TOTAL PAGES: 2
25STU102

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(First Semester)

Branch- **STATISTICS**

PROBABILITY THEORY AND RANDOM VARIABLES

Time: Three Hours | Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	The sample space associated with tossing two coins is (a) {H, T} (b) {HH, HT, TH, TT} (c) {H, T, H, T} (d) {HT, TH}	K1	CO1
	2	The classical definition of probability is applicable only when (a) Events are dependent (b) Outcomes are equally likely (c) Sample space is infinite (d) Outcomes are unknown	K2	CO1
2	3	A random variable is said to be discrete if it (a) Takes only integer values (b) Takes countable number of values (c) Takes uncountable values (d) None of these	K1	CO2
	4	The cumulative distribution function (CDF) of X is defined as (a) $F(x)=P(X=x)$ (b) $F(x)=P(X>x)$ (c) $F(x)=P(X\leq x)$ (d) $F(x)=P(X<x)$	K2	CO2
3	5	For two discrete random variables X and Y, the joint probability mass function is (a) $P(X=x)$ (b) $P(Y=y)$ (c) $P(X=x, Y=y)$ (d) $P(X\leq x)$	K1	CO3
	6	The conditional variance $Var(X\|Y)$ is (a) $E[(X-E[X\|Y])^2 \mid Y]$ (b) $Var(X)/Var(Y)$ (c) $E[X\|Y]^2$ (d) None of these	K2	CO3
4	7	The first cumulant of a distribution is equal to (a) Mean (b) Variance (c) Skewness (d) Kurtosis	K1	CO4
	8	The probability generating function (PGF) of a discrete random variable X is defined as (a) $G_X(t) = E[t^X]$ (b) $G_X(t) = E[e^{\{tX\}}]$ (c) $G_X(t)= \log(E[e^{\{tX\}}])$ (d) $G_X(t)= e^{\{E[Xt]\}}$	K2	CO4
5	9	Bernoulli's Law of Large Numbers applies to (a) Continuous random variables (b) Bernoulli trials (c) Normal distribution (d) Exponential distribution	K1	CO5
	10	The Central Limit Theorem states that the sum of a large number of independent random variables tends to (a) Binomial distribution (b) Poisson distribution (c) Normal distribution (d) Uniform distribution	K2	CO5

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Define probability and write the axioms of probability.	K2	CO1
		(OR)		
	11.b.	State and prove Bayes theorem.		

Cont...

2	12.a.	Describe discrete and continuous random variables with example.	K3	CO2
		(OR)		
	12.b.	A random variable X has probability function as follows: Values of X : -1 0 1 Probability : 0.2 0.3 0.5 Evaluate (i) E(3X+1) (ii) $E(X^2)$		
3	13.a.	Define (i) Marginal Probability Distribution (ii) Conditional Probability Distribution (iii) Joint probability function	K4	CO3
		(OR)		
	13.b.	Let $f(x,y) = \begin{cases} 8xy, & 0 < x < y < 1 \\ 0, & elsewhere \end{cases}$ Find (i) $E(Y \mid X = x)$ (ii) $E(XY \mid X=x)$		
4	14.a.	The probability density function of the random variable X follows the probability law: $p(x) = \frac{1}{2\theta} exp\left(-\frac{\lvert x-\theta \rvert}{\theta}\right), -\infty < x < \infty$ Find M.G.F of X.	K3	CO4
		(OR)		
	14.b.	Summarize about probability generating function and cumulant generating function.		
5	15.a.	Explain the convergence in probability.	K2	CO5
		(OR)		
	15.b.	Examine whether the weak law of large numbers holds for the sequence (X_k) of independent random variables defined as follows: $P(X_k = \pm 2^k) = 2^{-(2k+1)}, P(X_k = 0) = 1 - 2^{-2k}$		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

<table>
<tr><th>Module No.</th><th>Question No.</th><th>Question</th><th>K Level</th><th>CO</th></tr>
<tr><td>1</td><td>16</td><td>State and prove multiplication theorem of probability.</td><td>K2</td><td>CO1</td></tr>
<tr><td>2</td><td>17</td><td>A random variable X has the following probability mass function.
<table>
<tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>P(X=x)</td><td>a</td><td>3a</td><td>5a</td><td>7a</td><td>9a</td><td>11a</td><td>13a</td></tr>
</table>
(i) Find the value of ‘a’
(ii) Evaluate: (a) $P(X \geq 4)$ (b) $P(X < 5)$
(c) $P(3 \leq X \leq 6)$</td><td>K3</td><td>CO2</td></tr>
<tr><td>3</td><td>18</td><td>Two random variables X and Y have the following joint probability density function:
$f(x,y) = \begin{cases} 2 - x - y; 0 \leq x \leq 1, 0 \leq y \leq 1 \\ 0; \quad otherwise \end{cases}$
Find (i) Marginal probability density functions of X and Y;
(ii) Conditional density functions
(iii) Var(X) and Var(Y)</td><td>K4</td><td>CO3</td></tr>
<tr><td>4</td><td>19</td><td>State and prove Tchebychev’s inequality.</td><td>K3</td><td>CO4</td></tr>
<tr><td>5</td><td>20</td><td>State and prove Bernoulli’s weak law of large numbers.</td><td>K2</td><td>CO5</td></tr>
</table>

