CUET PG 2026 Statistics Question Paper with Solutions(Memory Based)

Time Allowed :1 Hour 30 Mins	Maximum Marks :300	Total Questions :75

General Instructions

Read the following instructions very carefully and strictly follow them:

- Answers to this Paper must be written on the paper provided separately.
- You will not be allowed to write during the first 15 minutes
- This time is to be spent in reading the question paper.
- The time given at the head of this Paper is the time allowed for writing the answers,
- The paper has four Sections.
- Section A is compulsory - All questions in Section A must be answered.
- You must attempt one question from each of the Sections B, C and D and one other question from any Section of your choice.

1. If $P(A) = 0.4$, $P(B) = 0.5$, and A and B are independent events, what is the value of $P(A \cup B)$?
(A) 0.60
(B) 0.65
(C) 0.70
(D) 0.75

Correct Answer: (3) 0.70

Solution:

Concept:
For any two events A and B, the probability of their union is given by:

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

If A and B are **independent events**, then:

$$P(A \cap B) = P(A)P(B)$$

Thus, the formula becomes:

$$P(A \cup B) = P(A) + P(B) - P(A)P(B)$$

Step 1: Find $P(A \cap B)$ using independence.

$$P(A \cap B) = P(A)P(B)$$

Substitute the given values:

$$P(A \cap B) = 0.4 \times 0.5 = 0.20$$

Step 2: Apply the union formula.

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

Substitute the values:

$$P(A \cup B) = 0.4 + 0.5 - 0.20$$

$$P(A \cup B) = 0.70$$

$$\therefore P(A \cup B) = 0.70$$

Quick Tip

For independent events, remember that the probability of both events occurring together is the product of their probabilities:

$$P(A \cap B) = P(A)P(B)$$

This simplifies many probability calculations.

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2. For a Poisson distribution where the mean is 4, what is the value of the third central moment?

(A) 4
(B) 8
(C) 16
(D) 64

Correct Answer: (1) 4

Solution:

Concept:
For a Poisson distribution with parameter λ:

- Mean $= \lambda$
- Variance $= \lambda$
- The **third central moment** μ_3 is also equal to λ

Thus,

$$\mu_3 = \lambda$$

Step 1: Identify the parameter of the distribution.
The mean of the Poisson distribution is given as:

$$\lambda = 4$$

Step 2: Use the formula for the third central moment.

$$\mu_3 = \lambda$$

Substituting the value:

$$\mu_3 = 4$$

$$\therefore \text{The third central moment is } 4$$

Quick Tip

For a Poisson distribution, several moments have simple forms:

$$\text{Mean} = \text{Variance} = \text{Third central moment} = \lambda$$

This property makes calculations involving Poisson moments very straightforward.

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3. Which property of an estimator is satisfied if its expected value equals the population parameter?
(A) Consistency
(B) Efficiency
(C) Unbiasedness
(D) Sufficiency

Correct Answer: (3) Unbiasedness

Solution:

Concept:
In statistical estimation, an estimator $\hat{\theta}$ is said to be **unbiased** if its expected value equals the true population parameter θ. Mathematically, this is expressed as:

$$E(\hat{\theta}) = \theta$$

This means that on average, the estimator correctly estimates the true parameter value.
Step 1: Understand the definition of an unbiased estimator.
If an estimator $\hat{\theta}$ satisfies

$$E(\hat{\theta}) = \theta$$

then the estimator does not systematically overestimate or underestimate the parameter.
Step 2: Identify the property.
The property that ensures the expected value of an estimator equals the population parameter is called **Unbiasedness**.

$$\therefore \text{The correct answer is Unbiasedness.}$$

Quick Tip

An estimator is **unbiased** if:

$$E(\hat{\theta}) = \theta$$

This means the estimator gives the correct value of the parameter on average over many samples.

