Test Paper : **II**

Test Subject : **MATHEMATICAL SCIENCE**

Test Subject Code : **K-2615**

Test Booklet Serial No. : ______________________

OMR Sheet No. : ______________________

Roll No. | | | | | | | | |

(Figures as per admission card)

Name & Signature of Invigilator/s

Signature : ______________________

Name : ______________________

Paper : II

Subject : MATHEMATICAL SCIENCE

Time : 1 Hour 15 Minutes

Maximum Marks : 100

Number of Pages in this Booklet : **8**

Number of Questions in this Booklet : **50**

ಅಭ್ಯರ್ಥಿಗಳಿಗೆ ಸೂಚನೆಗಳು

1. ಈ ಪುಟದ ಮೇಲ್ತುದಿಯಲ್ಲಿ ಒದಗಿಸಿದ ಸ್ಥಳದಲ್ಲಿ ನಿಮ್ಮ ರೋಲ್ ನಂಬರನ್ನು ಬರೆಯಿರಿ.
2. ಈ ಪತ್ರಿಕೆಯು ಬಹು ಆಯ್ಕೆ ವಿಧದ ಐವತ್ತು ಪ್ರಶ್ನೆಗಳನ್ನು ಒಳಗೊಂಡಿದೆ.
3. ಪರೀಕ್ಷೆಯ ಪ್ರಾರಂಭದಲ್ಲಿ, ಪ್ರಶ್ನೆಪುಸ್ತಿಕೆಯನ್ನು ನಿಮಗೆ ನೀಡಲಾಗುವುದು. ಮೊದಲ 5 ನಿಮಿಷಗಳಲ್ಲಿ ನೀವು ಪುಸ್ತಿಕೆಯನ್ನು ತೆರೆಯಲು ಮತ್ತು ಕೆಳಗಿನಂತೆ ಕಡ್ಡಾಯವಾಗಿ ಪರೀಕ್ಷಿಸಲು ಕೋರಲಾಗಿದೆ.
   (i) ಪ್ರಶ್ನೆ ಪುಸ್ತಿಕೆಗೆ ಪ್ರವೇಶಾವಕಾಶ ಪಡೆಯಲು, ಈ ಹೊದಿಕೆ ಪುಟದ ಅಂಚಿನ ಮೇಲಿರುವ ಪೇಪರ್ ಸೀಲನ್ನು ಹರಿಯಿರಿ. ಸ್ಟಿಕ್ಕರ್ ಸೀಲ್ ಇಲ್ಲದ ಅಥವಾ ತೆರೆದ ಪುಸ್ತಿಕೆಯನ್ನು ಸ್ವೀಕರಿಸಬೇಡಿ.
   (ii) **ಪುಸ್ತಿಕೆಯಲ್ಲಿನ ಪ್ರಶ್ನೆಗಳ ಸಂಖ್ಯೆ ಮತ್ತು ಪುಟಗಳ ಸಂಖ್ಯೆಯನ್ನು ಮುಖಪುಟದ ಮೇಲೆ ಮುದ್ರಿಸಿದ ಮಾಹಿತಿಯೊಂದಿಗೆ ತಾಳೆ ನೋಡಿರಿ. ಪುಟಗಳು/ಪ್ರಶ್ನೆಗಳು ಕಾಣೆಯಾದ, ಅಥವಾ ದ್ವಿಪ್ರತಿ ಅಥವಾ ಅನುಕ್ರಮವಾಗಿಲ್ಲದ ಅಥವಾ ಇತರ ಯಾವುದೇ ವ್ಯತ್ಯಾಸದ ದೋಷಪೂರಿತ ಪುಸ್ತಿಕೆಯನ್ನು ಕೂಡಲೆ 5 ನಿಮಿಷದ ಅವಧಿ ಒಳಗೆ, ಸಂವೀಕ್ಷಕರಿಂದ ಸರಿ ಇರುವ ಪುಸ್ತಿಕೆಗೆ ಬದಲಾಯಿಸಿಕೊಳ್ಳಬೇಕು. ಆ ಬಳಿಕ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯನ್ನು ಬದಲಾಯಿಸಲಾಗುವುದಿಲ್ಲ, ಯಾವುದೇ ಹೆಚ್ಚು ಸಮಯವನ್ನೂ ಕೊಡಲಾಗುವುದಿಲ್ಲ.**
4. ಪ್ರತಿಯೊಂದು ಪ್ರಶ್ನೆಗೂ (A), (B), (C) ಮತ್ತು (D) ಎಂದು ಗುರುತಿಸಿದ ನಾಲ್ಕು ಪರ್ಯಾಯ ಉತ್ತರಗಳಿವೆ. ನೀವು ಪ್ರಶ್ನೆಯ ಎದುರು ಸರಿಯಾದ ಉತ್ತರದ ಮೇಲೆ, ಕೆಳಗೆ ಕಾಣಿಸಿದಂತೆ ಅಂಡಾಕೃತಿಯನ್ನು ಕಪ್ಪಾಗಿಸಬೇಕು.