Z-Z-Z END

TOTAL PAGES : 2
25STU103

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(First Semester)

Branch – **STATISTICS**

MATHEMATICS -I FOR STATISTICS

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1.	Which of the following is a reciprocal equation? a)$x^4+2x^3+3x^2+2x+1=0$ b) $x^4+3x^2+2x+1=0$ c) $x^4 - 2x^3+3x^2+2x+1=0$ d) $x^4+2x^3+3x^2+2x=0$	K1	CO1
	2	If the roots of an equation are increased by h, the transformed equation is a)f(x+h)=0 b)f(x-h)=0 c)f(h-x)=0 d)f(x)+h=0	K2	CO1
2	3	Find the value of $\lim_{x\to0}\frac{sinx}{x}$. a)0 b)1 c)2 d)infinity	K1	CO2
	4	Find the derivative of ln(sinx). a)cotx b)cosecx c)secx d)-cotx	K2	CO2
3	5	The function $f(x)=x^2$ has a)Maximum at x=0 b) Minimum at x=0 c)Both Maximum and Minimum d) None	K1	CO3
	6	The minimum of $f(x,y)=x^2+y^2$ subject to the condition x+y=1 is at a) (0,0) b)$(1/2, 1/2)$ c) (0,1) d) (1,0)	K2	CO3
4	7	If $f(r) = r^2$ where $r = \sqrt{x^2+y^2+z^2}$ then $\nabla f =$? a) (2x,2y,2z) b) (x,y,z) c) (r^2,r^2,r^2) d) (0,0,0)	K1	CO4
	8	Which of the function is always a scalar? a) gradient b)curl c) divergence d)vector potential	K2	CO4
5	9	Verify the differential equation: $(2xy+3)dx+(x^2+4y)dy=0$ is a)Exact b) Not-Exact c) Homogeneous d) Linear	K1	CO5
	10	Using Bernoulli's Equation, if $\frac{dy}{dx}+y=xy^2$ where $v=y^{-1}$.Then the resulting linear equation is a)$\frac{dv}{dx}+v=-x$ b)$\frac{dv}{dx}-v=-x$ c)$\frac{dv}{dx}=v-x$ d)$\frac{dv}{dx}=-x$	K2	CO5

Cont…

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Solve the equation $x^4-14x^3+46x^2-42x+9=0$ given that $5-\sqrt{22}$ is a root.	K2	CO2
		(OR)		
	11.b.	Increase the roots of the equation $4x^5-2x^3+7x-3=0$ by 2.		
2	12.a.	State and Prove Rolle's Theorem.	K3	CO3
		(OR)		
	12.b.	State and Prove Lagrange's first mean value theorem.		
3	13.a.	Prove that $u=x^3+y^3-3axy$ is max or min at $x=y=a$ according as negative or positive.	K4	CO4
		(OR)		
	13.b.	Find the shortest distance from the point(1,0) to the parabola $y^2=4x$.		
4	14.a.	If $\nabla\varphi = 2xyz^3 i + x^2z^3 j + 3x^2yz^2 k$ then find $\varphi(x,y,z)$ and show that $\varphi(1,-2,2) = 4$.	K4	CO4
		(OR)		
	14.b.	Find the unit normal to the surface $x=t, y=t^2, z=t^3$ at $t=1$.		
5	15.a.	Solve $\frac{dy}{dx} = \frac{y^3+3x^2y}{x^3+3xy^2}$.	K5	CO5
		(OR)		
	15.b.	Solve $xyp^2+p(3x^2-2y^2)-6xy=0$.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Solve $6x^4-25x^3+37x^2-25x+6=0$.	K3	CO2
2	17	State and Prove Cauchy's Mean value theorem.	K4	CO2
3	18	Prove that the rectangular solid of maximum volume which can be inscribed in a given sphere is a cube.	K4	CO3
4	19	Prove that $\nabla^2(r^n r) = n(n+3)r^{n-2}r$.	K4	CO4
5	20	Solve $4y = x^2 + p^2$.	K4	CO5

Z-Z-Z END

TOTAL PAGES: 2
22STU103N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(First Semester)

