

Enrollment No.....



Knowledge is Power

Programme: B.Tech.

Branch/Specialisation: AU/CE/FT

/ME/RA

Faculty of Engineering

End Sem (Odd) Examination Dec-2022

EN3BS15 Engineering Mathematics -III

Duration: 3 Hrs.

Maximum Marks: 60

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

- Q.1 i. $E^{-1}(f(x)) = \text{_____}$ where E is shift operator and h is 1 interval of differencing. 1
 (a) $f(x)$ (b) $f(x + h)$ (c) $f(x - h)$ (d) None of these
- ii. To find the value of y corresponding to $x= 2$ is done by using 1 method for the given data:

x	0	1	4	5	8
y	12	68	153	180	200

- (a) Newtons Forward (b) Stirlings
 (c) Lagrange's (d) None of these
- iii. To apply _____ rule number of intervals n must be multiple of 3. 1
 (a) Trapezoidal (b) Simpsons 3/8
 (c) Weedle's (d) None of these
- iv. Runge Kutta method of first order is known as _____ methods. 1
 (a) Euler's (b) Modified Euler
 (c) Improved Euler (d) None of these
- v. If mean of the exponential distribution is $\frac{1}{2}$ then variance is _____. 1
 (a) $\frac{1}{2}$ (b) $\frac{1}{4}$ (c) 1 (d) None of these
- vi. If variance of the binomial distribution is 3 and mean is 5 then 1 probability of failure of the event is _____.
 (a) $\frac{3}{5}$ (b) 2 (c) $\frac{5}{3}$ (d) None of these
- vii. If values of one of the variable x decreases correspondingly y also 1 decreases, then correlation between them is _____.
 (a) Positive (b) Negative (c) Perfect (d) None of these
- viii. The two regression lines x on y and y on x always intersect at _____. 1
 (a) Mean (b) Mode (c) Median (d) None of these

P.T.O.

[2]

- ix. When we reject the null hypothesis though it is true then it is known as error of _____ kind. 1
 (a) First (b) Second (c) Third (d) None of these
- x. The probability level below which we reject the null hypothesis is called _____. 1
 (a) Level of significance (b) Confidence level
 (c) Critical level (d) None of these
- Q.2 Attempt any two:
- Represent the function $f(x) = x^4 - 12x^3 + 24x^2 - 30x + 9$ in factorial notation and find its successive differences. 5
 - Use Newton's divided difference formula to find $f(x)$ at $x = 3$ from the following data: 5
- | | | | | | | |
|--------|----|----|----|---|---|----|
| x | 0 | 1 | 2 | 4 | 5 | 6 |
| $f(x)$ | 11 | 14 | 15 | 5 | 6 | 19 |
- Obtain the value of $\frac{dy}{dx}$ at $x = 90$ using the following data: 5
- | | | | | | |
|-----|------|------|------|------|------|
| x | 60 | 75 | 90 | 105 | 120 |
| y | 28.2 | 38.2 | 43.2 | 40.9 | 37.7 |
- Q.3 Attempt any two:
- Apply Simpson's 3/8 rule to evaluate $\int_0^2 \frac{1}{1+x^3} dx$ to two decimal places by dividing the range in to eight equal parts. 5
 - Find the second approximation using Picard's method for the solution of $\frac{dy}{dx} = 1 + xy$ given that $y(0) = 1$. 5
 - Using Runge Kutta method of order four finds $y(0.1), y(0.2)$ given that $\frac{dy}{dx} = y - x; y(0) = 2$, taking $h = 0.1$. 5
- Q.4 Attempt any two:
- Prove that mean deviation about mean of the normal distribution is $4/5$ times the standard deviation. 5
 - The probability that a bomb dropped from a plane will strike the target is $1/5$. If 6 bombs are dropped, find the probability that-
 (a) Exactly two will strike the target
 (b) At least two will strike the target

[3]