   ಉದಾಹರಣೆ: (A) (B) ● (D)
   (C) ಸರಿಯಾದ ಉತ್ತರವಾಗಿದ್ದಾಗ.
5. ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ I ರಲ್ಲಿ ಕೊಟ್ಟಿರುವ OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ, **ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ I ಮತ್ತು ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆ II ರಲ್ಲಿ ಇರುವ ಪ್ರಶ್ನೆಗಳಿಗೆ ನಿಮ್ಮ ಉತ್ತರಗಳನ್ನು ಸೂಚಿಸತಕ್ಕದ್ದು.** OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಅಂಡಾಕೃತಿಯಲ್ಲದೆ ಬೇರೆ ಯಾವುದೇ ಸ್ಥಳದಲ್ಲಿ ಉತ್ತರವನ್ನು ಗುರುತಿಸಿದರೆ, ಅದರ ಮೌಲ್ಯಮಾಪನ ಮಾಡಲಾಗುವುದಿಲ್ಲ.
6. OMR ಉತ್ತರ ಹಾಳೆಯಲ್ಲಿ ಕೊಟ್ಟ ಸೂಚನೆಗಳನ್ನು ಜಾಗರೂಕತೆಯಿಂದ ಓದಿರಿ.
7. ಎಲ್ಲಾ ಕರಡು ಕೆಲಸವನ್ನು ಪುಸ್ತಿಕೆಯ ಕೊನೆಯಲ್ಲಿ ಮಾಡತಕ್ಕದ್ದು.
8. ನಿಮ್ಮ ಗುರುತನ್ನು ಬಹಿರಂಗಪಡಿಸಬಹುದಾದ ನಿಮ್ಮ ಹೆಸರು ಅಥವಾ ಯಾವುದೇ ಚಿಹ್ನೆಯನ್ನು, ಸಂಗತವಾದ ಸ್ಥಳ ಹೊರತು ಪಡಿಸಿ, OMR ಉತ್ತರ ಹಾಳೆಯ ಯಾವುದೇ ಭಾಗದಲ್ಲಿ ಬರೆದರೆ, ನೀವು ಅನರ್ಹತೆಗೆ ಬಾಧ್ಯರಾಗಿರುತ್ತೀರಿ.
9. ಪರೀಕ್ಷೆಯು ಮುಗಿದನಂತರ, ಕಡ್ಡಾಯವಾಗಿ OMR ಉತ್ತರ ಹಾಳೆಯನ್ನು ಸಂವೀಕ್ಷಕರಿಗೆ ನೀವು ಹಿಂತಿರುಗಿಸಬೇಕು ಮತ್ತು ಪರೀಕ್ಷಾ ಕೊಠಡಿಯ ಹೊರಗೆ OMR ನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ಕೊಂಡೊಯ್ಯಕೂಡದು.
10. ಪರೀಕ್ಷೆಯ ನಂತರ, ಪರೀಕ್ಷಾ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಯನ್ನು ಮತ್ತು ನಕಲು OMR ಉತ್ತರ ಹಾಳೆಯನ್ನು ನಿಮ್ಮೊಂದಿಗೆ ತೆಗೆದುಕೊಂಡು ಹೋಗಬಹುದು.
11. **ನೀಲಿ/ಕಪ್ಪು ಬಾಲ್‌ಪಾಯಿಂಟ್ ಪೆನ್ ಮಾತ್ರವೇ ಉಪಯೋಗಿಸಿರಿ.**
12. **ಕ್ಯಾಲ್ಕುಲೇಟರ್ ಅಥವಾ ಲಾಗ್ ಟೇಬಲ್ ಇತ್ಯಾದಿಯ ಉಪಯೋಗವನ್ನು ನಿಷೇಧಿಸಲಾಗಿದೆ.**
13. **ಸರಿ ಅಲ್ಲದ ಉತ್ತರಗಳಿಗೆ ಋಣ ಅಂಕ ಇರುವುದಿಲ್ಲ.**
14. **ಕನ್ನಡ ಮತ್ತು ಇಂಗ್ಲೀಷ್ ಆವೃತ್ತಿಗಳ ಪ್ರಶ್ನೆ ಪತ್ರಿಕೆಗಳಲ್ಲಿ ಯಾವುದೇ ರೀತಿಯ ವ್ಯತ್ಯಾಸಗಳು ಕಂಡುಬಂದಲ್ಲಿ, ಇಂಗ್ಲೀಷ್ ಆವೃತ್ತಿಗಳಲ್ಲಿರುವುದೇ ಅಂತಿಮವೆಂದು ಪರಿಗಣಿಸಬೇಕು.**

