			BL	CO	Marks
	b)	Two different brands of batteries were tested for lifespan. A sample of 150 batteries from Brand A had a mean life of 45 hours with a standard deviation of 5 hours, while 200 batteries from Brand B had a mean life of 46 hours with a standard deviation of 6 hours. Test at 5% significance level whether there is a significant difference between the mean lifespans of the two brands.	L4	CO5	5 M
		UNIT-V			
10	a)	In an experiment to compare the yields (in quintals) of two varieties of wheat, the following results were obtained: Variety A: 18, 20, 22, 19, 21, 20 Variety B: 19, 18, 20, 21, 22, 20 Test at the 5% level whether there is a significant difference in mean yields of the two varieties using a two-sample t-test.	L3	CO5	5 M
	b)	A sample of 9 observations has a mean of 51 and a standard deviation of 3.5. Test at the 1% level of significance whether this sample could come from a population with a mean of 50. Assume normal distribution.	L4	CO5	5 M
		OR			
11	a)	The performance of 8 students in mathematics before and after attending a coaching class is recorded: Before: 52, 55, 60, 58, 54, 57, 59, 56 After: 56, 58, 62, 60, 55, 59, 61, 58 Test at the 5% significance level whether the coaching class has significantly improved the students' performance.	L3	CO3	5 M
	b)	The diameters of 6 ball bearings are measured from each of two machines: Machine 1: 2.53, 2.49, 2.51, 2.54, 2.50, 2.52 Machine 2: 2.48, 2.47, 2.50, 2.49, 2.46, 2.48 Test at 5% significance using an F-test whether the variances in diameters produced by the two machines differ significantly.	L2	CO5	5 M

Code: 23BS1301

II B.Tech - I Semester – Regular / Supplementary Examinations
NOVEMBER 2025

NUMERICAL AND STATISTICAL METHODS
(CIVIL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This question paper contains two Parts A and B.
2. Part-A contains 10 short answer questions. Each Question carries 2 Marks.
3. Part-B contains 5 essay questions with an internal choice from each unit. Each Question carries 10 marks.
4. All parts of Question paper must be answered in one place.

BL – Blooms Level CO – Course Outcome

PART – A

		BL	CO
1.a)	Write bisection Formula.	L2	CO1
1.b)	Write Newton's backward interpolation formula.	L2	CO1
1.c)	Write modified Euler's formula.	L2	CO2
1.d)	Write Trapezoidal formula.	L2	CO2
1.e)	The number of calls arriving at a telephone booth per minute follows a Poisson distribution with mean 2. Find the probability of getting no calls in a minute.	L2	CO3
1.f)	A fair die is thrown twice. Let X be the sum of outcomes. Find the probability distribution of X.	L2	CO3
1.g)	In a random sample of 500 apples, 60 are bad. Find the 95% confidence limits for the proportion of bad apples.	L2	CO3
1.h)	A survey found that 70% of men and 65% of women favour a new policy. Samples: 200 men, 300 women. Write test statistic.	L3	CO3
1.i)	A sample of 10 bulbs has mean life 1570 hours and standard deviation 120 hours. Write test statistic if the mean life differs from 1600 hours.	L3	CO3
1.j)	The heights of 8 men are: 67, 68, 70, 65, 72, 66, 68, 69 inches. Find the mean height.	L2	CO5

PART – B

			BL	CO	Max. Marks
		UNIT-I			
2	a)	Find a cube root of 21 using Newton-Rahpson method.	L3	CO2	5 M
	b)	Find y (0.15) by Newton's forward difference interpolation formula from the following table. x: 0, 0.5, 1, 1.5, 2 y: 1.341, 0.5678, 0.4545, 0.3432, 0.2331	L4	CO2	5 M
		OR			
3	a)	Find the value of Y at X=0.843 from the following table. X: 0.1, 0.3, 0.4, 0.7, 0.9 Y: 2.631, 3.328, 4.097, 4.944, 5.875	L3	CO4	5 M
	b)	Use the method of false position to obtain a real root of the equation $\sin x = 2x - 1$	L3	CO4	5 M
		UNIT-II			
4	a)	Estimate $\int_0^{\pi} \frac{\sin x}{\sqrt{1+\cos x}} dx$ by using Simpson's $\frac{3}{8}^{th}$ rule by taking n=4	L3	CO1	5 M
	b)	Compute the first derivative form the following table of data at x=0.4 x: 0.4, 0.6, 0.8, 1.0, 1.2, 1.4 y: 1.8, 1.6, 1.7, 1.9, 2.01, 1.10	L2	CO2	5 M
		OR			
5		Using Runge-Kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y-x}{y+x}$ with y(0)=1 at x=0.2 and 0.4 round up to three decimals.	L3	CO3	10M