- iii. Fit Poisson distribution to the following data: 5
- | | | | | | |
|--------|-----|----|----|---|---|
| x | 0 | 1 | 2 | 3 | 4 |
| $f(x)$ | 122 | 60 | 15 | 2 | 1 |
- Q.5 Attempt any two:
- Fit a straight line to the following data: 5
- | | | | | | | | | | |
|-----|---|---|----|----|----|----|----|----|----|
| x | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| y | 9 | 8 | 10 | 12 | 11 | 13 | 14 | 16 | 15 |
- Find the two lines of regression from the following data: 5
- | | | | | | | | | |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| x | 78 | 89 | 97 | 69 | 59 | 79 | 68 | 61 |
| y | 125 | 137 | 156 | 112 | 107 | 136 | 123 | 108 |
- Find the rank correlation coefficient from the following data: 5
- | | | | | | | | | | | |
|-----|----|----|----|----|----|----|----|----|----|----|
| x | 68 | 64 | 75 | 50 | 64 | 80 | 75 | 40 | 55 | 64 |
| y | 62 | 58 | 68 | 45 | 81 | 60 | 68 | 48 | 50 | 70 |
- Q.6 Attempt any two:
- Find the student's t-statistics for the following variable values in a sample: -4, -2, -2, 0, 2, 2, 3, 3 taking the mean of the universe to be zero. 5
 - A dice is tossed 120 times with the following results: 5
- | No.
Turned up | 1 | 2 | 3 | 4 | 5 | 6 | Total |
|------------------|----|----|----|----|----|----|-------|
| Frequency | 30 | 25 | 18 | 10 | 22 | 15 | 120 |
- Test the hypothesis that the dice is unbiased ($\chi^2_{0.05,5} = 11.07$). 5
- Test whether the two sets of observations: 5
- | | | | | | | | | | |
|-----|----|----|----|----|----|----|----|----|----|
| I: | 17 | 27 | 18 | 25 | 27 | 29 | 27 | 23 | 17 |
| II: | 16 | 16 | 20 | 16 | 20 | 17 | 15 | 21 | |
- Indicates sample drawn from the same universe. [The value of z at 5% level of significance and for 8 and 7 degree of freedom is .6575].

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Q.1		
i> (c) $f(x-h)$	[1]	
ii> (c) Lagrange's	[1]	
iii> (b) Simpson's 3/8	[1]	
iv> (a) Euler's	[1]	
v> (b) 1/4	[1]	
vi> (a) 3/5	[1]	
vii> (a) Positive	[1]	
viii> (a) Mean	[1]	
ix> (a) First	[1]	
x> (a) Level of Significance	[1]	
Q.2		
i> $f(x) = x^4 - 12x^3 + 24x^2 - 30x + 9$ $= A x^{[4]} + B x^{[3]} + C x^{[2]} + D x^{[1]} + E x^{[0]}$	[2]	
$\begin{array}{ c c c c c c } \hline 1 & 1 & -12 & 24 & -30 & 9 = E \\ \hline & 0 & 1 & -11 & 13 & \\ \hline 2 & 1 & -11 & 13 & -17 = 0 & \\ \hline & 0 & 2 & -18 & & \\ \hline 3 & 1 & -9 & -5 = C & & \\ \hline & 0 & 3 & & & \\ \hline \end{array}$ $L = A$ $r = B$	[3]	

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$$f(x) = x^4 - 6x^3 - 5x^2 - 17x + 9$$

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[4]

$$\therefore \Delta f(x) = 4x^3 - 18x^2 - 10x - 17x^0$$

$$\Delta^2 f(x) = 12x^2 - 36x^1 + 10x^0$$

$$\Delta^3 f(x) = 24x^1 - 36x^0$$

$$\Delta^4 f(x) = 24x^0$$

$$\Delta^n f(x) = 0 ; n \geq 5$$

[5]

Q2
ii>

x	f(x)	$\Delta f(x)$	$\Delta^2 f(x)$	$\Delta^3 f(x)$	$\Delta^4 f(x)$	$\Delta^5 f(x)$
0	11	3	-1			
1	14	1	-2	$-\frac{1}{4}$	$\frac{1}{4}$	
2	15	-5	2	1	0	$-\frac{1}{24}$
3	5	1	6			
4	6	13				
5	19					

[2]

$$\begin{aligned}
 y &= f(x_0) + (x-x_0) \Delta f(x_0) + (x-x_0)(x-x_1) \Delta^2 f(x_0) \\
 &\quad + (x-x_0)(x-x_1)(x-x_2) \Delta^3 f(x_0) + \dots \\
 &\quad + (x-x_0)(x-x_1)(x-x_2)(x-x_3) \Delta^4 f(x_0) \\
 &\quad + (x-x_0)(x-x_1)(x-x_2)(x-x_3)(x-x_4) \Delta^5 f(x_0) \quad [3]
 \end{aligned}$$

$$\begin{aligned}
 &= 11 + (x-0) 3 + (x-0)(x-1) (-1) + (x-0)(x-1)(x-2) (-\frac{1}{4}) \\
 &\quad + (x-0)(x-1)(x-2)(x-3) (\frac{1}{4}) + (x-0)(x-1)(x-2)(x-3)(x-4) \\
 &\quad \times (-\frac{1}{24}) \quad [4]
 \end{aligned}$$