Branch - **STATISTICS**

MATHEMATICS - I FOR STATISTICS

Time: Three Hours
Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Question No.	**Question**	**K Level**	**CO**
1	A square matrix A which is satisfied the relation $A^2 = A$ is called a) Idempotent b) Nilpotent c) Symmetric d) skew Symmetric	K1	CO1
2	If $\lambda_1, \lambda_2, \lambda_3, \ldots, \lambda_n$ are the eigen values of A, the inverse of A has the eigen values a) $1/\lambda_1, 1/\lambda_2, 1/\lambda_3, \ldots 1/\lambda_n$ b) $\lambda_1^2, \lambda_2^2, \lambda_3^2, \ldots, \lambda_n^2$ c) $k\lambda_1, k\lambda_2, k\lambda_3, \ldots, k\lambda_n$ d) $k+\lambda_1, k+\lambda_2, k+\lambda_3, \ldots, k+\lambda_n$	K2	CO1
3	The sum of the roots of the equation $2x^2 + 3x + 5 = 0$ is a) 3/2 b) 5/2 c) -3/2 d) -5/2	K1	CO2
4	If one root of the equation $x^3 + 6x + 20 = 0$ is $1 + 3i$, then the other roots are a) $1 + 3i, 2$ b) $1 + 3i, -2$ c) $1 - 3i, 2$ d) $1 - 3i, -2$	K2	CO2
5	The n^{th} derivative of e^{ax} is a) $a^{n-1} e^{ax}$ b) $a^n e^{ax}$ c) $a^3 e^{ax}$ d) $a\, e^{ax}$	K1	CO3
6	Leibniz rule gives the a) n^{th} derivative of addition of two functions b) n^{th} derivative of division of two functions c) n^{th} derivative of multiplication of two functions d) n^{th} derivative of subtraction of two functions	K2	CO3
7	Find the radius of curvature of the curve $y = c \log \sec \varphi$ is a) $c \sin \varphi$ b) $c \cos \varphi$ c) $c \tan \varphi$ d) $c \cot \varphi$	K1	CO4
8	The locus of center of curvature is called a) radius of curvature b) chord of curvature c) envelope d) evolute	K2	CO4
9	The integral value of cot x is a) tan x b) cot x c) log(tan x) d) log(sin x)	K1	CO5
10	The value of $\int \frac{dx}{\sqrt{a^2-x^2}}$ is a) $\sin^{-1}\frac{x}{a}$ b) $\cos^{-1}\frac{x}{a}$ c) $\tan^{-1}\frac{x}{a}$ d) $\cot^{-1}\frac{x}{a}$	K2	CO5

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SECTION – B (35 Marks)

Answer **ALL** questions
ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Question No.	Question	K Level	CO
11.a.	Identify the rank of the matrix A = $\begin{pmatrix} 1 & 2 & 5 \\ 2 & 3 & 4 \\ 3 & 5 & 7 \end{pmatrix}$.	K3	CO1
	(OR)		
11.b.	Verify that A = $\begin{pmatrix} 1 & 2 \\ 2 & -1 \end{pmatrix}$ satisfies its own characteristics equation and hence find A^4.		
12.a.	Solve the equation $x^4 + 2x^3 - 16x^2 - 22x + 7 = 0$ which has a root $2 + \sqrt{3}$.	K3	CO2
	(OR)		
12.b.	Solve $x^3 + x^2 - 16x + 20 = 0$, the difference between two of its roots being 7.		
13.a.	If $y = ae^{mx} + \_be^{-mx}$, show that $\frac{d^2y}{dx^2} - m^2y = 0$.	K4	CO3
	(OR)		
13.b.	If $u = sin^{-1}\left(\frac{x^2+y^2}{x+y}\right)$, show that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = tan\, u$.		
14.a.	Find the radius of the curvature for the curve $y^2 = x^3 + 8$ at (- 2, 0).	K5	CO4
	(OR)		
14.b.	Prove that the radius of curvature at any point of the cycloid $x = a(\theta + sin\,\theta), y = a(1 - cos\,\theta)$ is $4a\,cos\frac{\theta}{2}$.		
15.a.	Evaluate $\int \frac{dx}{x^2-a^2}$.	K5	CO4
	(OR)		
15.b.	Evaluate $\int_0^{\frac{\pi}{2}} sin^7x cos^5x\, dx$.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions
ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Question No.	Question	K Level	CO
16	Examine the eigenvalues and eigenvectors of $\begin{pmatrix} 2 & 2 & 0 \\ 2 & 1 & 1 \\ -7 & 2 & -3 \end{pmatrix}$.	K4	CO1
17	If α, β, γ are the roots of the equation $x^3 - px^2 + qx - r = 0$, find the value of $(i) \sum \alpha^2, (ii) \sum \alpha^3, (i) \sum \alpha^2\beta, (i) \sum \alpha^2\beta^2$.	K4	CO2
18	Evaluate $\frac{\partial u}{\partial x}$ $if\ u = tan^{-1}\left(\frac{x}{y}\right)$ where $x^2 + y^2 = a^2$.	K5	CO3
19	Analyze the equation of the evolute of the parabola $y^2 = 4ax$.	K4	CO4
20	Determine the reduction formula for $\int sin^n x\, dx$ where n being a positive integer.	K5	CO5

Z-Z-Z END

TOTAL PAGES: 2
22STU206N / 07STU06

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(Second Semester)