Instructions for the Candidates

1. Write your roll number in the space provided on the top of this page.
2. This paper consists of fifty multiple-choice type of questions.
3. At the commencement of examination, the question booklet will be given to you. In the first 5 minutes, you are requested to open the booklet and compulsorily examine it as below :
   (i) To have access to the Question Booklet, tear off the paper seal on the edge of the cover page. Do not accept a booklet without sticker seal or open booklet.
   (ii) **Tally the number of pages and number of questions in the booklet with the information printed on the cover page. Faulty booklets due to pages/questions missing or duplicate or not in serial order or any other discrepancy should be got replaced immediately by a correct booklet from the invigilator within the period of 5 minutes. Afterwards, neither the Question Booklet will be replaced nor any extra time will be given.**
4. Each item has four alternative responses marked (A), (B), (C) and (D). You have to darken the oval as indicated below on the correct response against each item.
   Example : (A) (B) ● (D)
   where (C) is the correct response.
5. Your responses to the questions are to be indicated in the **OMR Sheet kept inside the Paper I Booklet only**. If you mark at any place other than in the ovals in the Answer Sheet, it will not be evaluated.
6. Read the instructions given in OMR carefully.
7. Rough Work is to be done in the end of this booklet.
8. If you write your name or put any mark on any part of the OMR Answer Sheet, except for the space allotted for the relevant entries, which may disclose your identity, you will render yourself liable to disqualification.
9. You have to return the test OMR Answer Sheet to the invigilators at the end of the examination compulsorily and must NOT carry it with you outside the Examination Hall.
10. You can take away question booklet and carbon copy of OMR Answer Sheet soon after the examination.
11. **Use only Blue/Black Ball point pen.**
12. **Use of any calculator or log table etc., is prohibited.**
13. **There is no negative marks for incorrect answers.**
14. **In case of any discrepancy found in the Kannada translation of a question booklet the question in English version shall be taken as final.**

MATHEMATICAL SCIENCE
Paper – II

Note : This paper contains **fifty (50)** objective type questions, **each** question carries **two (2)** marks. Attempt **all** the questions.