$$y_{x=3} = 11 + 9 - 6 + 6(-\frac{1}{4}) - 6(\frac{1}{4}) + 12(-\frac{1}{24})$$

$$[47] \quad \frac{1}{1+x_3} dx = \int \frac{8}{3y} [y_0 + y_1 + 3(y_1 + y_2 + y_3 + y_4) + 2(y_5 + y_6 + y_7 + y_8)] dy$$

$$[48] \quad x : 0 \quad \frac{1}{4} \quad \frac{1}{4} \quad \frac{1}{4} \quad \frac{1}{4} \quad \frac{1}{2} \quad \frac{1}{4} \quad 0 \quad y : 1 \cdot 0.9846 \cdot 0.9846 \cdot 0.9846 \cdot 0.9846 \cdot 0.9846 \cdot 0.9846 \cdot 0.9846$$

$$[49] \quad h = \frac{2-x_3}{1+x_3} = \frac{1}{4} = \frac{8}{0-8} = h$$

$$[50] \quad = 0.672222$$

$$= \frac{1}{15} [1.35 - 341666]$$

$$[51] \quad = \frac{1}{15} \left[\frac{5-2.3}{2} - \frac{1}{6} [6.4 - 2.3] \right]$$

$$[52] \quad \frac{dy}{dx} = \frac{1}{h} \left[f \frac{\Delta y_0 + \Delta y_1}{2} \right] - \frac{1}{6} \left[\Delta^3 y_{-1} + \Delta^3 y_{-2} \right]$$

x	y	Δy	$\Delta^2 y$	$\Delta^3 y$	$\Delta^4 y$	$\Delta^5 y$	$\Delta^6 y$	$\Delta^7 y$	$\Delta^8 y$	$\Delta^9 y$	$\Delta^{10} y$
60 = x_1	28.2	-5	-10	-5	-5	-5	-5	-5	-5	-5	-5
75 = x_2	38.2	-7.3	-14.6	-21.9	-29.2	-36.5	-43.8	-51.1	-58.4	-65.7	-73.0
90 = x_3	43.2	-7.3	-14.6	-21.9	-29.2	-36.5	-43.8	-51.1	-58.4	-65.7	-73.0
105 = x_4	40.9	-6.9	-13.8	-20.7	-27.6	-34.5	-41.4	-48.3	-55.2	-62.1	-69.0
120 = x_5	37.7	-6.9	-13.8	-20.7	-27.6	-34.5	-41.4	-48.3	-55.2	-62.1	-69.0

$$[53] \quad = \frac{2}{2} = 10.5$$

$$= 14 - \frac{6}{2} - \frac{2}{2}$$

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$$= \frac{3}{4 \times 8} [11.5828]$$

$$= 1.0859$$

Marks

[5]

To apply simpsons 3/8 rule interval must be multiple of 3 if considered with this then it should be considered.

3
ii)

$$\text{Here } f(x, y) = 1 + xy$$

$$x_0 = 0$$

$$y_0 = 1$$

$$y_1 = y_0 + \int_{x_0}^x f(x, y_0) dx$$

$$= 1 + \int_0^x (1 + x \cdot 1) dx$$

$$= 1 + x + \frac{x^2}{2}$$

[2.5]

$$y_2 = y_0 + \int_{x_0}^x f(x, y_1) dx$$

$$= 1 + \int_0^x \left[1 + x \left(1 + x + \frac{x^2}{2} \right) \right] dx$$

$$= 1 + x + \frac{x^2}{2} + \frac{x^3}{3} + \frac{x^4}{8}$$

[5]

3
iii) Given $x_0 = 0, y_0 = 2, h = 0.1$

$$k_1 = h f(x_0, y_0) = 0.1 (2 - 0) = 0.2$$

$$k_2 = h f\left(x_0 + \frac{h}{2}, y_0 + \frac{k_1}{2}\right) = 0.1 [2.1 - 0.05] = 0.205$$

$$k_3 = h f\left(x_0 + \frac{h}{2}, y_0 + \frac{k_2}{2}\right) = 0.1 [2.1025 - 0.05] \\ = 0.20525$$

$$M.A = \int_{-\infty}^{\infty} e^{-xt} \cdot \frac{1}{\sqrt{2\pi}} e^{-\frac{(x-t)^2}{2}} dt$$

$$\text{Put } t = x - u \Rightarrow dt = dx \quad \therefore \int_{-\infty}^{\infty} e^{-xu} \cdot \frac{1}{\sqrt{2\pi}} e^{-\frac{u^2}{2}} du$$