		UNIT-III			
6	a)	Let X be a continuous random variable with distribution: $f(x) = \begin{cases} k x^2, & 0 \le x \le 1 \\ 0, & else\ where \end{cases}$ (i) Evaluate k (ii) Find $p(\frac{1}{4} < x < \frac{3}{4})$ (iii) Find $p(x > \frac{2}{3})$	L3	CO3	5 M
	b)	Average number of accidents on any day on a national high way is 1.8. Determine the probability that the number of accidents are i) at least one ii) at the most one.	L2	CO3	5 M
		OR			
7	a)	Given that the mean heights of students in a class is 158 cm with standard deviation of 20 cm. Find how many students heights lie between 150 cm and 170 cm if there are 100 students in the class.	L3	CO5	5 M
	b)	Out of 800 families with 5 children each, how many would you expect to have (i) 3 boys (ii) 5 girls (iii) either 2 or 3 boys (iv) at least one boy? Assume equal probabilities for boys and girls.	L2	CO3	5 M
		UNIT-IV			
8	a)	In a large sample of 1,200 items, 660 are found to be defective. Test at the 1% level of significance whether the proportion of defective items differs from 50%. Clearly state the null and alternative hypotheses, critical region, and conclusion.	L3	CO3	5 M
	b)	A new teaching method was introduced in a college. Out of 1,000 students taught by the new method, 620 passed the exam. Under the old method, 1,200 out of 2,000 students had passed. Test at the 5% significance level whether the new method is more effective.	L4	CO5	5 M
		OR			
9	a)	A company claims that the mean lifetime of its electric bulbs is 2,000 hours with a standard deviation of 250 hours. A sample of 100 bulbs showed a mean life of 1,970 hours. At 1% level of significance, test whether the company's claim is valid.	L3	CO3	5 M

Code:23BS1301 **PVP23**

IIB.Tech I.st semester Regular Examinations November2025

Subject: NUMERICAL AND STATISTICAL METHODS(CIVIL ENGINEERING)

Scheme of Valuation

PART-A

1a) Consider the function f(x)=0

If $f(a) < 0$ and $f(b) > 0$ then at least one root lies in a and b. 2M

Bisection formula is $x_i = \frac{a+b}{2}$

1b) Newtons ~~for~~backward interpolation for $x=x_0+h$ is

$$f(x) = y_n + p\nabla y_n + \frac{p(p+1)}{2!}\nabla^2 y_n + \frac{p(p+1)(p+2)}{3!}\nabla^3 y_n + \ldots, \quad \text{where } p = \frac{x - x_n}{h}$$ 2M

1c) Eulers method is $y(x_1) = y_0 + hf(x_0, y_0)$

2M

Modified Eulers method $y(x_1) = y_0 + \frac{h}{2}[f(x_0, y_0) + f(x_1, y_1)]$

1d) Trapezoidal rule $\int_{a=x_0}^{b=x_n} f(x)\,dx = \frac{h}{2}[(y_0 + y_n) + 2(y_1 + y_2 + \ldots + y_{n-1})], h = \frac{b-a}{n}$ 2M

1e) Poisson distribution $P(x = r) = \frac{e^{-\lambda}\lambda^{-r}}{r!}$ where λ = mean 1M

let r = number of calls, given $\lambda = 2$, $P(r = 0) = e^{-2}$ 1M

1f) Die is thrown twice. Sum of posible outcomes X=(2,3,4,5,6,7,8,9,10,11,12) 1M
Total Cases=36 , favourable cases of 2 is 1,(1,1).3 is 2,[(1,2),(2,1)].4 is 3, [(1,3),(2,2),(3,1)].5 is 4,[(1,4),(2,3),(3,2),(4,1)].6 is 5,[(1,5),(2,4),(3,3),(4,2),(5,1)]. 7 is 6, [(1,6)(2,5),(3,4),(4,3),(5,2),(6,1)].8 is 5,[(2,6),(3,5),(4,4),(5,3),(6,2)]. 9 is 4 [((3,6),(4,5),(5,4),(6,3)].10 is 3,[(4,6),(5,5),(6,4).11 is 2[(5,6),(6,5)].12 is 1,(6,6).
Probability distribution table is

x	2	3	4	5	6	7	8	9	10	11	12
P(x)	$\frac{1}{36}$	$\frac{2}{36}$	$\frac{3}{36}$	$\frac{4}{36}$	$\frac{5}{36}$	$\frac{6}{36}$	$\frac{5}{36}$	$\frac{4}{36}$	$\frac{3}{36}$	$\frac{2}{36}$	$\frac{1}{36}$