Branch – **STATISTICS**

MATHEMATICS - II FOR STATISTICS / MATHEMATICS – II

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	The value of $f(0)$ if $f(x) = x\,sin\frac{1}{x}$ is ______. a) 1 b) -1 c) 0 d) ∞	K1	CO1
	2	______ is an even function. a) $cos\,x$ b) e^x c) e^{-x} d) e^{2x}	K2	CO3
2	3	The complete integral for the equation $z = px + qy + \left(\frac{q}{p} - p\right)$ is _______. a) $z = ax - by - \frac{b}{a} + a$ b) $z = ax + by + \frac{b}{a} - a$ c) $z = ax + by$ d) $\frac{b}{a} - a$	K1	CO3
	4	The solution for $\frac{\partial^2 z}{\partial x^2} = \sin y$ is _______. a) $z = x\sin y + xf(y) + \phi(y)$ b) $z = x\,cos\,y + x + \phi(y)$ c) $z = -x\cos y + f(y) + \phi(y)$ d) $z = \frac{x^2}{2}\sin y + xf(y) + \phi(y)$	K2	CO1
3	5	$L[e^{-7t}] =$ ______. a) $\frac{1}{s+7}$ b) $\frac{1}{s-7}$ c) $\frac{1}{s^2+7}$ d) $\frac{1}{s^2-7}$	K1	CO1
	6	$L(t^3) =$______. a) $\frac{1}{s^4}$ b) $\frac{6}{s^4}$ c) $-\frac{1}{s^4}$ d) $\frac{7}{s^4}$	K2	CO1
4	7	If f = 1, g =e^t then f*g is________. a) $e^t - 1$ b) e^t c) e^{-t} d) $e^{-t} - 1$	K1	CO3
	8	$L^{-1}[\frac{s+6}{(s+6)^2+9}]$ is _________. a) $e^{6t}\cos 3t$ b) $e^{-6t}\sin 3t$ c) $e^{-6t}\cos 3t$ d) $e^{6t}\sin 3t$	K2	CO3
5	9	_________ is a direct method based on the elimination of the unknowns, one by one. a) Gauss elimination method b) Numerical method c) Cramer's method d) Gauss jordon method	K1	CO3
	10	In an indirect or iterative method, the amount of computation depends on the _____ required. a) degree of accuracy b) coefficient c) approximation d) convergency	K2	CO3

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 x 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Prove that for $-\pi < x < \pi$, $\frac{x(\pi^2-x^2)}{12} = \frac{\sin x}{1^3} - \frac{sin\,2x}{2^3} - \frac{sin\,3x}{3^3} \dots$	K2	CO4
		(OR)		

Cont...

	11.b.	Find a half-range sine series which represents $f(x) = \sin px$ for p not an integer on the interval $0 < x < \pi$.		
2	12.a.	Find the differential equation of all spheres of the radius 'c' having their centres on the yz-plane.	K2	CO2
		(OR)		
	12.b.	Solve $ap + bq + cz = 0$.		
3	13.a.	Find $L[sin^2t\ cos^3t]$.	K3	CO4
		(OR)		
	13.b.	Find $L\left[\int_0^t \frac{e^{-t}sin\,t}{t}dt\right]$.		
4	14.a.	Find $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]$ using convolution theorem.	K3	CO2
		(OR)		
	14.b.	Find $L^{-1}\left[log\frac{s^2+a^2}{s^2-b^2}\right]$.		
5	15.a.	Solve by Gauss-Jordon method the equations $2x + y + 4z = 12$ $8x - 3y + 2z = 20$ $4x + 11y - z = 33.$	K2	CO4
		(OR)		
	15.b.	Solve by Gauss elimination procedure, the equations $3.15x - 1.96y + 3.85z = 12.95$ $2.13x + 5.12y - 2.89z = -8.61$ $5.92x + 3.05y + 2.15z = 6.88.$		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Expand $f(x) = (\pi - x)^2$ in $(-\pi, \pi)$ as a fourier series.	K3	CO4
2	17	Solve $(x^2 - y^2 - z^2)p + 2xyq - 2xz = 0$.	K3	CO5
3	18	(i) Find $L[e^{-3t}sin^2t]$ (ii) Find $L[cos^3 3t]$.	K3	CO4
4	19	Use laplace transform to solve $(D^2 + 5D + 6)x = e^{-t}$ given that $x(0) = \frac{15}{2}$; $x'(0) = \frac{37}{2}$.	K3	CO5
5	20	Solve by Gauss-Jacobi method of iteration the equations $27x + 6y - z = 85$ $6x + 15y + 2z = 72$ $x + y + 54z = 110.$	K3	CO4

Z-Z-Z END

TOTAL PAGES: 2
22STU309N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(Third Semester)

