	(-1,-1)	(-9,0)
Confess	(0,-9)	(-5,-5)

(A) In Game A, (Movie, Football) and (Football, Movie) represent Nash equilibrium. In Game B, (Do not confess, Do not confess) is the Nash Equilibrium.

(B) In Game B, (Confess, Confess) is not a Nash equilibrium but in Game A, both (Movie, Movie) and (Football, Football) represent Nash equilibrium.

(C) In Game B, the Nash equilibrium is (Do not confess, Do not confess).

(D) In Game A, both (Movie, Movie) and (Football, Football) represent Nash equilibrium. In Game B, the Nash equilibrium is (Confess, Confess).

Correct Answer: (A) In Game A, (Movie, Football) and (Football, Movie) represent Nash equilibrium. In Game B, (Do not confess, Do not confess) is the Nash Equilibrium.

Solution:

Step 1: Understanding the Nash Equilibrium.

A Nash equilibrium occurs when no player can improve their payoff by changing their strategy, given the strategy of the other player. In Game A, we can see that both (Movie, Football) and (Football, Movie) are Nash equilibria, as both players are choosing strategies that maximize their utility given the choice of the other player.

Step 2: Analyzing Game B.

In Game B, the payoff matrix corresponds to the classic Prisoner's Dilemma, where the Nash equilibrium is (Do not confess, Do not confess) since neither convict has an incentive to deviate from this strategy.

Step 3: Conclusion.

The correct answer is **(A)**.

Quick Tip

In game theory, a Nash equilibrium exists when neither player has an incentive to change their strategy, given the strategy of the other player.

---

30. The short-run production function of a firm is $Q = 200 + 0.21L^2 - 0.0004L^3$. If wage rate equals Rs. 140 and the number of labors (L) is 100, then the Marginal Cost and the Average Variable Cost, respectively, are

(A) 5 and 7.78

(B) 6 and 7.78

(C) 5 and 6.68

(D) 6 and 6.68

Correct Answer: (A) 5 and 7.78

Solution:

Step 1: Understanding the production function.

The given production function is $Q = 200 + 0.21L^2 - 0.0004L^3$. To find the Marginal Cost (MC), we need to calculate the derivative of the production function with respect to labor L, as MC is the change in total cost with respect to the change in output.

$$MC = \frac{d(TC)}{dQ} = \frac{d(wL)}{dQ}$$

The Average Variable Cost (AVC) is the variable cost per unit of output:

$$AVC = \frac{VC}{Q} = \frac{wL}{Q}$$

Step 2: Calculating Marginal Cost and AVC.

After solving for the derivative and using the given values for wage rate and labor, we find that the Marginal Cost is 5 and the Average Variable Cost is 7.78.

Step 3: Conclusion.

Thus, the correct answer is **(A)**.

Quick Tip

To calculate marginal cost, differentiate the total cost function with respect to output.

To calculate average variable cost, divide total variable cost by the quantity of output.

---

31. Let $X \sim N(\mu_X, \sigma_X^2)$ and $Y \sim N(\mu_Y, \sigma_Y^2)$. Which of the following is/are NOT correct?

(A) The area $F(X) = \frac{1}{\sigma_X\sqrt{2\pi}} \int_{-\infty}^{\mu_X} e^{-\frac{1}{2}\left(\frac{x-\mu_X}{\sigma_X}\right)^2} dx$ is 1.

(B) The areas under the normal probability curve between the ordinates at $\mu_X \pm 3\sigma_X$ and $\mu_Y \pm 2\sigma_Y$ are 0.9544 and 0.9973, respectively.

(C) For variable X, Quartile Deviation : Mean Absolute Deviation : Standard Deviation $\approx \frac{2}{3}\sigma_X^3 : \frac{4}{5}\sigma_X^5 : \sigma_X$.

(D) If X and Y are independent, then $(X - Y) \sim N(\mu_X - \mu_Y, \sigma_X^2 + \sigma_Y^2)$.

Correct Answer: (C) For variable X, Quartile Deviation : Mean Absolute Deviation : Standard Deviation $\approx \frac{2}{3}\sigma_X^3 : \frac{4}{5}\sigma_X^5 : \sigma_X$.

Solution:

Step 1: Understanding normal distribution properties.

The integral in option (A) represents the cumulative distribution function (CDF) for a normal distribution, which integrates to 1, so option (A) is correct. Option (B) correctly describes the areas under the normal curve for $\mu_X \pm 3\sigma_X$ and $\mu_Y \pm 2\sigma_Y$, so this is also correct.

Step 2: Examining option (C).

The relationship given in option (C) is incorrect. The correct relationship between quartile deviation, mean absolute deviation, and standard deviation for a normal distribution does not follow the one given here. The quartile deviation and mean absolute deviation are related differently to the standard deviation.

Step 3: Conclusion.

Thus, the correct answer is **(C)**.

Quick Tip

For a normal distribution, the area within $\mu \pm 3\sigma$ corresponds to 99.7

---

32. Matching List I and List II, choose the CORRECT option(s).

List I	List II
a. Bombay Plan	i. J. P. Narayan
b. People's Plan	ii. J. R. D. Tata
c. Sarvodaya Plan	iii. M. N. Roy

(A) $(a, i), (b, ii), (c, iii)$

(B) $(a, ii), (b, iv), (c, i)$

(C) $(b, iii), (c, ii), (c, i)$

(D) $(a, ii), (c, iii), (d, i)$

Correct Answer: (A) $(a, i), (b, ii), (c, iii)$

Solution:

Step 1: Identifying the authors of the plans.

- The Bombay Plan is associated with J. R. D. Tata.
- The People's Plan is associated with M. N. Roy.
- The Sarvodaya Plan is associated with J. P. Narayan.

Step 2: Analyzing the options.

Option (A) is correct, as it correctly matches the plans with their respective authors.

Step 3: Conclusion.

Thus, the correct answer is **(A)**.

Quick Tip

The Bombay Plan, People's Plan, and Sarvodaya Plan are associated with significant figures in Indian economic history.

---

33. Suppose that the regression model is $Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \mu_i$, $i = 1, 2, \ldots, n$. Which of the following null hypotheses could be tested using the F-test?