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4. If a matrix A has eigenvalues 2 and 3, what are the eigenvalues of the matrix A^2?
(A) $2, 3$
(B) $4, 9$
(C) $5, 6$
(D) $8, 27$

Correct Answer: (2) 4, 9

Solution:

Concept:
If λ is an eigenvalue of a matrix A, then the eigenvalue of A^k is λ^k.
This follows from the eigenvalue definition:

$$A\mathbf{x} = \lambda\mathbf{x}$$

Multiplying both sides by A:

$$A^2\mathbf{x} = A(\lambda\mathbf{x}) = \lambda(A\mathbf{x}) = \lambda(\lambda\mathbf{x}) = \lambda^2\mathbf{x}$$

Thus, the eigenvalues of A^2 are the **squares of the eigenvalues of** A.
Step 1: Identify the eigenvalues of A.
Given:

$$\lambda_1 = 2, \qquad \lambda_2 = 3$$

Step 2: Find eigenvalues of A^2.
Square each eigenvalue:

$$\lambda_1^2 = 2^2 = 4$$

$$\lambda_2^2 = 3^2 = 9$$

Step 3: Write the eigenvalues of A^2.

$$\text{Eigenvalues of } A^2 = 4, 9$$

$$\therefore \text{ The correct answer is } 4, 9.$$

Quick Tip

If λ is an eigenvalue of A, then for any positive integer k:

$$\text{Eigenvalues of } A^k = \lambda^k$$

Thus, simply raise each eigenvalue of A to the power k.

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5. In a Normal distribution, what percentage of data falls within two standard deviations of the mean?
(A) 68%
(B) 95%
(C) 99.7%
(D) 90%

Correct Answer: (2) 95%

Solution:

Concept:
A Normal distribution follows the well-known **Empirical Rule** (also called the **68–95–99.7 rule**). This rule describes how data is distributed around the mean.

- About 68% of the data lies within 1 standard deviation of the mean.
- About 95% of the data lies within 2 standard deviations of the mean.
- About 99.7% of the data lies within 3 standard deviations of the mean.

Step 1: Identify the required interval.
The question asks for the percentage of data within **two standard deviations** from the mean.

$$\mu - 2\sigma \leq X \leq \mu + 2\sigma$$

Step 2: Apply the Empirical Rule.
According to the empirical rule:

$$P(\mu - 2\sigma \leq X \leq \mu + 2\sigma) \approx 95\%$$

$$\therefore \text{ Approximately } 95\% \text{ of the data lies within two standard deviations of the mean.}$$

Quick Tip

Remember the **68–95–99.7 rule** for Normal distribution:

$$1\sigma \to 68\%, \qquad 2\sigma \to 95\%, \qquad 3\sigma \to 99.7\%$$

It is frequently used in statistics and data analysis.

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6. What is the rank of a 3×3 identity matrix added to a 3×3 null matrix?
(A) 0
(B) 1
(C) 2
(D) 3

Correct Answer: (4) 3

Solution:

Concept:
The **identity matrix** I_n is a square matrix with ones on the main diagonal and zeros elsewhere.
The **null matrix** (or zero matrix) has all its elements equal to zero.
Key properties:

- Adding a null matrix to any matrix does not change the matrix.

$$A + O = A$$

- The rank of the identity matrix I_n is n because all rows (and columns) are linearly independent.

Step 1: Add the matrices.
Let the identity matrix be

$$I_3 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

The null matrix is

$$O = \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

Adding them:

$$I_3 + O = I_3$$

Step 2: Find the rank of the resulting matrix.
Since the resulting matrix is still the identity matrix I_3, all its rows (and columns) are linearly independent.

$$\text{Rank}(I_3) = 3$$

$$\therefore \text{The rank of the matrix is 3.}$$

Quick Tip

The rank of an identity matrix I_n is always n, because all rows and columns are linearly independent.

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7. In Simple Random Sampling Without Replacement (SRSWOR), what is the probability of selecting a specific unit at the second draw?