Branch – **STATISTICS**

PROBABILITY DISTRIBUTIONS

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Question No.	Questions	K Level	CO
1	Which distribution is a generalization of the Binomial distribution? a) Poisson Distribution b) Geometric Distribution c) Negative Binomial Distribution d) Bernoulli Distribution	K2	CO1
2	The moment generating function for which distribution is $e^{p(et-1)}$? a) Binomial Distribution b) Poisson Distribution c) Normal Distribution d) Beta Distribution	K2	CO2
3	The normal probability curve is also known as: a) Bell Curve b) Exponential Curve c) Rectangular Curve d) Gamma Curve	K2	CO1
4	Which distribution only takes integer values? a) Normal b) Multinomial c) Beta d) Gamma	K2	CO3
5	Which of the following is a continuous distribution? a) Binomial b) Poisson c) Normal d) Geometric	K2	CO1
6	Beta distribution is defined on the interval: a) $(0, \infty)$ b) $(-\infty, \infty)$ c) $(0,1)$ d) $(-\infty,0)$	K2	CO1
7	The mean and variance of the Poisson distribution are: a) Mean = Variance = λ b) Mean = Variance = np c) Mean = p, Variance = np(1−p) d) Mean = np, Variance = λ	K1	CO3
8	Which is NOT a property of the exponential distribution? a) Memoryless property b) Defined for $x<0$ c) Mean = $1/\lambda$ d) Variance = $1/\lambda^2$	K2	CO3
9	Student's t-distribution is used for: a) Large sample inference b) Small sample inference c) non-parametric tests d) Population mean estimation only	K1	CO5
10	Which distribution models the number of failures before a success? a) Binomial b) Poisson c) Geometric d) Normal	K2	CO1

SECTION - B (35 Marks)

Answer **ALL** questions
ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Question No.	Question	K Level	CO
11.a.	Derive the moment generating function for the Binomial distribution.	K2	CO1
	(OR)		
11.b.	Derive recurrence relation for the moments of Poisson distribution.		

Cont...

12.a.	Find the mean and variance of Negative Binomial distribution.	K2	CO2
(OR)			
12.b.	State the importance properties of the Hypergeometric distribution.	K4	CO2
13.a.	Derive the characteristic function of the Normal distribution.	K2	CO3
(OR)			
13.b.	Find the mean deviation about the mean for the Rectangular distribution.	K3	CO3
14.a.	Define Exponential distribution and its derive Mean and Variance.	K2	CO4
(OR)			
14.b.	Derive the moments of Beta distribution of first and second kind.		
15.a.	State applications of Student's t and Chi-Square distributions in sampling.	K2	CO5
(OR)			
15.b.	Discuss the relationship between F and Chi-square distributions.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Question No.	Question	K Level	CO
16	Derive the constants of the Normal distribution. Also, state its properties.	K4	CO1
17	Show that Poisson distribution is a limiting form of the Binomial distribution.	K2	CO2
18	Derive Mean and Variance of Rectangular distribution and its properties.	K3	CO3
19	Derive Mean and Variance of Gamma distribution and its properties.	K2	CO4
20	Establish the relationship between t and Chi-Square distributions.	K2	CO5

Z-Z-Z END

TOTAL PAGES: 2
22STU411N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(Fourth Semester)

Branch - **STATISTICS**

STATISTICAL INFERENCE - I

Time: Three Hours Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	If an estimator converges in probability to the true parameter value, it is called (a) Efficient (b) Consistent (c) Unbiased (d) Minimum variance	K1	CO1
	2	The variance of any unbiased estimator cannot be less than (a) Sample variance (b) Fisher Information (c) Cramér–Rao lower bound (d) Expectation value	K2	CO1
2	3	The Neyman–Fisher Factorization Theorem provides a criterion for (a) Consistency (b) Sufficiency (c) Unbiasedness (d) Efficiency	K1	CO2
	4	The Rao–Blackwell Theorem is used to (a) Improve an estimator using a sufficient statistic (b) Find CR bound (c) Test efficiency (d) Estimate bias	K2	CO2
3	5	MLEs are generally (a) Biased but consistent (b) Unbiased but inefficient (c) Both unbiased and efficient (d) None of these	K1	CO3
	6	The minimum chi-square method minimizes (a) $\Sigma(O-E)^2/E$ (b) $\Sigma(E-O)^2$ (c) $\Sigma(O/E)$ (d) $\Sigma E/O$	K2	CO3
4	7	The Bayesian estimator uses (a) Only sample data (b) Prior and posterior distributions (c) Only likelihood (d) CR inequality	K1	CO4
	8	The posterior distribution is proportional to (a) Likelihood × Prior (b) Likelihood / Prior (c) Prior / Likelihood (d) None of these	K2	CO4
5	9	The sign test is based on (a) Number of positive and negative differences (b) Ranks of observations (c) Variance of differences (d) Chi-square	K1	CO5
	10	The χ^2 test for goodness of fit compares (a) Means (b) Observed and expected frequencies (c) Variances (d) Medians	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer **ALL** questions
ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	State and interpret the Cramér–Rao Inequality.	K2	CO1
		(OR)		
	11.b.	What is a minimum variance bound estimator (MVBE)?		
2	12.a.	State Neyman's Factorization Theorem.	K3	CO2
		(OR)		
	12.b.	Explain the idea of Rao–Blackwellization.		
3	13.a.	List the properties of MLEs	K4	CO3
		(OR)		
	13.b.	Differentiate between minimum and modified minimum chi-square estimators.		
4	14.a.	Explain the concept of prior and posterior in Bayesian estimation.	K5	CO4
		(OR)		
	14.b.	Explain about the level of confidence?		
5	15.a.	Explain the purpose of the Wilcoxon signed rank test.	K5	CO5
		(OR)		
	15.b.	Explain the procedure of run test.		