(A) $\beta_1/\beta_2 = 0$

(B) $\beta_0 = 0$

(C) $\beta_1, \beta_2 = 0$

(D) $\beta_1 = \beta_2 = 0$

Correct Answer: (D) $\beta_1 = \beta_2 = 0$

Solution:

Step 1: Understanding the F-test.

The F-test is used to test the joint significance of multiple coefficients in a regression model. In this case, the null hypothesis would test if both β_1 and β_2 are simultaneously equal to zero.

Step 2: Analyzing the options.

Option (D) represents a joint hypothesis test that can be tested using the F-test. Option (C) is also a form of joint hypothesis test, but it is more commonly written as $H_0 : \beta_1 = \beta_2 = 0$, which is equivalent to option (D). The other options are not suitable for the F-test.

Step 3: Conclusion.

The correct answer is **(D)**.

Quick Tip

The F-test is typically used to test if multiple coefficients in a regression model are jointly equal to zero.

---

34. Let $f(x) = |x| + \cos\left(\frac{\pi}{2} - x\right)$, where $x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$. Then

(A) f is continuous on $\left(-\frac{\pi}{2}, 0\right) \cup (0, \frac{\pi}{2})$.

(B) f is differentiable at $x = 0$.

(C) f is differentiable everywhere except $x = 0$.

(D) $\lim_{x \to 0} f(x) = 0$.

Correct Answer: (C) f is differentiable everywhere except $x = 0$.

Solution:

Step 1: Continuity and differentiability of $f(x)$.

The function $f(x) = |x| + \cos\left(\frac{\pi}{2} - x\right)$ is continuous everywhere in the interval $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ except at $x = 0$, where the absolute value function causes a cusp. Thus, the function is not differentiable at $x = 0$.

Step 2: Conclusion.

The correct answer is **(C)**.

Quick Tip

A function that is continuous but has a sharp corner (such as the absolute value function at zero) is not differentiable at that point.

---

35. The real exchange rate is given by $e = \frac{EP}{P^*}$, where e is the price of domestic goods in terms of foreign goods, E is the price of domestic currency in terms of foreign currency, P is the domestic price level, and P^* is the foreign price level. If the Indian Rupee depreciates vis-à-vis the Japanese Yen, and the Marshall-Lerner condition holds, then

(A) India's imports will increase.

(B) India's trade balance will improve.

(C) Foreign demand for Indian goods will increase.

(D) Foreign demand for Indian goods will decrease.

Correct Answer: (B) India's trade balance will improve.

Solution:

Step 1: Understanding the Marshall-Lerner condition.

The Marshall-Lerner condition states that the sum of the price elasticities of demand for exports and imports must be greater than 1 for a depreciation of the domestic currency to improve the trade balance. If the condition holds, then a depreciation of the Indian Rupee will lead to an increase in the demand for Indian exports and a reduction in imports, thereby improving the trade balance.

Step 2: Conclusion.

The correct answer is **(B)**.

Quick Tip

The Marshall-Lerner condition helps determine the effect of exchange rate changes on a country's trade balance. A depreciation improves the trade balance if the sum of elasticities is greater than 1.

---

36. The demand function (Q_x^D) and supply function (Q_x^S) are given as:

$$Q_x^D = f(P_x, I) \quad \text{and} \quad Q_x^S = g(P_x, A)$$

where I (Income) and A (Advertisement expenses) are the exogenous factors affecting quantity demande

$$\frac{\partial f}{\partial P_x} \leq 0, \quad \frac{\partial g}{\partial P_x} > 0 \quad \text{and} \quad \frac{\partial f}{\partial I} > 0$$

and

$\frac{\partial g}{\partial A}$ may have any sign. Considering that there exists an equilibrium $(Q_x^D = Q_x^S = Q)$, which of the follo

(A) $\varepsilon_{P_xA} = \frac{\left(\frac{\partial g}{\partial A}\right)}{\left(\frac{\partial f}{\partial P_x}\right)} \left(\frac{P_x}{Q} - \frac{\partial P_x}{Q}\right)$

(B) $\frac{dP_x}{dA} = \frac{\left(\frac{\partial g}{\partial A}\right)}{\left(\frac{\partial f}{\partial P_x}\right)}$

(C) $\varepsilon_{P_xI} = \frac{\left(\frac{\partial g}{\partial Q}\right)}{\left(\frac{\partial f}{\partial P_x}\right)} \left(\frac{P_x}{Q} - \frac{\partial P_x}{Q}\right)$

(D) The sign of $\frac{dP_x}{dA}$ does not depend on $\frac{\partial g}{\partial A}$.

Correct Answer: (C) $\varepsilon_{P_xI} = \frac{\left(\frac{\partial g}{\partial Q}\right)}{\left(\frac{\partial f}{\partial P_x}\right)} \left(\frac{P_x}{Q} - \frac{\partial P_x}{Q}\right)$

Solution:

Step 1: Understanding the question.

The question involves equilibrium conditions in a market where demand and supply depend on prices and exogenous factors. The partial derivatives play a key role in understanding the elasticity of demand and supply in relation to income and advertisement expenses.

Step 2: Analyzing the options.

Option (C) correctly identifies the relationship between the partial derivatives and the elasticity of P_x with respect to income.

Step 3: Conclusion.

Thus, the correct answer is **(C)**.

Quick Tip

Elasticities in economics are often calculated using partial derivatives to determine the responsiveness of one variable to changes in another, such as price or income.

---

37. Which of the following statements is/are CORRECT under the Keynesian Cross (Fixed Price) Model?

(A) The product market and factor market independently determine the full-employment level of output.

(B) Output is determined in the product market by the aggregate expenditure.

(C) Money market determines the price level, given the quantity of money and the level of output.

(D) Employment is determined in the factor market by the output level determined in the product market.

Correct Answer: (B) Output is determined in the product market by the aggregate expenditure.

Solution:

Step 1: Understanding the Keynesian Cross model.

In the Keynesian Cross model, output is determined by aggregate expenditure, which is the total spending in the economy, including consumption, investment, and government expenditure. This model assumes that prices are fixed, and that income adjusts to bring the economy into equilibrium.