1. If $f(x) = x \log(1 + x^{-1}), 0 < x < \infty$, then $\lim_{x \to 0} f(x)$ and $\lim_{x \to \infty} f(x)$ are respectively equal to

(A) $0, +\infty$ (B) $+\infty, 1$
(C) 0, 1 (D) 1, 1

2. The sum of the series

$$\sum_{n=0}^{\infty} \arctan\left(\frac{1}{n^2+n+1}\right) \text{ is}$$

(A) $\frac{\pi}{2}$ (B) $\frac{\pi}{4}$
(C) 1 (D) 0

3. Let $x_1 \geq x_2 \geq \ldots \geq x_k \geq 0$. Then $\lim_{n \to \infty} \left(x_1^n + x_2^n + \ldots + x_k^n\right)^{1/n}$ is equal to

(A) 0 (B) x_1
(C) k (D) ∞

4. If $u = \frac{yz}{x}$, $v = \frac{xz}{y}$, $w = \frac{xy}{z}$, then the Jacobian $J\left(\frac{u, v, w}{x, y, z}\right)$ is equal to

(A) 0 (B) 6
(C) 2 (D) 4

5. The number of different committees of 5 members that can be formed from a set of 8 members is

(A) 28 (B) 56
(C) 8 (D) 70

6. If 'a' and 'b' are two distinct integers, then there is always an integer x such that

(A) x – a and x – b are divisible by 7
(B) x – a and x – b are divisible by 7 and 49
(C) x – a and x – b are divisible by 7 and 7^3
(D) x – a is divisible by 7 and x – b is divisible by 5

7. Let G be a finite non-trivial cyclic group. Then the number of normal subgroups of G is

(A) Always equal to the order of the group
(B) 2, if the order of the group is prime
(C) Always 2
(D) Always 1

8. The number of 5-sylow subgroups of the symmetric group S_5 on 5 symbols is

(A) 6 (B) 1
(C) 25 (D) 11

9. Let G be a group of order 27. Then

(A) G always has a quotient group of order 9
(B) G is always abelian
(C) G is always cyclic
(D) G always has an element of order 9

10. The Cauchy product of the series $\sum_{n=1}^{\infty}\frac{(-1)^{n-1}}{n}$ with itself is

(A) $\sum_{n=1}^{\infty}\frac{1}{n^2}$ (B) Divergent

(C) Convergent (D) $\sum_{n=1}^{\infty}\frac{1}{n(n+1)}$

11. Which one of the following statements is false ?

(A) $\mathbb{R}$ in the discrete topology is connected

(B) A path connected space is connected

(C) The subspace Q of $\mathbb{R}$ is not connected

(D) Every convex subset of $\mathbb{R}$ is connected

12. Which one of the following is a metric on $\mathbb{R}$?

(A) $d(x, y) = |x^2 - y^2|$

(B) $d(x, y) = |x - 2y|$

(C) $d(x, y) = \frac{|x-y|}{1+|x-y|}$

(D) $d(x, y) = (x - y)^2$

13. If A is a subset of a topological space X, then

Int A $\cup$ BdA $\cup$ Int (X – A) is equal to

(A) A (B) $\overline{A}$

(C) ϕ (D) X

14. Let $\{x_n\}$ be an arbitrary sequence of real numbers such that given $\varepsilon > 0$ there exists an $N \in \mathbb{N}$ with the property that $|x_n - x_{n+1}| < \varepsilon$ for all $n \geq N$. Then the sequence $\{x_n\}$

(A) Is Cauchy

(B) Diverges

(C) Has no limit

(D) May or may not converge

15. A basis for the orthogonal complement of the linear span of {(1, 2, 0), (2, 3, 0)} in $\mathbb{R}^3$ as a vector space over $\mathbb{R}$ is

(A) {(0, 1, 0), (0, 0, 1)}

(B) {(0, 0, 1)}

(C) {(1, 0, 0)}

(D) {(3, 5, 0)}

16. Consider the xy-plane $\mathbb{R}^2$ as a vector space over $\mathbb{R}$. Which of the following is not a linear transformation ?