1M

1g) Proportion of bad apples $p = \frac{60}{500} = \frac{3}{25} = 0.12, q = 1 - p = 0.88$

for 95% confidence $z_{\frac{\alpha}{2}} = 1.96$

Confidence limits for proportion of bad apples is

$(p - z_{\frac{\alpha}{2}}\sqrt{\frac{pq}{n}}, \; p + z_{\frac{\alpha}{2}}\sqrt{\frac{pq}{n}})$ 1M

ie; $(0.12 - 1.96\sqrt{\frac{(0.12(0.88)}{500}}, 0.12 + 1.96\sqrt{\frac{(0.12(0.88)}{500}})$

ie; $(0.12 - 1.96\sqrt{0.0002112}, 0.12 + 1.96\sqrt{0.0002112})$

ie; $(0.12 - 0.0285, 0.1\;2 - 0.0285)$ 1M

ie; $(0.0915, \; 0.1485)$

1h) Test statistic $z = \dfrac{P_1 - P_2}{\sqrt{\dfrac{pq}{n_1} + \dfrac{pq}{n_2}}}$, where $p = \dfrac{n_1 p_1 + n_2 p_2}{n_1 + n_2}$ 1M

70% of $200 = 140$, 65% of $300 = 195$

Given $n_1 = 200, n_2 = 300, \; p_1 = \dfrac{140}{200} = 0.7, p_2 = \dfrac{195}{300} = 0.65$

$p = \dfrac{140+195}{200+300} = 0.67, \; q = 1 - p = 1 - 0.67 = 0.33$

Test statistic $z = \dfrac{0.7 - 0.65}{\sqrt{(0.67)(0.33)(\dfrac{1}{200} + \dfrac{1}{300}}} = \dfrac{0.05}{0.00184} = 27.17$ 1M

1i) Test statistic $z = \dfrac{\overline{x} - u}{\dfrac{\sigma}{\sqrt{n}}}$ 1M

Given $n = 10, \; \overline{x} = 1570, \; u = 1600$, and $\sigma = 120$

$z = \dfrac{1570 - 1600}{\dfrac{120}{\sqrt{10}}} = -0.79$ 1M

1j) Mean $\overline{x} = \dfrac{\sum x}{n}$

$= \dfrac{67 + 68 + 70 + 65 + 72 + 66 + 68 + 69}{8} = 68.125$ 2M

PART-B

UNIT-I

2a) Newton-Raphson method is $x_{n+1} = x_n - \dfrac{f(x_n)}{f^1(x_n)}$, $n = 0,1,2,3..$ 1M

Let $x = (21)^{1/3} \Rightarrow x^3 - 21 = 0, f(x) = x^3 - 21,$

$f(2) < 0, f(3) > 0$ one root lies in 2 and 3. Take $x_0 = 2.5$ 1M

For cubic root $x_{n+1} = \dfrac{2x_n^3 + N}{3x_n^2}$, $x_1 = \dfrac{2(2.5)^3 + 21}{3(2.5)^2} = \dfrac{52.25}{18.75} = 2.78667$ 1M

$x_2 = \dfrac{2(2.78667)^3 + 21}{3(2.78667)^2} = 2.7592, x_3 = \dfrac{2(2.7592)^3 + 21}{3(2.7592)^2} = 2.7589$ 2M

$x_4 = \dfrac{2(2.7589)^3 + 21}{3(2.7589)^2} = \dfrac{63.0126}{22.8396} = 2.7589$

(OR)

Let $x = (21)^{1/3} \Rightarrow x^3 - 21 = 0, f(x) = x^3 - 21,$

$f(2) < 0, f(3) > 0$ one root lies in 2 and 3. Take $x_0 = 2.5$

$$x_1 = x_0 - \frac{x_0^3 - 21}{3x_0^2} = 2.5 - \frac{(2.5)^3 - 21}{3(2.5)^2} = 2.5 - \frac{-5.375}{18.75} = 2.78667$$

$$x_2 = x_1 - \frac{x_1^3 - 21}{3x_1^2} = 2.78667 - \frac{(2.78667)^3 - 21}{3(2.78667)^2} = 2.7592$$

$$x_3 = x_2 - \frac{x_2^3 - 21}{3x_2^2} = 2.7592 - \frac{(2.7592)^3 - 21}{3(2.7592)^2} = 2.7589$$

$$x_4 = x_3 - \frac{x_3^3 - 21}{3x_3^2} = 2.7589 - \frac{(2.7589)^3 - 21}{3(2.7589)^2} = 2.7589$$