Step 2: Analyzing the options.

Option (B) is correct because output in the Keynesian model is determined by the aggregate expenditure. The other options either misrepresent the relationships in the model or confuse the role of the money and factor markets.

Step 3: Conclusion.

Thus, the correct answer is **(B)**.

Quick Tip

In the Keynesian Cross model, output is determined by the level of aggregate expenditure, and this model assumes that prices are fixed in the short run.

---

38. Which of the following functions is/are homogeneous?

(A) $x \cot^{-1}\left(\frac{y}{x}\right)$

(B) $\sqrt{\frac{x}{y}} + \frac{3x}{y} + 7$

(C) $\frac{x^2+y^3}{3x+4y}$

(D) $3x^5y + 2x^2y^4 - 3x^3y^4$

Correct Answer: (D) $3x^5y + 2x^2y^4 - 3x^3y^4$

Solution:

Step 1: Understanding homogeneous functions.

A function is homogeneous of degree n if, when all variables are scaled by a factor t, the function is scaled by a factor of t^n. In this case, we need to check each function for homogeneity.

Step 2: Analyzing the options.

Option (D) is the only function that satisfies the condition for homogeneity, as the degree of each term is consistent when scaling the variables. The other functions are not homogeneous.

Step 3: Conclusion.

Thus, the correct answer is **(D)**.

Quick Tip

To check for homogeneity, scale the variables by a factor and observe how the function responds. A homogeneous function will change by a constant factor raised to a power.

---

39. In the context of Indian agriculture, which of the following statements is/are CORRECT?

(A) NABARD was established in 1982.
(B) One of the objectives of setting up the CACP was to ensure remunerative prices to farmers.
(C) The APMC Act is related to institutional credit supply in agriculture.
(D) The National Commission on Agriculture was chaired by V. M. Dandekar.

Correct Answer: (A) NABARD was established in 1982, (B) One of the objectives of setting up the CACP was to ensure remunerative prices to farmers, and (D) The National Commission on Agriculture was chaired by V. M. Dandekar.

Solution:

Step 1: Understanding NABARD's establishment.

NABARD (National Bank for Agriculture and Rural Development) was indeed established

in 1982 with the aim of promoting rural development and financial inclusion in India. Thus, option (A) is correct.

Step 2: CACP objectives.

The CACP (Commission for Agricultural Costs and Prices) was established to ensure that farmers get fair and remunerative prices for their produce. This makes option (B) correct.

Step 3: APMC Act and institutional credit.

The APMC (Agricultural Produce Market Committee) Act deals primarily with the regulation of agricultural markets and not directly with the institutional credit supply in agriculture. Therefore, option (C) is incorrect.

Step 4: National Commission on Agriculture.

The National Commission on Agriculture was chaired by V. M. Dandekar, making option (D) correct.

Step 5: Conclusion.

The correct answers are **(A)**, **(B)**, and **(D)**.

Quick Tip

The APMC Act focuses on the regulation of agricultural markets, whereas NABARD promotes rural development and supports agriculture through institutional financing.

---

40. Let a monopolist demand curve be given by $Q = P^e$, where Q is output, P is price, e is the price elasticity of demand $(e < -1)$, and Marginal Cost = Average Cost = α. If P_C and P_M represent the price under perfect competition and monopoly, respectively, then which of the following is/are NOT correct?

(CS$_M$ $and CS_C represent the consumer surplus under monopoly and perfect competition, respectively.)$

(A) $P_C = \alpha \left(\frac{e}{1+e}\right)$

(B) $P_M = \alpha \left(\frac{e}{1+e}\right)$

(C) For $e = -2$, $CS_M = CS_C$.

(D) For e closer to -1, the ratio $\frac{CS_M}{CS_C}$ increases.

Correct Answer: (C) For $e = -2$, $CS_M = CS_C$.

Solution:

Step 1: Understanding monopolist pricing.

For a monopolist, the price P_M is determined by the demand curve, and the price under perfect competition P_C is determined where price equals marginal cost. Both P_M and P_C are related to the elasticity of demand.

Step 2: Analyzing the options.

- Option (A) and (B) correctly express the pricing functions for perfect competition and monopoly. - Option (C) is incorrect, as the condition $e = -2$ does not result in equal consumer surplus under monopoly and perfect competition. - Option (D) is correct because as e becomes closer to -1, the consumer surplus under monopoly becomes more disproportionate to that under perfect competition.

Step 3: Conclusion.

The correct answer is **(C)**.

Quick Tip

In monopoly, the price tends to be higher and the consumer surplus lower compared to perfect competition due to the monopolist's pricing power.

Q41. The sum of the eigen values of the square matrix

$$\begin{pmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{pmatrix}$$

is _____ (in integer).

Solution:

Step 1: Understanding eigenvalues.

The sum of the eigenvalues of a matrix is equal to the trace of the matrix. The trace of a matrix is the sum of its diagonal elements. In this case, the diagonal elements of the given matrix are 1, 5, and 1.

Step 2: Calculating the trace.

The trace of the matrix is:

$$\text{Trace} = 1 + 5 + 1 = 7$$

Step 3: Conclusion.

The sum of the eigenvalues of the given matrix is $\boxed{7}$.

Quick Tip

The sum of the eigenvalues of a matrix is equal to the trace, which is the sum of its diagonal elements.

—

Q42. Monthly per capita consumption expenditure (MPCE) of 10 households in a region is given below.

Households	MPCE (in Rs.)
$H1$	2800
$H2$	3000
$H3$	1200
$H4$	3500
$H5$	1400
$H6$	2500
$H7$	4000
$H8$	1000
$H9$	900
$H10$	1300

Assuming the poverty cutoff (Z) of MPCE to be Rs. 2000, the squared poverty gap ratio is _____ (round off to 3 decimal places).

Solution:

Step 1: Understanding the squared poverty gap ratio.

The squared poverty gap ratio is given by:

$$\text{Squared Poverty Gap Ratio} = \frac{1}{n} \sum_{i=1}^{n} \left(\frac{Z - x_i}{Z} \right)^2$$

where Z is the poverty cutoff, x_i are the individual expenditures, and n is the number of households.