(A) $\frac{1}{N}$

(B) $\frac{1}{N-1}$

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

(D) $\frac{1}{N^2}$

Correct Answer: (1) $\frac{1}{N}$

Solution:

Concept:
In **Simple Random Sampling Without Replacement (SRSWOR)**, each unit in the population has an equal probability of being selected at any draw.
Even though units are not replaced, the probability that any particular unit appears in a specific draw remains the same due to symmetry of selection.
If the population size is N, then the probability that a specific unit is selected in any particular position of the sample is:

$$P = \frac{1}{N}$$

Step 1: Consider the population size.
Let the population contain N units, and suppose we are interested in the probability that a particular unit (say unit i) is selected at the second draw.
Step 2: Consider the two possible ways this can happen.
The specific unit can appear in the second draw if:

- It was **not selected in the first draw**.
- It is **selected in the second draw**.

Thus,

$$P(\text{unit } i \text{ at second draw}) = P(\text{not selected in first}) \times P(\text{selected in second})$$

$$= \left(\frac{N-1}{N}\right)\left(\frac{1}{N-1}\right)$$

$$= \frac{1}{N}$$

Step 3: Interpret the result.
Hence, the probability that a particular unit is selected at the second draw is:

$$\frac{1}{N}$$

$$\therefore \text{The correct answer is } \frac{1}{N}.$$

Quick Tip

In SRSWOR, every unit has an equal chance of appearing in any position of the sample. Thus, the probability that a specific unit appears in the k^{th} draw is always:

$$\frac{1}{N}$$

where N is the population size.

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8. If the correlation coefficient between X and Y is 0.8, what is the coefficient of determination?
(A) 0.64
(B) 0.80
(C) 0.16
(D) 1.60

Correct Answer: (1) 0.64

Solution:

Concept:
The **coefficient of determination** is the square of the correlation coefficient. It represents the proportion of the variation in the dependent variable that is explained by the independent variable.
If the correlation coefficient is r, then:

$$R^2 = r^2$$

where R^2 is called the coefficient of determination.
Step 1: Identify the given correlation coefficient.

$$r = 0.8$$

Step 2: Square the correlation coefficient.

$$R^2 = (0.8)^2$$

$$R^2 = 0.64$$

Step 3: Interpret the result.
Thus, the coefficient of determination is:

$$0.64$$

$$\therefore \text{The correct answer is } 0.64.$$

Quick Tip

The coefficient of determination is simply the square of the correlation coefficient:

$$R^2 = r^2$$

It indicates the proportion of variation in one variable explained by the other.

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9. A bag contains 5 red and 7 blue balls. If two balls are drawn at random, what is the probability that both are red?

(A) $\frac{5}{66}$
(B) $\frac{10}{66}$
(C) $\frac{5}{33}$
(D) $\frac{25}{66}$

Correct Answer: (2) $\frac{10}{66}$

Solution:

Concept:
When objects are drawn **without replacement**, the probability of successive events changes after each draw. If the total number of objects is n, and r objects satisfy a condition, the probability can be computed using either:

- Multiplication rule of probability, or
- Combination formula

$$P(\text{both red}) = \frac{\text{Number of favorable outcomes}}{\text{Total number of outcomes}}$$

Step 1: Determine the total number of balls.

$$\text{Total balls} = 5 + 7 = 12$$

Step 2: Compute the probability using the multiplication rule.
Probability that the first ball is red:

$$P(R_1) = \frac{5}{12}$$

After drawing one red ball, remaining red balls = 4 and total balls = 11.
Probability that the second ball is red:

$$P(R_2|R_1) = \frac{4}{11}$$

Step 3: Find the joint probability.

$$P(\text{both red}) = \frac{5}{12} \times \frac{4}{11}$$

$$= \frac{20}{132}$$

$$= \frac{10}{66}$$

$$\therefore \text{The probability that both balls are red is } \frac{10}{66}.$$

Quick Tip

For drawing without replacement:

$$P(A \cap B) = P(A) \times P(B|A)$$

Alternatively, use combinations:

$$P(\text{both red}) = \frac{\binom{5}{2}}{\binom{12}{2}}$$

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10. Which test is most appropriate for testing the significance of the difference between two small sample means?
(A) Z-test
(B) t-test
(C) Chi-square test
(D) F-test

Correct Answer: (2) t-test

Solution:

Concept:
When comparing the means of two samples, the choice of test depends mainly on the sample size and knowledge of population variance.