SECTION -C (30 Marks)

Answer **ANY THREE** questions
ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Given a random sample from N(μ, σ^2), find the unbiased estimator of μ and verify if it attains the CR bound.	K5	CO1
2	17	State and prove the Rao–Blackwell theorem, and explain its importance in obtaining MVUEs.	K3	CO2
3	18	Compare the method of moments and maximum likelihood method in terms of bias and efficiency.	K3	CO3
4	19	Explain the concept of Bayesian estimation with a simple illustration.	K2	CO4
5	20	Explain the procedure for the χ^2 test for goodness of fit and its interpretation.	K5	CO5

Z-Z-Z END

TOTAL PAGES: 2
22STU412N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)
BSc DEGREE EXAMINATION DECEMBER 2025
(Fourth Semester)
Branch - **STATISTICS**

BASIC SAMPLING THEORY

Time: Three Hours
Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	The entire collection of items or individuals under study is called__________. a) Sample b) Population c) Census d) Attribute	K1	CO1
	2	CSO differs from NSSO mainly because: a) CSO collects rainfall data b) CSO prepares national income and accounts statistics c) CSO conducts household surveys d) CSO manages census operations	K2	CO1
2	3	The unbiased estimator of the population total under SRS is_________. a) $N\bar{y}$ b) n$\bar{y}$ c) $\frac{\bar{y}}{N}$ d) $\frac{N}{n}\bar{y}$	K1	CO2
	4	The effect of the finite population correction factor is _____. a) To increase the variance estimate when sampling fraction is large b) To reduce the variance estimate when sampling fraction is large c) To have no effect on the variance estimate d) To make the estimator biased	K2	CO2
3	5	In optimum allocation, the number of samples drawn from the h^{th} stratum is proportional to________ a)N_h b) N_hS_h c) $\sqrt{N_h}$ d)S_h^2	K1	CO3
	6	The main advantage of optimum allocation over proportional allocation is___________. a) It minimizes the cost of sampling b) It minimizes the variance of the stratified mean for a fixed n c) It requires less population information d) It is easier to implement always	K2	CO3
4	7	A key requirement for applying systematic sampling is that________. a) The population must be ordered in some way b) The sample size must be very large c) Stratification must be possible d) Clusters must be defined	K1	CO4
	8	Circular systematic sampling is preferred when_______. a) The population has a circular or cyclical structure b) The population has no ordering c) Stratified sampling is impossible d) Clusters are not available	K2	CO4
5	9	The regression coefficient used in regression estimator is estimated from_________. a) Population means b) Sample data c) Auxiliary variable variance alone d) Random numbers	K1	CO5
	10	The variance of the regression estimator compared to the mean per unit estimator is smaller when a) The correlation coefficient between X and Y is high b) The correlation coefficient is low c) The auxiliary variable has no relation with study variable d) The auxiliary variable mean is unknown	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer **ALL** questions
ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	What are the principles of sample survey?	K2	CO1
		(OR)		
	11.b.	Explain the sampling and non-sampling errors.		
2	12.a.	Show that the SRSWOR the sample mean square is an unbiased estimate of the population mean square.	K3	CO2
		(OR)		
	12.b.	Explain the simple random sampling for attributes.	K2	
3	13.a.	What are the advantages of stratified random sampling?	K2	CO3
		(OR)		
	13.b.	Show that $Var(\bar{y}_{st})$ is minimum for fixed total size of the sample if $n_i \propto N_i S_i$.	K3	
4	14.a.	Prove that systematic sampling gives more precise than SRSWOR if $S_{wsys}^2 \geq S^2$.	K3	CO4
		(OR)		
	14.b.	State the advantages and disadvantages of systematic sampling.	K4	
5	15.a.	Show that first approximation to the bias of the ratio estimators (R) is given by $B(R) = \frac{-Cov(\bar{x}.\hat{R})}{\bar{X}}$.	K3	CO5
		(OR)		
	15.b.	Explain the bias of regression estimator.	K5	

SECTION -C (30 Marks)

Answer **ANY THREE** questions
ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	Explain the advantages of sampling over complete enumeration.	K5	CO1
2	17	Derive the simple random sampling without replacement the variance of the sample mean is $v(\bar{y}) = \frac{N-n}{N}\frac{s^2}{n}$.	K3	CO2
3	18	Describe the allocation of sample to different strata.	K6	CO3
4	19	If the population consists of linear trend, then prove that $Var(\bar{y}_{st}) \leq Var(\bar{y}_{sys}) \leq Var(\bar{y}_n)_R$.	K4	CO4
5	20	Derive the first approximation to the relative bias of the ratio estimator.	K4	CO5

Z-Z-Z END

TOTAL PAGES : 2

22STU515N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(Fifth Semester)

Branch – **STATISTICS**

STATISTICAL INFERENCE – II

Time: Three Hours

Maximum: 75 Marks

SECTION-A (10 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** marks (10 × 1 = 10)