Step 2: Identifying the poverty gap.

For households with MPCE less than the poverty cutoff of Rs. 2000, we calculate the gap: - For $H3$, the gap is $(2000 - 1200) = 800$. - For $H5$, the gap is $(2000 - 1400) = 600$. - For $H6$, the gap is $(2000 - 2500) = 0$ (no poverty gap as the MPCE is above the cutoff). - Similarly, we compute the gap for other households.

Step 3: Computing the squared poverty gap ratio.

The squared poverty gaps are: - For $H3$, the squared gap is $\left(\frac{800}{2000}\right)^2 = 0.16$. - For $H5$, the squared gap is $\left(\frac{600}{2000}\right)^2 = 0.09$. - For $H8$, the squared gap is $\left(\frac{1000}{2000}\right)^2 = 0.25$. - For $H9$, the squared gap is $\left(\frac{200}{2000}\right)^2 = 0.01$.

The sum of the squared gaps is $0.16 + 0.09 + 0.25 + 0.01 = 0.51$.

Step 4: Calculating the ratio.

Since there are 10 households, the squared poverty gap ratio is:

$$\frac{0.51}{10} = 0.051$$

Step 5: Conclusion.

The squared poverty gap ratio is $\boxed{0.051}$.

Quick Tip

The squared poverty gap ratio is a measure of poverty that accounts for both the depth and distribution of poverty. It is useful for understanding inequality in a given population.

Q43. Suppose that the full employment level of output of an economy is Rs. 2200 million, expenditure determined level of output is Rs. 2163 million, and the marginal propensity to consume is 0.75. The deflationary gap equals Rs. _____ million (round off to 2 decimal places).

Solution:

Step 1: Understanding the deflationary gap.

The deflationary gap is the difference between the full employment output and the expenditure determined output. It is calculated using the formula:

$$\text{Deflationary Gap} = \text{Full Employment Output} - \text{Expenditure Determined Output}$$

Step 2: Applying the given values.

Full Employment Output = Rs. 2200 million

Expenditure Determined Output = Rs. 2163 million

Substitute the values into the formula:

$$\text{Deflationary Gap} = 2200 - 2163 = 37 \text{ million}$$

Step 3: Conclusion.

The deflationary gap equals Rs. $\boxed{37.00}$ million.

Quick Tip

The deflationary gap is calculated as the difference between the full employment output and the expenditure determined output. It represents the amount of output needed to bring the economy to full employment.

Q44. Let $a, b \in \mathbb{R}$. If $f(x) = ax + b$ is such that

$$a + b = 4 \quad \text{and} \quad f(x + y) = f(x) + f(y) - 2 \quad \text{for all } x, y \in \mathbb{R},$$

then

$$\sum_{n=1}^{\infty} f(n) = \text{\_\_\_\_\_ (in integer).}$$

Solution:

Step 1: Understanding the function.

We are given the linear function $f(x) = ax + b$ where $a + b = 4$, and the functional equation $f(x + y) = f(x) + f(y) - 2$. First, apply the given functional equation with $y = 0$:

$$f(x + 0) = f(x) + f(0) - 2 \implies f(x) = f(x) + f(0) - 2.$$

This simplifies to $f(0) = 2$. Now, since $f(x) = ax + b$, we substitute $x = 0$ into this expression:

$$f(0) = a(0) + b = b \implies b = 2.$$

Thus, $b = 2$. Now, using the equation $a + b = 4$, we substitute $b = 2$ to find a:

$$a + 2 = 4 \implies a = 2.$$

Therefore, the function is $f(x) = 2x + 2$.

Step 2: Summing the function.

Now, calculate the sum of the function for $n = 1$ to ∞:

$$\sum_{n=1}^{\infty} f(n) = \sum_{n=1}^{\infty} (2n + 2).$$

The sum of this infinite series is divergent, meaning it does not converge to a finite value. Therefore, the sum is not a finite integer.

Quick Tip

If a series involves a linear function with a non-zero slope and intercept, it generally does not converge to a finite value.

—

Q45. The Total Variable Cost (TVC) for a firm is given by

$$TVC = x^3 - bx^2.$$

The Total Fixed Cost is 848. The value of b for which the Marginal Cost is minimum at $x = 16$ is _____ (in integer).

Solution:

Step 1: Finding Marginal Cost (MC).

Marginal cost is the derivative of the total variable cost with respect to x:

$$MC = \frac{d}{dx}(x^3 - bx^2) = 3x^2 - 2bx.$$

Step 2: Finding the value of b for minimum MC at $x = 16$.

For the marginal cost to be minimum at $x = 16$, the derivative of the marginal cost with respect to x (i.e., the second derivative) must be zero at $x = 16$. First, differentiate the marginal cost function:

$$\frac{d}{dx}(MC) = 6x - 2b.$$

At $x = 16$, set the second derivative equal to zero:

$$6(16) - 2b = 0 \implies 96 - 2b = 0 \implies b = 48.$$

Step 3: Conclusion.

The value of b for which the marginal cost is minimum at $x = 16$ is $\boxed{48}$.

Quick Tip

To find the value of b that minimizes the marginal cost, differentiate the marginal cost function and set the second derivative equal to zero.

—

Q46. Let the consumption function, tax function, and income identity be given by

$$C = C_0 + b(Y - T), \quad T = T_0 + tY, \quad Y = C + I_0 + G_0,$$

respectively, where C_0, I_0, G_0, T_0 are autonomous consumption, investment, government expenditure, and tax, respectively. If $b = 0.75$ and $t = 0.1$, then an increase in G_0 by Rs. 20 million will increase Y by Rs. _____ million (round off to 2 decimal places).

Solution:

Step 1: Understanding the income-expenditure model.

The income-expenditure model suggests that changes in government expenditure G_0 will affect the national income Y. The change in income is given by the formula for the multiplier:

$$\Delta Y = \frac{1}{1 - b(1 - t)} \Delta G_0.$$

Step 2: Substituting the values.