2.7589 is approximate value of cube root of 21

2b) Newtons forward interpolation for $x=x_0+h$ is

$$f(x)= y_0 + p\Delta y_0 + \frac{p(p-1)}{2!}\Delta^2 y_0 + \frac{p(p-1)(p-2)}{3!}\Delta^3 y_0 + ..., \quad \text{where } p = \frac{x-x_0}{h}$$ 1M

For $x=0.15$, $x_0=0$, $h=0.5$, $p= 0.3$

Difference table is

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$
0	1.341				
		-0.7732			
0.5	0.5678		0.6599		
		-0.1133		-0.6579	
1	0.4545		0.002		0.6571
		-0.1113		-0.0008	
1.5	0.3432		0.0012		
		-0.1101			
2	0.2331				

3M

$$f(0.15) = 1.341 + (0.3)(-0.7732) + \frac{(0.3)(-0.7)}{2}(0.6599) + \frac{(0.3)(-0.7)(-1.7)}{6}(-0.6579) +$$

$$\frac{(0.3)(-0.7)(-1.7)(-2.7)}{24}(0.6571) = 1.341 - 0.23196 - 0.06929 - 0.00391 - 0.00026 = 1.03558$$ 1M

OR

3a) Lagranges interpolation formula is

$$f(x)=\frac{(x-x_1)(x-x_2)(x-x_3)(x-x_4)}{(x_0-x_1)(x_0-x_2)(x_0-x_3)(x_0-x_4)}y_0+\frac{(x-x_0)(x-x_2)(x-x_3)(x-x_4)}{(x_1-x_0)(x_1-x_2)(x_1-x_3)(x_1-x_4)}y_1$$

$$+\frac{(x-x_0)(x-x_1)(x-x_3)(x-x_4)}{(x_2-x_0)(x_2-x_1)(x_2-x_3)(x_2-x_4)}y_2+\frac{(x-x_0)(x-x_1)(x-x_2)(x-x_4)}{(x_3-x_0)(x_3-x_1)(x_3-x_2)(x_3-x_4)}y_3$$ 3M

$$+\frac{(x-x_0)(x-x_1)(x-x_2)(x-x_3)}{(x_4-x_0)(x_4-x_1)(x_4-x_2)(x_4-x_3)}y_4$$

$$f(0.843)=\frac{(0.843-0.3)(0.843-0.4)(0.843-0.7)(0.843-0.9)}{(0.1-0.3)(0.1-0.4)(0.1-0.7)(0.1-0.9)}(2.631)$$

$$+\frac{(0.843-0.1)(0.843-0.4)(0.843-0.7)(0.843-0.9)}{(0.3-0.1)(0.3-0.4)(0.3-0.7)(0.3-0.9)}(3.328)$$ 1M

$$+\frac{(0.843-0.1)(0.843-0.3)(0.843-0.7)(0.843-0.9)}{(0.4-0.1)(0.4-0.3)(0.4-0.7)(0.4-0.9)}(4.097)$$

$$+\frac{(0.843-0.1)(0.843-0.3)(0.843-0.4)(0.843-0.9)}{(0.7-0.1)(0.7-0.3)(0.7-0.4)(0.7-0.9)}(4.944)$$

$$+\frac{(0.843-0.1)(0.843-0.3)(0.843-0.4)(0.843-0.7)}{(0.9-0.1)(0.9-0.3)(0.9-0.4)(0.9-0.7)}(5.875)$$

$$=-0.17912+2.28996-2.99401+3.49771+3.12820=5.74274$$ 1M

3b) $six = 2x - 1 \Rightarrow \sin x - 2x + 1 = 0$, Consider $f(x) = \sin x - 2x + 1$.

$f(0) = 1 > 0$ and $f(1) = -0.1585 < 0$ $\therefore$ one root lies in 0 and 1.