- If the sample size is **large** ($n \geq 30$), the **Z-test** is generally used.
- If the sample size is **small** ($n < 30$) and the population variance is unknown, the **Student's t-test** is used.

The **t-test** is specifically designed for small samples and accounts for additional uncertainty in estimating the population variance.
Step 1: Identify the condition given in the question.
The problem states that the samples are **small**.
Step 2: Choose the appropriate statistical test.
For small sample means, the correct test is the **Student's t-test**.
Step 3: State the conclusion.

$$\therefore \text{The appropriate test for comparing two small sample means is the t-test.}$$

Quick Tip

Use the **t-test** when:

- Sample size is small ($n < 30$)
- Population variance is unknown

It is commonly used to test the significance of the difference between two sample means.

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11. If the null hypothesis H_0 is rejected when it is actually true, what type of error has been committed?
(A) Type I Error
(B) Type II Error
(C) Sampling Error
(D) Standard Error

Correct Answer: (1) Type I Error

Solution:

Concept:
In hypothesis testing, two types of errors may occur when making a decision about the null hypothesis.

- **Type I Error:** Rejecting the null hypothesis H_0 when it is actually true.
- **Type II Error:** Failing to reject the null hypothesis H_0 when it is actually false.

The probability of committing a Type I error is denoted by α, which is also called the **level of significance**.
Step 1: Understand the situation given in the question.
The question states that the null hypothesis H_0 is **rejected** even though it is **actually true**.
Step 2: Identify the type of error.
This situation exactly matches the definition of a **Type I Error**.
Step 3: State the conclusion.

$$\therefore \text{Rejecting a true null hypothesis results in a Type I Error.}$$

Quick Tip

Remember the two main hypothesis testing errors:

$$\text{Type I Error: Reject } H_0 \text{ when it is true}$$

$$\text{Type II Error: Fail to reject } H_0 \text{ when it is false}$$

Type I error probability is the **significance level** α.

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12. What is the value of the integral $\int_{-\infty}^{\infty} e^{-x^2}\,dx$?

(A) $\sqrt{\pi}$
(B) π
(C) 1
(D) $\frac{\sqrt{\pi}}{2}$

Correct Answer: (1) $\sqrt{\pi}$

Solution:

Concept:
The integral

$$\int_{-\infty}^{\infty} e^{-x^2}\,dx$$

is known as the **Gaussian integral**. It plays a fundamental role in probability theory, especially in the Normal distribution.
A well-known result from calculus states:

$$\int_{-\infty}^{\infty} e^{-x^2}\,dx = \sqrt{\pi}$$

This result is usually derived by squaring the integral and converting it into polar coordinates.
Step 1: Define the integral.
Let

$$I = \int_{-\infty}^{\infty} e^{-x^2}\,dx$$

Step 2: Square the integral.

$$I^2 = \left(\int_{-\infty}^{\infty} e^{-x^2}\,dx\right)\left(\int_{-\infty}^{\infty} e^{-y^2}\,dy\right)$$
$$= \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} e^{-(x^2+y^2)}\,dx\,dy$$

Step 3: Convert to polar coordinates.
Using $x^2 + y^2 = r^2$ and $dx\,dy = r\,dr\,d\theta$:

$$I^2 = \int_0^{2\pi}\int_0^{\infty} e^{-r^2} r\,dr\,d\theta$$
$$= 2\pi \int_0^{\infty} e^{-r^2} r\,dr$$

Let $u = r^2$, $du = 2r\,dr$:

$$\int_0^{\infty} e^{-r^2} r\,dr = \frac{1}{2}$$

Thus,

$$I^2 = 2\pi \times \frac{1}{2} = \pi$$

Step 4: Take the square root.

$$I = \sqrt{\pi}$$

$$\therefore \int_{-\infty}^{\infty} e^{-x^2}\,dx = \sqrt{\pi}$$

Quick Tip

The Gaussian integral is a standard result in calculus and statistics:

$$\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}$$

It is closely related to the Normal distribution.