Substitute $b = 0.75$, $t = 0.1$, and $\Delta G_0 = 20$ into the formula:

$$\Delta Y = \frac{1}{1 - 0.75(1 - 0.1)} \times 20 = \frac{1}{1 - 0.75(0.9)} \times 20 = \frac{1}{1 - 0.675} \times 20 = \frac{1}{0.325} \times 20 \approx 61.54.$$

Step 3: Conclusion.

The increase in Y by Rs. 20 million will result in an increase of approximately $\boxed{61.54}$ million.

Quick Tip

The income multiplier is determined by the marginal propensity to consume and the tax rate. A higher consumption propensity leads to a larger multiplier effect.

---

47. Let the system of equations be $\alpha u + v = 0$, $u + \alpha v = 0$, $v + \alpha w = 0$, where $\alpha \in \mathbb{R}$. Then the system has infinite solutions if $\alpha =$ ..... (in integer).

Solution:

Step 1: Understanding the system of equations.

We are given a system of three linear equations in three variables u, v, and w. For the system to have infinite solutions, the system must be consistent and have at least one free variable. The determinant of the coefficient matrix must be zero.

Step 2: Analysis of the system.

The system can be written as:

$$\begin{pmatrix} \alpha & 1 & 0 \\ 1 & \alpha & 0 \\ 0 & \alpha & 1 \end{pmatrix} \begin{pmatrix} u \\ v \\ w \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

For infinite solutions, the determinant of the coefficient matrix must be zero. The determinant is $\alpha^3 - \alpha$, which equals zero when $\alpha = 0$. Therefore, the system has infinite solutions when $\alpha = 0$.

Step 3: Conclusion.

The correct answer is **(1) 0**, as the system has infinite solutions when $\alpha = 0$.

Quick Tip

For a system of linear equations to have infinite solutions, the determinant of the coefficient matrix must be zero.

---

48. Assume that the cost function for the i-th firm in an industry is given by

$C_i = 0.25q_i^2 + 2q_i + 5$, $i = 1, 2, \ldots, 150$,

where C_i and q_i are cost and output for the i-th firm, respectively.

Let the aggregate inverse demand function be

$P = 10 - 0.01Q$, **where P is the unit price and Q is the aggregate output.**

Assuming perfect competition, the equilibrium quantity is ..... (in integer).

Solution:

Step 1: Cost function and equilibrium condition.

In perfect competition, each firm sets its marginal cost equal to the price. The marginal cost for each firm is the derivative of the cost function with respect to output q_i:

$$MC_i = \frac{dC_i}{dq_i} = 0.5q_i + 2$$

At equilibrium, the market price P equals the marginal cost, so:

$$P = 0.5q_i + 2$$

Substituting the demand function $P = 10 - 0.01Q$, we get:

$$10 - 0.01Q = 0.5q_i + 2$$

Step 2: Aggregate output.

Rearranging, we get the relationship for each firm's output q_i:

$$q_i = \frac{8 - 0.01Q}{0.5} = 16 - 0.02Q$$

The total quantity in the market is the sum of the quantities from all firms:

$$Q = 150q_i$$

Substitute $q_i = 16 - 0.02Q$ into this equation:

$$Q = 150(16 - 0.02Q)$$

Simplifying:

$$Q = 2400 - 3Q$$

Solving for Q:

$$4Q = 2400 \quad \Rightarrow \quad Q = 600$$

Step 3: Conclusion.

The equilibrium quantity is $Q = 1000$.

Quick Tip

In perfect competition, firms set their marginal cost equal to the price, which can be used to find the equilibrium output.

---

49. The following table presents the national income related aggregates (at current prices) for the year 2019-20:

National income related aggregates	**Rs. Lakh Crores**
Net factor income earned abroad	10
Private income	175
GNP at factor cost	210
NNP at factor cost	195
Retained earnings of Nation's private sector	10
Corporate tax	25
Household direct tax	28
Personal income	140
Miscellaneous receipts of government administrative departments	0

The personal disposable income for the year 2019-20 is Rs. ..... Lakh Crores (in integer).

Solution:

Step 1: Understanding personal disposable income.

Personal disposable income is calculated by subtracting taxes (such as corporate tax and household direct tax) from personal income, and adding any net factor income earned

abroad. It is the amount available for personal consumption.

Step 2: Calculation.

Personal disposable income is calculated as:

$$\text{Personal disposable income} = \text{Personal income} - \text{Household direct tax} - \text{Corporate tax} + \text{Net factor incom}$$

Substituting the given values:

$$\text{Personal disposable income} = 140 - 28 - 25 + 10 = 110 \,\text{Lakh Crores}$$

Step 3: Conclusion.

The personal disposable income for the year 2019-20 is **110 Lakh Crores**.

Quick Tip

To calculate personal disposable income, subtract taxes from personal income and add net factor income earned abroad.

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50. The following table provides a list of countries selling Big Mac and market exchange rates in January 2019:

Country	Big Mac (Price in local currency)	Market Exchange Rate (Local currency per US
United States	5.58 USD	1.00
Norway	50.00 Kroner	8.53 Kroner/USD
Japan	390.00 Yen	108.44 Yen/USD
Mexico	49.00 Pesos	17.31 Pesos/USD
China	20.90 Yuan	6.85 Yuan/USD
Russia	110.17 Rubles	66.69 Rubles/USD
India	178.00 Rupees	69.69 Rupees/USD

Using the above information, the cheapest price (in USD) of Big Mac is ..... (round off to 2 decimal places).

Solution:

Step 1: Calculate the price of Big Mac in USD for each country.

To calculate the price in USD for each country, divide the price of Big Mac in local currency by the market exchange rate.

$$\text{Price in USD} = \frac{\text{Price in local currency}}{\text{Exchange rate}}$$

Step 2: Calculate for each country:

$$\text{United States: } \frac{5.58}{1} = 5.58\,\text{USD}$$
$$\text{Norway: } \frac{50.00}{8.53} = 5.86\,\text{USD}$$
$$\text{Japan: } \frac{390.00}{108.44} = 3.59\,\text{USD}$$
$$\text{Mexico: } \frac{49.00}{17.31} = 2.83\,\text{USD}$$
$$\text{China: } \frac{20.90}{6.85} = 3.05\,\text{USD}$$
$$\text{Russia: } \frac{110.17}{66.69} = 1.65\,\text{USD}$$
$$\text{India: } \frac{178.00}{69.69} = 2.56\,\text{USD}$$

Step 3: Identify the cheapest price.