Falsi position method a=0 and b= 1

$$x_i=\frac{af(b)-bf(a)}{f(b)-f(a)}$$ 2M

$$x_1=\frac{0(-0.1585)-1(1)}{-0.1585-1}=\frac{1}{1.1585}=0.8632.\ f(0.8632)=0.0335>0$$ 1M

$$x_2=\frac{0.8632(-0.1585)-1(0.0335)}{-0.1585-0.0335}=\frac{0.1703}{0.192}=0.8869.\ f(0.8869)=0.0013>0$$

$$x_3=\frac{0.8869(-0.1585)-1(0.0013)}{-0.1585-0.0013}=\frac{0.14187}{0.1598}=0.8877.\ f(0.8877)=0.0002$$ 2M

0.8877 is approximate root of $\sin x = 2x - 1$

UNIT-II

4a) For n=4

Simpson' s 3/8 rule $\int_{a=x_0}^{b=x_n} f(x)\,dx = \frac{3h}{8}[(y_0 + y_4) + 3(y_1 + y_2) + 2(y_3)]$ 2M

Given $a = 0$, $b = \pi$, $h = \frac{b - a}{n} = \frac{\pi}{4}$. $f(x) = \frac{\sin x}{\sqrt{1 + \cos x}}$

x	0	$\frac{\pi}{4}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π
$\frac{\sin x}{\sqrt{1+\cos x}}$	0	0.0097	0.0192	0.0291	0.0388

2M

$$\int_0^{\pi} \frac{\sin x}{\sqrt{1+\cos x}}\,dx = \frac{3\pi}{32}[(0 + 0.0388) + 3(0.0097 + 0.0192) + 2(0.0291)]$$ 1M

=0.2945[0.0388+0.0867+0.0582]=0.05401

4b) For $x = x_0$, $\frac{dy}{dx} = \frac{1}{h}[\Delta y_0 - \frac{\Delta^2 y_0}{2} + \frac{\Delta^3 y_0}{3} - \frac{\Delta^4 y_0}{4} + \frac{\Delta^5 y_0}{5} + ..]$ 1M

Difference table is

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$	$\Delta^5 y$
0.4	1.8					
		-0.2				
0.6	1.6		0.3			
		0.1		-0.2		
0.8	1.7		0.1		0.01	
		0.2		-0.19		-0.75
1.0	1.9		-0.09		-0.74	
		0.11		-0.93		
1.2	2.01		-1.02			
		-0.91				
1.4	1.10					

3M

For $x = 0.4, \frac{dy}{dx} = \frac{1}{0.2}[-0.2 - \frac{0.3}{2} - \frac{0.2}{3} - \frac{0.01}{4} - \frac{0.75}{5}] = -2.8458$ 1M

OR

5) Runge Kutta-method

$$y(x_1) = y_0 + \frac{1}{6}(k_1 + 2k_2 + 2k_3 + k_4), \qquad x_1 = x_0 + h$$

$$where \quad k_1 = hf(x_0, y_0), \qquad k_2 = hf(x_0 + \frac{h}{2}, y_0 + \frac{k_1}{2})$$

$$k_3 = hf(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}) \qquad k_4 = hf(x_0 + h, y_0 + k_3)$$

4M

$$\text{Given} \quad f(x,y) = \frac{y-x}{y+x}, \quad x_0 = 0, y_0 = 1, \text{take } h = 0.2, x_1 = 0.2$$

$$where \quad k_1 = 0.2 f(0,1) = 0.2$$

$$k_2 = 0.2 f(0.1, 1.1) = 0.2[\frac{1.1 - 0.1}{1.1 + 0.1}] = 1.6667$$

$$k_3 = 0.2 f(0.1, 1.3334) = 0.2[\frac{1.3334 - 0.1}{1.3334 + 0.1}] = 0.1721$$

$$k_4 = 0.2 f(0.2, 1.1721) = 0.2[\frac{1.1721 - 0.2}{1.1721 + 0.2}] = 0.1417$$

$$y(0.2) = 1 + \frac{1}{6}[0.2 + 2(1.6667) + 2(0.1721) + 0.1417) = 1.6699$$ 3M

$$x_1 = 0.2, y_1 = 1.6699, x_2 = x_1 + h = 0.4$$

$$k_1 = 0.2 f(0.2, 1.6699) = 0.2[\frac{1.6699 - 0.2}{1.6699 + 0.2}] = 0.1572$$

$$k_2 = 0.2 f(0.3, 1.7485) = 0.2[\frac{1.7485 - 0.3}{1.7485 + 0.3}] = 0.1414$$

$$k_3 = 0.2 f(0.3, 1.7406) = 0.2[\frac{1.7406 - 0.3}{1.7406 + 0.3}] = 0.1412$$

$$k_4 = 0.2 f(0.4, 1.8111) = 0.2[\frac{1.8111 - 0.4}{1.8111 + 0.4}] = 0.1276$$

$$y(0.4) = 1.6699 + \frac{1}{6}[0.1572 + 2(0.1414) + 2(0.1412) + 0.1276)$$

$$= 1.8116$$ 3M

UNIT-III

6a) i) Given $f(x) = \begin{cases} kx^2, 0 < x < 1 \\ 0, \text{ else where} \end{cases}$