(A) Rotation by 90°, clockwise, about the origin

(B) Reflection about the x-axis

(C) Reflection about the y-axis

(D) Reflection about the line y = 1

17. Let V be a vector space over the field $\mathbb{C}$ of complex numbers. Which one of the following statements is true ?

(A) $\dim_{\mathbb{R}} V$ may be infinite even if $\dim_{\mathbb{C}} V$ is finite

(B) $\dim_{\mathbb{R}} V = \dim_{\mathbb{C}} V$

(C) $\dim_{\mathbb{Q}} V$ is infinite

(D) $\dim_{\mathbb{Q}} V = \dim_{\mathbb{C}} V$

18. Rank of the linear transformation given by the matrix $\begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 12 \end{pmatrix}$ is

(A) 3 over the field $\mathbb{F}_3$ with three elements

(B) 2 over the field of real numbers

(C) 2 over the field $\mathbb{F}_2$ with two elements

(D) 3 over the field of rational numbers

19. If T is a singular linear transformation of a vector space V over real numbers, then

(A) T has no real eigen-values

(B) T has no non-zero eigen-vectors

(C) T has atleast one non-zero eigen-vector

(D) T has atleast one non-zero eigen-value

20. If $x_n = 1+\frac{1}{2}+...+\frac{1}{n}$, then for n > 1,

(A) $n^2(n+1)^{1/n} < n + x_n$

(B) $n(n+1)^{1/n} < n + x_n$

(C) $n(n+1)^{1/n} < x_n$

(D) $n(n+1)^{1/n} > n + x_n$

21. Let f(z) = $z^3 - 1$ and let I denote the integral $I = \int_C \frac{f(z)}{z-1} dz$

Where C is the circle with centre (1, 0) and radius 2, clockwise oriented. Then the value of I is

(A) $2\pi i$ (B) $-2\pi i$

(C) 0 (D) 1

22. Consider the power series

$P(z) = 1 + z + z^2 + ...$

and

$Q(z) = 1 + 2z + 3z^2 + ...$

and let r, s denote their radii of convergence respectively. Then

(A) $0 < r < s \leqq 1$

(B) $0 < s < r \leqq 1$

(C) $0 < r < s < +\infty$

(D) r = s = 1

23. Given that

f(z) = u(x, y) + iv (x, y) is analytic in $\mathbb{C}$. If u(x, y) = e^x cosy then v(x, y) must be

(A) e^x siny (B) e^y cosx

(C) e^x cosx (D) e^y sinx

24. Let $f(z) = \frac{1+z}{1-z}$. Then f maps the unit disc D = {z| |z| < 1}

(A) Onto the right half-plane

(B) Onto the left half-plane

(C) Onto the upper half-plane

(D) Onto the lower half-plane

25. Let K(x, y) be a given real function defined for $0 \leq x \leq 1$, $0 \leq y \leq 1$, f(x) a given real function defined for $0 \leq x \leq 1$ and λ an arbitrary complex number. Then the general linear Fredholm integral equation of the second kind for a function $\phi(x)$ is an equation of the type,

(A) $\lambda \int_0^1 K(x, y)\phi(y)\,dy = f(x) \quad (0 \leq x \leq 1)$

(B) $\lambda \int_0^1 K(x, y)\phi(x)\,dy = f(x) \quad (0 \leq x \leq 1)$

(C) $\phi(x) - \lambda \int_0^1 K(x, y)\,\phi(y)dy = f(x)$ $(0 \leq x \leq 1)$

(D) $f(x) - \lambda \int_0^1 K(x,y)\phi(y)dy = \phi(x) \; (0 \leq x \leq 1)$

26. The order of convergence and asymptotic error constant in bisection method are respectively

(A) 1, 1

(B) 1, $\frac{1}{2}$

(C) 2, 1

(D) 2, $\frac{1}{2}$

27. Consider a partial differential equation $au_{xx} + 2bu_{xy} + cu_{yy} + du_x + eu_y + fu = g \ldots (1)$ where a, b, c, d, e, f, g are of class $c^2(\Omega)$, $\Omega \subseteq \mathbb{R}^2$ is a domain and $(a, b, c) \neq (0, 0, 0)$ in Ω. Let $\Delta(x,y) = (b(x, y))^2 - a(x, y)\, c(x, y)$. Then the equation (1) at a point $p(x, y) \in \Omega$.