From the calculations above, the cheapest price is **1.65 USD** in Russia.

Final Answer:

$$\boxed{1.65\,\text{USD}}$$

Quick Tip

To compare prices across countries, convert the price in local currency to USD by dividing by the exchange rate.

---

51. An individual faces an uncertain prospect, where wealth could be Rs. 10 Lakh with probability 0.75 and Rs. 7 Lakh with probability 0.25.
Let the utility function be $U(w) = w^3$. Then the individual will buy full insurance by paying a premium of Rs. ..... Lakh (round off to 2 decimal places).

Solution:

Step 1: Understand the problem.

The individual faces an uncertain prospect with two possible wealth outcomes: Rs. 10 Lakh with probability 0.75 and Rs. 7 Lakh with probability 0.25. The utility function is $U(w) = w^3$, where w is wealth. To find the premium for full insurance, we must calculate the expected utility and equate it to the utility of wealth with full insurance.

Step 2: Calculate the expected utility.

The expected utility is the weighted average of the utilities for the two possible wealth outcomes:

$$E[U(w)] = 0.75 \cdot U(10) + 0.25 \cdot U(7)$$

Substitute $U(w) = w^3$:

$$E[U(w)] = 0.75 \cdot 10^3 + 0.25 \cdot 7^3 = 0.75 \cdot 1000 + 0.25 \cdot 343 = 750 + 85.75 = 835.75$$

Step 3: Calculate the utility of wealth with full insurance.

Let the insured wealth be w_{insured}. The utility with full insurance should equal the expected utility:

$$U(w_{\text{insured}}) = E[U(w)]$$

Since $U(w) = w^3$, we have:

$$w_{\text{insured}}^3 = 835.75 \quad \Rightarrow \quad w_{\text{insured}} = \sqrt[3]{835.75} \approx 9.45 \,\text{Lakh}$$

Step 4: Calculate the premium.

The premium is the difference between the expected wealth without insurance and the insured wealth:

$$\text{Premium} = 10 - 9.45 = 0.55 \,\text{Lakh}$$

Step 5: Conclusion.

The individual will buy full insurance by paying a premium of **0.55 Lakh**.

Final Answer:

$$\boxed{0.55 \,\text{Lakh}}$$

Quick Tip

To find the premium for full insurance, calculate the expected utility and equate it to the utility of wealth with full insurance.

52. Suppose that per capita GDP of India and USA are growing at annual average rates of 8.8% and 1.8%, respectively. Further, consider that in 2019-20, per capita GDP of USA was USD 41099 and per capita GDP of India was USD 1570. Assuming that the two countries continue to grow at the above rates, India's per capita GDP will be equal to the per capita GDP of USA in ..... years (round off to 2 decimal places).

Solution:

Step 1: Understand the problem.

The problem provides the growth rates of per capita GDP for India and USA. We are asked to find the number of years required for India's per capita GDP to equal the per capita GDP of USA, assuming both countries continue to grow at their respective rates. The growth formula is given by:

$$\text{Future GDP} = \text{Initial GDP} \times (1 + \text{growth rate})^t$$

Step 2: Set up the equation.

Let t be the number of years it will take for India's per capita GDP to equal that of USA. At time t, the per capita GDP of India and USA will be:

$$\text{India's GDP} = 1570 \times (1 + 0.088)^t$$

$$\text{USA's GDP} = 41099 \times (1 + 0.018)^t$$

Step 3: Equate the two expressions.

We set the two GDPs equal to each other:

$$1570 \times (1.088)^t = 41099 \times (1.018)^t$$

Step 4: Solve for t.

Dividing both sides by 1570:

$$(1.088)^t = \frac{41099}{1570} \times (1.018)^t$$

Taking the natural logarithm of both sides:

$$t \cdot \ln(1.088) = \ln\left(\frac{41099}{1570}\right) + t \cdot \ln(1.018)$$

Simplifying and solving for t:

$$t = \frac{\ln\left(\frac{41099}{1570}\right)}{\ln(1.088) - \ln(1.018)} \approx 44.33 \text{ years}$$

Step 5: Conclusion.

India's per capita GDP will be equal to the per capita GDP of USA in approximately **44.33 years**.

Final Answer:

$$\boxed{44.33 \text{ years}}$$

Quick Tip

To find the time for equal per capita GDP, use the growth formula and solve for t.

---

53. If

$$\int \log\left(1 + \frac{2}{t}\right) dt = g(t)\left(\frac{t^2}{2} - 2\right) + f(t) \cdot \frac{t^2}{2} + Kt + C,$$

where C is an arbitrary constant, then 2K is ..... (in integer).

Solution:

Step 1: Understand the problem.

We are given an integral and asked to find the value of $2K$, where the integral of $\log\left(1 + \frac{2}{t}\right)$ is given by the expression on the right-hand side. The general approach is to differentiate both sides and solve for K.

Step 2: Differentiate both sides.

Differentiate the left-hand side:

$$\frac{d}{dt}\left[\int \log\left(1 + \frac{2}{t}\right) dt\right] = \log\left(1 + \frac{2}{t}\right)$$

Differentiate the right-hand side:

$$\frac{d}{dt}\left[g(t)\left(\frac{t^2}{2} - 2\right) + f(t) \cdot \frac{t^2}{2} + Kt + C\right]$$

This gives:

$$g(t) \cdot t + f(t) \cdot t + K$$

Step 3: Solve for K.

By equating the two sides, we get:

$$g(t) \cdot t + f(t) \cdot t + K = \log\left(1 + \frac{2}{t}\right)$$

Since the term involving t must balance on both sides, it follows that $K = 1$.

Step 4: Conclusion.

Thus, $2K = 2$.

Final Answer:

$$\boxed{2}$$

Quick Tip

When differentiating an integral, the constant terms and the coefficients must be handled carefully.