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13. In a negatively skewed distribution, what is the correct relationship between the Mean, Median, and Mode?
(A) Mean > Median > Mode
(B) Mean < Median < Mode

(C) Mean = Median = Mode
(D) Mode < Median < Mean

Correct Answer: (2) Mean < Median < Mode

Solution:

Concept:
A **negatively skewed distribution** (also called **left-skewed distribution**) has a longer tail on the **left side**. In such distributions, smaller values pull the mean toward the left.
Because of this effect:

- The **mean** is pulled most toward the tail.
- The **median** lies between the mean and the mode.
- The **mode** remains near the peak of the distribution.

Thus, the relationship becomes:

$$\text{Mean} < \text{Median} < \text{Mode}$$

Step 1: Understand the effect of skewness.
In a negatively skewed distribution, extreme low values pull the mean toward the left side.
Step 2: Determine the order of central tendencies.
Since the mean is affected the most by extreme values:

$$\text{Mean} < \text{Median} < \text{Mode}$$

Step 3: State the conclusion.

$$\therefore \text{The correct relationship is Mean } < \text{ Median } < \text{ Mode.}$$

Quick Tip

Remember the order of central tendencies:

$$\text{Negatively skewed: Mean} < \text{Median} < \text{Mode}$$

$$\text{Positively skewed: Mean} > \text{Median} > \text{Mode}$$

$$\text{Symmetrical distribution: Mean} = \text{Median} = \text{Mode}$$

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14. Find the limit of $\left(1+\frac{1}{n}\right)^n$ as $n \to \infty$.
(A) 1
(B) e
(C) 0
(D) 2

Correct Answer: (2) e

Solution:

Concept:
The limit

$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n$$

is a well-known fundamental limit in calculus. It defines the mathematical constant e, which is the base of natural logarithms.

$$e \approx 2.71828$$

Thus,

$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$$

Step 1: Identify the standard limit form.
The expression given in the question exactly matches the standard definition of e:

$$e = \lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n$$

Step 2: Apply the known result.
Since the expression is the same as the definition of e,

$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$$

Step 3: State the final result.

$$\therefore \text{The value of the limit is } e.$$

Quick Tip

A very important limit in calculus is:

$$\lim_{n\to\infty}\left(1+\frac{1}{n}\right)^n = e$$

This limit is used in compound interest, exponential growth, and many areas of mathematics.

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15. What is the degree of freedom for a Chi-square test used in a 3×4 contingency table?
(A) 6
(B) 8
(C) 9
(D) 12

Correct Answer: (1) 6

Solution:

Concept:
In a Chi-square test for independence using a contingency table, the **degrees of freedom** are calculated using the formula:

$$df = (r-1)(c-1)$$

where:

- r = number of rows
- c = number of columns

Step 1: Identify the number of rows and columns.
Given contingency table:

$$3 \times 4$$

Thus,

$$r = 3, \qquad c = 4$$

Step 2: Apply the formula for degrees of freedom.

$$df = (r-1)(c-1)$$

$$df = (3-1)(4-1)$$

$$df = (2)(3)$$

$$df = 6$$

Step 3: State the conclusion.

$$\therefore \text{The degree of freedom is } 6.$$

Quick Tip

For a Chi-square test using a contingency table:

$$df = (r-1)(c-1)$$

where r is the number of rows and c is the number of columns.