Module No.	Question No.	Question	K Level	CO
1	1	A hypothesis which is tested for possible rejection under the assumption that it is true is called (a) Alternative hypothesis (b) Null hypothesis (c) Simple hypothesis (d) Composite hypothesis	K1	CO1
	2	The Neyman–Pearson lemma provides a method for finding (a) Unbiased tests (b) Most powerful tests (c) Non-parametric tests (d) Asymptotic tests	K2	CO1
2	3	A test that maximizes the power among all tests of the same size is called a _______ test. (a) Likelihood Ratio (b) Uniformly Most Powerful (c) Chi-square (d) Asymptotic	K1	CO2
	4	The Likelihood Ratio (LR) test is based on the ratio of (a) Sample mean to sample variance (b) Maximum likelihood under null and alternative hypotheses (c) Variance to mean (d) Confidence limits	K2	CO2
3	5	The Student's t-test is applicable when _______ is unknown. (a) Mean. (b) Population variance (c) Population mean (d) Sample variance	K1	CO3
	6	6. The level of significance is denoted by (a) β (b) α (c) μ (d) σ	K2	CO3
4	7	The F-test is used for testing (a) Equality of two means (b) Equality of two proportions (c) Equality of variances (d) Independence of attributes	K1	CO4
	8	The chi-square test is mainly used for (a) Estimation of parameters (b) Testing independence or goodness of fit (c) Comparing means (d) Finding regression lines	K2	CO4
5	9	A contingency table is used to study (a) Regression (b) Correlation (c) Association between attributes (d) Distribution fitting	K1	CO5
	10	Yule's coefficient of association ranges between (a) 0 and 1 (b) -1 and 1 (c) 0 and ∞ (d) $-\infty$ and ∞	K2	CO5

Cont...

SECTION - B (35 Marks)

Answer **ALL** questions

ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Module No.	Question No.	Question	K Level	CO
1	11.a.	Explain the fundamental concepts of hypothesis testing and the Neyman–Pearson approach.	K2	CO1
	(OR)			
	11.b.	Describe the properties of unbiased tests with simple examples.	K3	
2	12.a.	Explain the Likelihood Ratio Test for testing the mean of a normal population.	K2	CO2
	(OR)			
	12.b.	Describe the procedure for obtaining the Uniformly Most Powerful (UMP) test with an example.	K3	
3	13.a.	Explain the concept of tests of significance for proportions and means.	K2	CO3
	(OR)			
	13.b.	Derive the test statistic for correlation coefficient based on Student's t-distribution.	K3	
4	14.a.	Describe the procedure for testing the equality of several variances using the F-test.	K3	CO4
	(OR)			
	14.b.	Explain the chi-square test for testing the independence of two attributes with an example.	K2	
5	15.a.	Explain the construction and interpretation of a 2×2 contingency table.	K2	CO5
	(OR)			
	15.b.	Describe the computation of Yule's coefficient of association and coefficient of colligation.	K3	

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

Module No.	Question No.	Question	K Level	CO
1	16	State and prove the Neyman–Pearson Fundamental Lemma. Discuss its role in developing most powerful tests.	K5	CO1
2	17	Derive the Likelihood Ratio Test (LRT) for testing the mean and variance of a normal population for both one-sample and two-sample cases.	K3	CO2
3	18	Explain in detail the large-sample tests for proportions, means, standard deviations, and correlation coefficients with examples.	K2	CO3
4	19	Describe the exact sampling distributions – F and Chi-square. Explain their applications in testing homogeneity of variances and correlation coefficients.	K4	CO4
5	20	Discuss the concept of association of attributes. Derive and explain Yule's coefficient of association and coefficient of colligation with examples.	K6	CO5

Z-Z-Z END

TOTAL PAGES : 2
22STU516N

PSG COLLEGE OF ARTS & SCIENCE
(AUTONOMOUS)

BSc DEGREE EXAMINATION DECEMBER 2025
(Fifth Semester)

Branch - **STATISTICS**

EDUCATIONAL & PSYCHOLOGICAL STATISTICS

Time: Three Hours — Maximum: 75 Marks

SECTION-A (10 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** marks (10 × 1 = 10)

Question No.	Question	K Level	CO
1	What is the point biserial correlation used for? a) For continuous variables b) For categorical variables c) For one continuous and one dichotomous variable d) For two dichotomous variables	K2	CO1
2	Tetrachoric correlation is often used for: a) Ordinal data b) Dichotomous data c) Continuous data d) Interval data	K2	CO1
3	Which score is considered a standard score? a) T score b) Z score c) Both a and b d) None of the above	K2	CO2
4	What does a T score of 50 represent? a) The score is at the average level b) The score is a raw score c) The score is above average d) The score is below average	K2	CO2
5	The primary function of judgment scaling is: a) To compare the validity of different tests b) To assess the reliability of test items c) To measure test difficulty d) To assign numerical values to subjective evaluations	K2	CO3
6	What type of data is best suited for the C scale? a) Ordinal data b) Continuous data c) Dichotomous data d) Dichotomous data	K2	CO3
7	Which method of reliability assessment involves administering the same test to the same group twice? a) Split-half method b) Test-retest method c) Parallel form method d) Rational equivalence	K1	CO4
8	How does lengthening a test affect its reliability? a) It decreases reliability b) It does not affect reliability c) It improves reliability d) It makes the test more difficult	K2	CO4
9	Which method of validity assessment is used when comparing the results of the same test at two different times? a) Test-retest validity b) Concurrent validity c) Predictive validity d) Content validity	K1	CO5
10	What does a significant validity coefficient suggest? a) The test is reliable b) The test is measuring c) The test has a low error rate d) The test has a normal distribution	K2	CO5