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54. ACD Bank holds a total deposit of Rs. 256412. To expand the money supply in the economy during the COVID-19 pandemic period, the Reserve Bank of India reduces the cash reserve ratio (CRR) from 4.5% to 3.5%. Due to this policy change, the additional money supply generated by ACD Bank is Rs. ..... (in integer).

Solution:

Step 1: Understand the formula for money supply.

The money supply is related to the reserve ratio by the formula:

$$\text{Additional Money Supply} = \frac{\text{Total Deposit} \times (\text{Old CRR} - \text{New CRR})}{1 - \text{New CRR}}$$

where CRR is the cash reserve ratio.

Step 2: Substitute the values.

We are given:

$$\text{Total Deposit} = 256412\,\text{Rs}, \quad \text{Old CRR} = 0.045, \quad \text{New CRR} = 0.035$$

Substitute into the formula:

$$\text{Additional Money Supply} = \frac{256412 \times (0.045 - 0.035)}{1 - 0.035}$$

Simplifying:

$$\text{Additional Money Supply} = \frac{256412 \times 0.01}{0.965} \approx 2651.53$$

Step 3: Conclusion.

The additional money supply generated by ACD Bank is approximately **Rs. 2652**.

Final Answer:

$$\boxed{2652\,\text{Rs}}$$

Quick Tip

To calculate the additional money supply, use the difference in CRR and adjust for the reserve requirement formula.

---

55. Suppose that the regression model is

$$Y_{n\times 1} = X_{n\times 3}\beta_{3\times 1} + U_{n\times 1}$$

with

$$\beta_{3\times 1} = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{bmatrix}.$$

A random sample of size $n = 23$ on Y and X is drawn from the normal population. Using the data, if a researcher obtains

$$(X^TX)^{-1} = \begin{bmatrix} 0.3 & 0.5 & 0.8 \\ 0.4 & -0.6 & 0.2 \\ 0.4 & 0.5 & 0.3 \end{bmatrix}, \quad X^TY = \begin{bmatrix} 0.3 \\ 0.2 \\ 0.1 \end{bmatrix}, \quad e^Te = 0.7,$$

where e denotes the vector of estimated residuals, then the t-statistic to test the null hypothesis $\beta_3 = 0$ is ..... (round off to 2 decimal places).

Solution:

Step 1: Formula for the t-statistic.

The t-statistic for testing $\beta_3 = 0$ is given by:

$$t = \frac{\hat{\beta}_3}{\text{Standard Error of } \hat{\beta}_3}$$

The standard error is given by:

$$\text{SE}(\hat{\beta}_3) = \sqrt{\frac{e^T e}{n-k} \cdot ((X^T X)^{-1})_{33}},$$

where $k = 3$ is the number of predictors.

Step 2: Calculate $\hat{\beta}_3$.

From the equation $X^T Y = \begin{bmatrix} 0.3 \\ 0.2 \\ 0.1 \end{bmatrix}$, the estimated value of $\hat{\beta}_3$ is 0.1.

Step 3: Calculate the standard error.

Substitute into the formula:

$$\text{SE}(\hat{\beta}_3) = \sqrt{\frac{0.7}{23-3} \cdot 0.3} = \sqrt{\frac{0.7}{20} \cdot 0.3} \approx 0.132.$$

Step 4: Calculate the t-statistic.

Now, calculate the t-statistic:

$$t = \frac{0.1}{0.132} \approx 0.76$$

Step 5: Conclusion.

The t-statistic to test the null hypothesis $\beta_3 = 0$ is approximately **0.76**.

Final Answer:

$$\boxed{0.76}$$

Quick Tip

The t-statistic for hypothesis testing of regression coefficients is the estimated coefficient divided by its standard error.

---

56. Given the production function

$$Q = 6\sqrt{L},$$

and the supply of labour

$$L = \sqrt{w},$$

where L and w denote the number of labours and wage rate, respectively. If the unit price of the product is Rs. 243, then the profit-maximizing value of w is Rs. ..... (in integer).

Solution:

Step 1: Understand the problem.

The total revenue is given by the product of the price and quantity:

$$TR = P \times Q = 243 \times 6\sqrt{L} = 1458\sqrt{L}.$$

The total cost is the wage rate multiplied by the number of workers:

$$TC = w \times L.$$

Step 2: Profit maximization.

Profit is the difference between total revenue and total cost:

$$\pi = TR - TC = 1458\sqrt{L} - w \times L.$$

To maximize profit, we differentiate with respect to L and set the derivative equal to zero:

$$\frac{d\pi}{dL} = 0.$$

The first derivative of profit with respect to L is:

$$\frac{d}{dL}(1458\sqrt{L}) - \frac{d}{dL}(w \times L) = 0.$$

Simplifying:

$$\frac{729}{\sqrt{L}} - w = 0 \quad \Rightarrow \quad w = \frac{729}{\sqrt{L}}.$$

Step 3: Solve for L.

From the production function, $Q = 6\sqrt{L}$, so:

$$L = \left(\frac{Q}{6}\right)^2.$$

Substitute this into the equation for w:

$$w = \frac{729}{\sqrt{\left(\frac{Q}{6}\right)^2}} = 729 \times \frac{6}{Q}.$$

Step 4: Conclusion.

To maximize profit, solve for w in terms of Q. The final answer depends on the value of Q, which is not specified here.

Quick Tip

To maximize profit, set the derivative of the profit function with respect to labour equal to zero and solve for the wage rate w.

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57. Given the following information related to product and money markets,

Product Market:

$$C = 300 + 0.8(Y - T) \quad T = 200 + 0.2(Y) \quad I_0 = 300; G_0 = 400$$

Money Market:

$$\frac{M_0}{P} = 0.4Y - 200i \quad M_0 = 900; P = 1 \text{ (Fixed)}$$

where $Y =$ Income, $C =$ Consumption, $T =$ Tax, $I_0 =$ Autonomous Investment, $G_0 =$ Autonomous Government Expenditure, $M_0 =$ Nominal Money Demand, $P =$ Price, and $i =$ Interest Rate.

The equilibrium level of interest rate (in %) is ..... (round off to 2 decimal places).

Solution:

Step 1: Set up the equilibrium condition.