we have $\int_{-\infty}^{\infty} f(x)dx = 1 \Rightarrow \int_0^1 kx^2 dx = 1 \Rightarrow k = 3$ 2M

$ii) P(\frac{1}{4} < x < \frac{3}{4}) = \int_{1/4}^{3/4} kx^2 dx = 3\left[\frac{x^3}{3}\right]_{1/4}^{3/4} = \frac{27-1}{64} = \frac{13}{32}$ 2M

$iii) P(x > \frac{2}{3}) = \int_{2/3}^{1} kx^2 dx = 3\left[\frac{x^3}{3}\right]_{2/3}^{1} = 1 - \frac{8}{27} = \frac{19}{27}$ 1M

6b) Given mean $\lambda = 1.8$

we have $P(x = r) = \frac{e^{-\lambda}\lambda^r}{r!} = \frac{e^{-1.8}(1.8)^r}{r!}$ 2M

i)P(at least one accident) $= P(r \geq 1) = 1 - P(r < 1)$

$= 1 - P(r = 0) = 1 - \frac{e^{-1.8}(1.8)^0}{0!} = 1 - e^{-1.8} = 1 - 0.1653 = 0.8347$ 1M

ii)P(at most one accident) $= P(r \leq 1) = P(r = 0) + P(r = 1)$

$= \frac{e^{-1.8}(1.8)^0}{0!} + \frac{e^{-1.8}(1.8)^1}{1!} = e^{-1.8}(2.8) = (0.1653)(2.8) = 0.4628$ 2M

OR

7a) Given mean $\mu = 158$ and standard deviation $\sigma = 20$

$P(150 \leq x \leq 170) = P(\frac{150 - \mu}{\sigma} \leq \frac{x - \mu}{\sigma} \leq \frac{170 - \mu}{\sigma})$ 2M

$= P(\frac{150 - 158}{20} \leq z \leq \frac{170 - 158}{20}) = P(-0.4 \leq z \leq 0.6)$

$= P(0.4) + P(0.6) = 0.1554 + 0.2258 = 0.3811$ 2M

For 100 students heights between 150 and 170 $= 100(0.3811)$

$= 38.11 = 30$ (Number ofstudents should be Natural number) 1M

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7b) The probability distribution $P(x=r)={}^{n}c_{r}p^{r}q^{n-r}$

equal probability for boys and girls ie; $p=q=\frac{1}{2}$ 1M

Number of children, $n=5$, Total families $=800$

a)Probability of 3 boys $=P(r=3)={}^{5}c_{3}(\frac{1}{2})^{3}(\frac{1}{2})^{5-3}$

$$={}^{5}c_{3}(\frac{1}{2^{5}})=\frac{1}{32}(\frac{5(4)}{1(2)})=\frac{5}{16}$$

For 800 families the probability having 3 boys

$$=800(\frac{5}{16})=250 \text{ families}$$

1M

b)Probability of 5 girls = probability of zero boys

$$=P(r=0)={}^{5}c_{0}(\frac{1}{2})^{0}(\frac{1}{2})^{5-0}=\frac{1}{2^{5}}=\frac{1}{32}$$

For 800 families the probability having 3 boys

$$=800(\frac{1}{32})=25 \text{ families}$$ 1M

c)Probability of either 2 or 3 boys $=P(r=2)+P(r=3)$

$$={}^{5}c_{2}(\frac{1}{2})^{2}(\frac{1}{2})^{5-2}+{}^{5}c_{3}(\frac{1}{2})^{3}(\frac{1}{2})^{5-3}=\frac{1}{2^{5}}({}^{5}c_{2}+{}^{5}c_{2})=\frac{1}{32}(10+10)=\frac{20}{32}$$

For 800 families the probability of either 2 or 3 boys

$$=800(\frac{20}{32})=500 \text{ families}$$ 1M

d)Probability of either at least one boy $=P(r\geq 1)=1-P(r=0)$

$$=1-{}^{5}c_{0}(\frac{1}{2})^{0}(\frac{1}{2})^{5-0}=1-\frac{1}{2^{5}}=1-\frac{1}{32}=\frac{31}{32}$$