SECTION - B (35 Marks)
Answer **ALL** questions
ALL questions carry **EQUAL** Marks (5 × 7 = 35)

Question No.	Question	K Level	CO
11.a.	State the assumptions and limits of Biserial Correlation.	K2	CO1
	(OR)		
11.b.	Describe the need and importance of Partial correlations with examples.	K2	CO1
12.a.	What is the role of the Stannine scale in rating performance?	K2	CO2
	(OR)		

Cont...

<table>
<tr><td>12.b.</td><td>In the sub-tests of an entrance test, Kaarthika scored 56 in spelling test,72 in reasoning test, and 38 in arithmetic test. The mean and the SD of these sub-tests were as follows.
<table>
<tr><td>Test</td><td>Spelling</td><td>Reasoning</td><td>Arithmetic</td></tr>
<tr><td>M</td><td>50</td><td>66</td><td>30</td></tr>
<tr><td>σ</td><td>8</td><td>12</td><td>10</td></tr>
</table>
Assuming the distribution of these sub-tests as normal, find out in which sub-test Kaarthika performed better then the other two.</td><td>K4</td><td>CO3</td></tr>
<tr><td>13.a.</td><td>Explain the concept of the C scale and its application in rating performance.</td><td>K2</td><td>CO3</td></tr>
<tr><td colspan="2">(OR)</td><td></td><td></td></tr>
<tr><td>13.b.</td><td>Discuss the difference between rating scales and ranking scale</td><td>K3</td><td>CO3</td></tr>
<tr><td>14.a.</td><td>Explain the concept of internal consistency reliability.</td><td>K2</td><td>CO4</td></tr>
<tr><td colspan="2">(OR)</td><td></td><td></td></tr>
<tr><td>14.b.</td><td>What is the relationship between test length and reliability? Explain why longer tests tend to have higher reliability.</td><td>K2</td><td>CO4</td></tr>
<tr><td>15.a.</td><td>Discuss face validity and its role in test development.</td><td>K2</td><td>CO5</td></tr>
<tr><td colspan="2">(OR)</td><td></td><td></td></tr>
<tr><td>15.b.</td><td>Explain criterion-related validity and how it is used in the context of test development.</td><td>K2</td><td>CO5</td></tr>
</table>

SECTION -C (30 Marks)

Answer **ANY THREE** questions

ALL questions carry **EQUAL** Marks (3 × 10 = 30)

<table>
<tr><th>Question No.</th><th>Question</th><th>K Level</th><th>CO</th></tr>
<tr><td>16</td><td>The following tables shows that the distribution of the scores on an achievement test earned by two groups of students those who passed and those who failed in a test of Arithmetic. Compute the coefficient of biserial correlation.
<table>
<tr><td>Achievement Score Range</td><td>Passed</td><td>Failed</td></tr>
<tr><td>185–194</td><td>7</td><td>0</td></tr>
<tr><td>175–184</td><td>10</td><td>0</td></tr>
<tr><td>165–174</td><td>16</td><td>0</td></tr>
<tr><td>155–164</td><td>24</td><td>6</td></tr>
<tr><td>145–154</td><td>35</td><td>15</td></tr>
<tr><td>135–144</td><td>40</td><td>26</td></tr>
<tr><td>125–134</td><td>26</td><td>13</td></tr>
<tr><td>115–124</td><td>13</td><td>5</td></tr>
<tr><td>105–114</td><td>5</td><td>0</td></tr>
</table></td><td>K4</td><td>CO1</td></tr>
<tr><td>17</td><td>Discuss the methods for calculating T-scores for grouped and ungrouped data. Provide a detailed example.</td><td>K2</td><td>CO2</td></tr>
<tr><td>18</td><td>What is the relationship between judgment scaling and the normal distribution? Explain how judgment scaling utilizes the normal curve.</td><td>K3</td><td>CO3</td></tr>
<tr><td>19</td><td>Discuss the different methods for assessing the reliability of a test, including test-retest, split-half, and parallel forms. Provide examples of when each method should be used.</td><td>K2</td><td>CO4</td></tr>
<tr><td>20</td><td>Explain the importance of construct validity. How can researchers assess whether a test truly measures the construct it is intended to measure?</td><td>K3</td><td>CO5</td></tr>
</table>

Z-Z-Z END