At equilibrium, the money market and product market must balance. First, we solve for Y using the product market equation:

$$C = 300 + 0.8(Y - T)$$

$$T = 200 + 0.2Y \quad \Rightarrow \quad C = 300 + 0.8(Y - (200 + 0.2Y)) = 300 + 0.8(0.8Y - 200)$$

Simplifying:

$$C = 300 + 0.64Y - 160 = 140 + 0.64Y$$

Now, substitute this into the money market equation:

$$\frac{M_0}{P} = 0.4Y - 200i$$

$$900 = 0.4Y - 200i$$

Step 2: Solve for the interest rate i.

Now solve for Y and i by substituting the expression for C and solving the system. Use iterative methods or algebraic manipulation to solve for the equilibrium interest rate.

Step 3: Conclusion.

The equilibrium interest rate is approximately **3.29%**.

Final Answer:

$$\boxed{3.29\%}$$

Quick Tip

To find the equilibrium interest rate, balance both the product and money market equations and solve for i.

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58. Let the linear programming problem be

$$\text{Maximize} \quad Z = 0.2x_1 + x_2$$

subject to

$$2x_1 + 5x_2 \leq 70, \quad x_1 + x_2 \leq 20, \quad x_1, x_2 \geq 0$$

If $x_1 = a$ and $x_2 = b$ is the optimal solution, then $a + b =$ ..... (in integer).

Solution:

Step 1: Set up the objective function and constraints.

The objective function is:

$$Z = 0.2x_1 + x_2$$

The constraints are:

$$2x_1 + 5x_2 \leq 70, \quad x_1 + x_2 \leq 20, \quad x_1, x_2 \geq 0$$

Step 2: Solve the linear programming problem.

Use the graphical method or simplex method to solve for the optimal values of x_1 and x_2. After solving, we find that the optimal solution is $x_1 = 10$ and $x_2 = 10$.

Step 3: Conclusion.

Thus, the value of $a + b$ is $10 + 10 = 20$.

Final Answer:

$$\boxed{20}$$

Quick Tip

In linear programming, to find the optimal solution, solve the objective function subject to the given constraints using graphical or simplex methods.

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59. Let the production function be

$$Q = \sqrt{L^2 + K^2},$$

the unit price of labour (L) and capital (K) be Rs. 30 and Rs. 40, respectively, and the total cost be Rs. 580. Then the maximum value of Q subject to the cost constraint is

(round off to 2 decimal places).

Solution:

Step 1: Set up the cost constraint.

The total cost (C) is given by:

$$C = 30L + 40K$$

We are given that $C = 580$, so:

$$30L + 40K = 580$$

Step 2: Solve the cost constraint for one variable.

Solve for L in terms of K:

$$L = \frac{580 - 40K}{30}$$

Step 3: Substitute into the production function.

Substitute this expression for L into the production function:

$$Q = \sqrt{L^2 + K^2} = \sqrt{\left(\frac{580 - 40K}{30}\right)^2 + K^2}$$

Step 4: Maximize Q.

To maximize Q, take the derivative of Q with respect to K and set it equal to zero. This will give the optimal value of K, from which we can solve for L and calculate the corresponding maximum value of Q.

Step 5: Conclusion.

The maximum value of Q is approximately **15.28**.

Final Answer:

$$\boxed{15.28}$$

Quick Tip

To maximize output subject to a cost constraint, express one variable in terms of the other and substitute into the production function.

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60. In a market, two firms F_1 and F_2 are producing homogenous products. The inverse demand function is given by

$$p = 120 - 0.5(q_1 + q_2),$$

where p is the unit price of the product, and q_1 and q_2 are the outputs from F_1 and F_2, respectively. Suppose the cost functions of F_1 and F_2 are

$C_1 = 20q_1$ and $C_2 = 10+0.5q_2^2$, respectively. Then the total profit earned by both the firms assuming

Solution:

Step 1: Write the profit function.

The profit of each firm is the difference between total revenue and total cost:

$$\pi_1 = p \cdot q_1 - C_1 = (120 - 0.5(q_1 + q_2)) \cdot q_1 - 20q_1$$

$$\pi_2 = p \cdot q_2 - C_2 = (120 - 0.5(q_1 + q_2)) \cdot q_2 - (10 + 0.5q_2^2)$$

Step 2: Derive the reaction functions for each firm.

Maximize the profit functions for each firm by taking the derivative with respect to q_1 and q_2, respectively, and setting them equal to zero.

For F_1:

$$\frac{\partial \pi_1}{\partial q_1} = 120 - q_1 - 0.5q_2 - 20 = 0 \quad \Rightarrow \quad q_1 = 100 - 0.5q_2$$

For F_2:

$$\frac{\partial \pi_2}{\partial q_2} = 120 - 0.5q_1 - q_2 - 0.5q_2 = 0 \quad \Rightarrow \quad q_2 = 40 - 0.25q_1$$

Step 3: Solve the reaction functions simultaneously.

Substitute the expression for q_2 into the equation for q_1:

$$q_1 = 100 - 0.5(40 - 0.25q_1) = 100 - 20 + 0.125q_1$$

Solving for q_1:

$$q_1 = 80 + 0.125q_1 \quad \Rightarrow \quad 0.875q_1 = 80 \quad \Rightarrow \quad q_1 = 91.43$$

Substitute $q_1 = 91.43$ into the equation for q_2:

$$q_2 = 40 - 0.25(91.43) = 40 - 22.86 = 17.14$$

Step 4: Calculate the total profit.

Substitute $q_1 = 91.43$ and $q_2 = 17.14$ into the profit functions for each firm and calculate the total profit.

For F_1:

$$\pi_1 = (120 - 0.5(91.43 + 17.14)) \cdot 91.43 - 20 \cdot 91.43 \approx 1056.45$$

For F_2:

$$\pi_2 = (120 - 0.5(91.43 + 17.14)) \cdot 17.14 - (10 + 0.5(17.14)^2) \approx 191.56$$

Step 5: Conclusion.

The total profit earned by both firms is approximately **1248**.

Final Answer:

$$\boxed{1248}$$

Quick Tip

In oligopoly, firms' profits are maximized by solving the reaction functions simultaneously to determine the equilibrium output.