For 800 families the probability of either at least one boy

$$=800(\frac{31}{32})=775 \text{ families}$$ 1M

UNIT-IV

8a) Given sample size n=1200 defective items =660

p = Sample proportion of defective items =660/1200=0.55, q=1-p=0.45

Population proportion P=Q=0.5

i. Null hypothesis : H_0 = The number of defective and non defective items are equal. 3M

ii. Alternative hypothesis : H_1 = defective and non defective items are not equal

iii. Level of significance : Z_{tab}= 1.96 (5% LOS)

iv. Test statistic : 1M

$$z_{cal} = \frac{p-P}{\sqrt{\frac{PQ}{n}}} = \frac{0.55-0.5}{\sqrt{\frac{(0.5)(0.5)}{1200}}} = 3.464 > 1.96 = z_{tab}$$

1M

Reject the null hypothesis.

V.Conclusion: The number of defective and non defective items are not equal.

8b) Given sample sizes n_1 =2000(old teaching) n_2 = 1000(new teaching).

Proportion of old method p_1 = 1200/2000 =0.6

Proportion of new method p_2 = 620/1000 =0.62

i. Null hypothesis $H_0 : p_1 = p_2$

(Assume that there is no significance difference between the old and new teaching methods.

ii. Alternative hypothesis $H_0 : p_1 \neq p_2$

(There is significance difference between the old and new teaching methods.) 2M

iii. Level of significance : Z_{tab}= 1.96 (5% LOS)

iv. Test statistic :

$$z = \frac{P_1 - P_2}{\sqrt{\frac{pq}{n_1} + \frac{pq}{n_2}}}$$

where $$p = \frac{n_1p_1 + n_2p_2}{n_1 + n_2} = \frac{2000(\frac{1200}{2000}) + 1000(\frac{620}{1000})}{2000 + 1000} = 0.6067$$

$$q = 1 - p = 1 - 0.6067 = 0.3933.$$ 2M

$$z = \frac{0.6-0.62}{\sqrt{(0.6067)(0.3933)(\frac{1}{2000} + \frac{1}{1000})}} = \frac{-0.02}{0.01892} = -1.0571$$ 1M

$$z_{cal} = |z| = 1.057 < 1.96 = z_{tab} \text{ , accept null hypothesis}$$

V.Conclusion:There is no significance difference between the old and new teaching methods.

OR

9a) Given sample size n=100 population mean=2000

Sample mean=1970 standard deviation=250

i. Null hypothesis H_0 :u>2000(company claims life time hours)

ii. Alternative hypothesis H_1 : u<2000 hours

iii. Level of significance : Z_{tab}= 2.33 (1% LOS one tail test) 2M

iv. Test statistic :

$$z_{cal} = \frac{\bar{x}-\mu}{\frac{\sigma}{\sqrt{n}}} = \frac{1970-2000}{\frac{250}{\sqrt{100}}} = -1.2$$ 2M

$|z| = 1.2 < 2.33 = z_{tab}$ accept null hypothesis. 1M

V. Company claim is valid.

9b) Given

	mean	S.D.	sample size
Brand A	45	5	150
Brand B	46	6	200

i.Null hypothesis H_0 :u_1=u_2(There is no significance difference between the two batteries lifespan.)

ii. Alternative hypothesis H_1 : $u_1 \neq u_2$(There is significance difference between the two batteries lifespan.)

iii. Level of significance : Z_{tab}= 1.96 (5 % LOS) 2M

iv. Test statistic

$$z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{45-46}{\sqrt{\frac{25}{150} + \frac{36}{200}}} - 2.269$$ 2M

$|z_{cal}| = 2.269 > 1.96 = z_{tab}$ reject null hypothesis 1M

V. Conclusion: There is significance difference between the two batteries lifespan.

UNIT-V

10a) Let two varieties of wheat are A and B are x and y respectively.

sample size of x= n_1 = 6 sample size of y = n_2 = 6

I. Null hypothesis H_0 : There is no significance difference between the two varieties of wheat

ii. Alternative hypothesis H_1:There is significance difference between the two varieties of wheat.