(A) is parabolic if $\Delta(x, y) > 0$

(B) is hyperbolic if $\Delta(x, y) < 0$

(C) is elliptic if $\Delta(x, y) \neq 0$

(D) is hyperbolic if $\Delta(x, y) > 0$

28. Let M(x, y) and N (x, y) be homogeneous functions of the same degree n such that $M(x, y)dx + N(x, y)\, dy = 0 \ldots (1)$ Then the solution of (1) is of the form

(A) $F\left(y/x\right) + \ln|x| = c$, where c is any arbitrary constant

(B) $F\left(x^2/y^2\right) + \ln|x| = c$, where c is any arbitrary constant

(C) $F\left(x/y\right) + 2\ln|x| = c$, where c is any arbitrary constant

(D) $F\left(y/x\right) + y\ln|x| = c$, where c is any arbitrary constant

29. If the function $y = \phi(x)$ at $x = 1$ is defined implicitly by the equation $e^{-x\cos y} + \sin y = e$.

Then $\left(\frac{dy}{dx}\right)_{x=1}$ is equal to

(A) $-e^{-1}$ (B) e

(C) e^{-1} (D) – e

30. Let E be a non compact bounded subset of $\mathbb{R}$, x_0 be a limit point of E, $x_0 \notin E$ and $g : E \to \mathbb{R}$ be defined by

$$g(x) = \frac{1}{1 + (x - x_0)^2}.$$

Then which one of the following statements is false ?

(A) g is continuous on E

(B) g is bounded on E

(C) g attains its maximum on E

(D) If $x_0 < x < y$, then $g(x) > g(y)$

31. For a negatively skewed distribution, the correct relation between mean, median and mode is

(A) mean = median = mode

(B) median < mean < mode

(C) mean < median < mode

(D) mode < mean < median

32. If A_1 and A_2 are two independent events then which of the following is not true ?

(A) $P(A_1 \cap A_2) = P(A_1).P(A_2)$

(B) $P(A_1 \cup A_2) = P(A_1) + P(A_2)$

(C) $P\left(A_1^C \cap A_2^C\right) = P\left(A_1^C\right) \cdot P\left(A_2^C\right)$

(D) $P\left(A_1 \cap A_2^C\right) = P(A_1) \cdot P\left(A_2^C\right)$

33. Let $\{X_n\}$ be a sequence of independent random variables with $P[X_n = n^2] = P[X_n = -n^2] = \frac{1}{2}$, n = 1, 2, . . . Then

(A) $\{X_n\}$ obeys weak law of large numbers

(B) $\{X_n\}$ obeys strong law of large numbers

(C) $\{X_n\}$ obeys central limit theorem

(D) $\{X_n\}$ does not obey any of the limit theorems

34. A Markov chain is irreducible if

(A) All states communicate with each other

(B) All states are absorbing

(C) Its transition probability matrix is non-singular

(D) Its states do not communicate with each other

35. Which one of the following statements is not true for a Brownian motion process ?

(A) It is a process with independent increments

(B) Its increments are normally distributed

(C) It is a Markov process

(D) It is strictly stationary

36. If X is a continuous random variable with distribution function F(.) then F(X) follows a

(A) Uniform distribution

(B) Pareto distribution

(C) Beta distribution

(D) Triangular distribution

37. If X and Y are independent unit mean exponential random variables then which one of the following statements is true ?

(A) Max (X, Y) follows exponential distribution

(B) Min (X, Y) follows exponential distribution

(C) X/Y follows exponential distribution

(D) $\frac{X}{X+Y}$ follows exponential distribution

38. If the variance of a binomial distribution is 5 its mean could be

(A) 5

(B) 8

(C) 3

(D) 1

39. Which one of the following distributions does not possess, the monotone likelihood ratio property ?

(A) Normal

(B) Exponential

(C) Gamma

(D) Cauchy

40. Let $X_1, X_2, \ldots, X_n$ be a random sample from the normal distribution with mean 0 and variance σ^2. Then the UMP test for testing $H_0 : \sigma = 1$ versus $H_1 : \sigma \neq 1$.

(A) is to reject H_0 if $\sum_{i=1}^{n} X_i^2 > C_2$

(B) is to reject H_0 if $\sum_{i=1}^{n} X_i^2 < C_1$

(C) is to reject H_0 if $C_1 < \sum_{i=1}^{n} X_i^2 < C_2$

(D) does not exist

41. With references to a Gauss-Markov model, which one of the following is not true given that :

$H : \alpha_1 - \alpha_2 = 0$

$\alpha_1 + \alpha_2 - 2\alpha_3 = 0$

(A) H is not a linear hypothesis

(B) H is a linear hypothesis

(C) H is equivalent to $H^* : \alpha_1 = \alpha_2 = \alpha_3$

(D) H is a testable hypothesis

42. If $a'\beta$ is an estimable function from a full rank linear model $y = X\beta + \in$ then the variance of $a'\hat{\beta}$ is

(A) $a'a\sigma^2$

(B) $a'(X'X)a\sigma^2$

(C) $a'X(X'X)^{-1}X'a\sigma^2$

(D) $a'(X'X)^{-1}a\sigma^2$

43. If X follows a trivariate normal distribution with mean vector μ and dispersion matrix Σ then for a q × 3 matrix A, then AX follows a

(A) q-variate normal with mean $A\mu$ and dispersion matrix Σ

(B) q-variate normal with mean $A\mu$ and dispersion matrix $A\Sigma A'$

(C) q-variate normal with mean $A\mu$ and dispersion matrix $A'\Sigma A$

(D) 3-variate normal with mean $A\mu$ and dispersion matrix $A\Sigma A'$

44. If the random vector (X_1, X_2, X_3) has the covariance matrix $\sum = \begin{pmatrix} 1 & -2 & 0 \\ -2 & 5 & 0 \\ 0 & 0 & 2 \end{pmatrix}$, then the first principal component is

(A) $Y_1 = -0.040\, X_1 + 0.999\, X_2$

(B) $Y_1 = 0.924\, X_1 + 0.383\, X_2$

(C) $Y_1 = 0.383\, X_1 - 0.924\, X_2$

(D) $Y_1 = X_1$

45. In a cluster sampling, the size of cluster decreases if

(A) total budget of survey decreases

(B) the cost of enumerating a unit decreases

(C) average cost of travel between clusters decreases

(D) average travel cost between clusters increases

46. Which one of the following need not be true for a BIBD with parameters v, b, r, k, λ ?

(A) $vr = bk$

(B) $b \geq v$

(C) $\lambda(v-1) = r(k-1)$

(D) $b = v$

47. A block design has 4 blocks, 5 treatments. What is the maximum rank of the design matrix of such a design ?

(A) 8 (B) 9

(C) 7 (D) 4

48. In type 1 censoring

(A) the study period is random

(B) the study period is fixed

(C) number of failed units is fixed

(D) number of censored units is fixed

49. Simplex method is employed to solve a

(A) quadratic programming problem

(B) dynamic programming problem

(C) linear programming problem

(D) stochastic programming problem

50. In a queuing process with mean arrival rate λ, if L and W denote the expected number of units and expected waiting time in the system at the steady state, then Little's formula is

(A) $L = \lambda W$ (B) $W = L\lambda$

(C) $L = \lambda^2 W$ (D) $W = \lambda^2 L$

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Space for Rough Work