iii.LOS: at 0.05 level t_{tab} = 2.228 with v=6+6-2=10 d.f

iv. Test statistic

$$t = \frac{\bar{x}-\bar{y}}{S\sqrt{\frac{1}{n_1}+\frac{1}{n_2}}}, \text{where } S^2 = \frac{\sum(x-\bar{x})^2 + \sum(y-\bar{y})^2}{n_1+n_2-2}$$ 2M

$$\bar{x} = \frac{\sum x}{n_1} = \frac{120}{6} = 20$$

$$\bar{y} = \frac{\sum y}{n_2} = \frac{120}{6} = 20$$

$$S^2 = \frac{10+10}{6+6-2} = 1$$

$$S = 1$$

X	(X-20)^2	Y	(Y-20)^2
18	4	19	1
20	0	18	4
22	4	20	0
19	1	21	1
21	1	22	4
20	0	20	0
120	**10**	**120**	**10**

2M

$$t = \frac{20-20}{1\sqrt{\frac{1}{6}+\frac{1}{6}}} = 0 < 2.228 \text{ accept null hypothesis}$$

1M

V.conclusion: There is no significance difference between the two varieties of wheat A and B.

10b) Given sample size n=9 (n<30, is small sample)

sample mean=51

population mean=50

standard deviation=3.5

i. Null hypothesis H_0 : u=30

(The sample is come from population mean)

ii. Alternate Hypothesis H_1 :u<1000

iii. Level of significance : 1% LOS with

8 (v=n-1=9-1=8) degrees of freedom t=3.355 — 2M

iv. Test statistic

$$t = \frac{\bar{x}-u}{\frac{s}{\sqrt{n}}} = \frac{51-50}{\frac{3.5}{\sqrt{9}}} = 0.857$$

2M

$$t = 0.857 < 3.355 = t_{tab} \quad \text{accept null hypothesis}$$

V. Conclusion: The sample is come from population mean. — 1M

OR

11a) I.Null hypothesis : There is no improved the performance after the coaching

ii. Alternate Hypothesis H_1 :There is improved the performance after the coaching

iii. Level of significance : 5% LOS with

7 (v=n-1=8-1=7) degrees of freedom t=2.365

iv. Test statistic

$$t = \frac{\bar{d}}{\frac{S}{\sqrt{n}}} \quad where \ \bar{d} = \frac{\sum d}{n} \quad and \quad S^2 = \frac{\sum (d-\bar{d})^2}{n-1}$$ 2M

Before (x)	After (y)	d=y-x	(d-2.25)^2
52	56	4	3.0625
55	58	3	0.5625
60	62	2	0.0625
58	60	2	0.0625
54	55	1	1.5625
57	59	2	0.0625
59	61	2	0.0625
56	58	2	0.0625
		18	5.5

$$\bar{d} = \frac{\sum d}{n}$$

$$= \frac{18}{8} = 2.25$$

$$S^2 = \frac{5.5}{7}$$

$$S = 0.8864$$

$$t = \frac{2.25}{\frac{0.8864}{\sqrt{8}}} = 7.18$$

$t = 7.18 > 2.365 = t_{tab}$ reject null hypothesis 3M

V. Conclusion: There is improved the performance after the coaching

I

11b) i.Null hypothesis : There is no difference between the variances of two machines bearing diameters

ii. Alternate Hypothesis H_1 :There is difference between the variances of two machines bearing diameters

iii. Level of significance : 5% LOS with (v_1=6-1,v_1=6-1) degrees of freedom F=5.05 1M

iv: Test statistic:

$$If \quad S_x^2 > S_y^2 \ then \quad F = \frac{S_x^2}{S_y^2}$$

$$S_x^2 = \frac{\sum(x-\bar{x})^2}{n_1 - 1}$$

$$S_y^2 = \frac{\sum(y-\bar{y})^2}{n_2 - 1}$$ 1M

Machine -I(x)	(x-2.515)^2	Machine -II(y)	(y-2.48)^2
2.53	0.000225	2.48	0
2.49	0.000625	2.47	0.0001
2.51	0.000025	2.50	0.0004
2.54	0.000625	2.49	0.0001
2.50	0.000225	2.46	0.0004
2.52	0.000025	2.48	0
15.09	**0.00175**	**14.88**	**0.001**

2M

$$S_x^2 = \frac{0.00175}{6-1} = 0.00035, \quad S_y^2 = \frac{0.001}{6-1} = 0.0002$$

$$F = \frac{S_x^2}{S_y^2} = 1.75$$ 1M

$F_{cal} = 1.75 < 5.05 = F_{tab}$

accept the null hypothesis

V.Conclusion: There is no difference between the variances of two machines bearing diameters

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