$$= \int_{-\infty}^{\infty} e^{-x|x-u|} \cdot \frac{1}{\sqrt{2\pi}} e^{-\frac{(x-u)^2}{2}} du$$

$$M.A = \int_{-\infty}^{\infty} |x-u| f(x) dx$$

$$[5] = 0.4214$$

$$y(2) = y_2 = y_1 + \frac{1}{2} [k_1 + 2k_2 + 2k_3 + k_4]$$

$$= 0.22215223$$

$$k_4 = h f(x_1 + h, y_1 + k_3) = 0.1 [0.4215223 - 0.2]$$

$$= 0.2163223$$

$$k_3 = h f(x_1 + \frac{h}{2}, y_1 + \frac{k_1 + k_2}{2}) = 0.1 [0.313223 - 0.15] \\ = 0.216046$$

$$k_2 = h f(x_1 + \frac{h}{2}, y_1 + \frac{k_1}{2}) = 0.1 [0.31046 - 0.15]$$

$$= 0.21052$$

$$k_1 = h f(x_1, y_1) = 0.1 [0.2052 - 0.1]$$

To find y_2

$$= 0.2052$$

$$= 0.20517$$

$$y(1) = y_1 = y_0 + \frac{1}{2} [k_1 + 2k_2 + 2k_3 + k_4]$$

$$= 0.1 [0.20525 - 0.1] = 0.210525$$

$$k_4 = h f(x_0 + h, y_0 + k_3)$$

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1.
$$= \frac{\sqrt{2}\sigma}{\sqrt{\pi}} \cdot 2 \int_0^{\infty} t e^{-t^2} dt$$

put $u = t^2 \Rightarrow du = 2t dt$

$$= \frac{\sqrt{2}\sigma}{\sqrt{\pi}} \int_0^{\infty} e^{-u} du$$

[4]

$$= \frac{\sqrt{2}\sigma}{\sqrt{\pi}} \left[-e^{-u} \right]_0^{\infty}$$

$$= \frac{\sqrt{2}\sigma}{\sqrt{\pi}} \sigma = \frac{4}{5}\sigma \text{ approx}$$

[5]

ii) $p = \frac{1}{5} \quad \& \quad n = 6$

$$q = 1 - \frac{1}{5} = \frac{4}{5}$$

(1)

Using Binomial Distribution

$$P(X) = {}^n C _k p^k q^{n-k} ; \quad k = 0, 1, 2, \dots, n$$

$$= {}^6 C _2 \left(\frac{1}{5}\right)^2 \left(\frac{4}{5}\right)^4$$

[2]

$$(a) P(X=2) = {}^6 C _2 \left(\frac{1}{5}\right)^2 \left(\frac{4}{5}\right)^4$$

$$= 15 \cdot \frac{4^4}{5^6}$$

$$= 24576.$$

[3.5]

(b) $P(\text{at least two will strike the target})$

$$= P(X \geq 2)$$

$$= P(X=2) + P(X=3) + P(X=4) + P(X=5) + P(X=6)$$

$$= 1 - P(X=0) - P(X=1)$$

$$= 1 - 0.2621 - 0.3932 = 0.3446$$

[57]

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Q4 Mean $m = \frac{\sum f x}{\sum f} = \frac{100}{200} = 0.5$

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[1]

$$f(x_2) = N \cdot \frac{e^{-m} m^{x_2}}{x_2!} \quad 200 \cdot \frac{e^{-0.5} (0.5)^{x_2}}{x_2!}; \quad x_2 = 0, 1, 2, \dots, 4 \quad [2]$$

$$x \quad f(x_2)$$

0	121
1	61
2	15
3	3
4	0

[3]

[4]

[5]

Q5 Equation of straight line for the given data is $y = a + bx$

Its equation of normal are

$$\Sigma y = na + b \Sigma x$$

$$\Sigma xy = a \Sigma x + b \Sigma x^2$$

[1]

x	y	$u = x - 5$	$v = y - 12$	uv	u^2
1	9	-4	-3	12	16
2	8	-3	-4	12	9
3	10	-2	-2	4	4
4	12	-1	0	0	1
5	11	0	-1	0	0
6	13	1	1	1	1
7	14	2	2	4	4
8	16	3	4	12	9
9	15	4	3	12	16
$\Sigma u = 0$		$\Sigma v = 0$	$\Sigma uv = 57$	$\Sigma u^2 = 60$	[3]

$$0 = 9a + 0 \Rightarrow a = 0; 57 = 0 + 60b \Rightarrow b = 0.95$$

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Req. eq. of straight line

$$y - 12 = 0.95(x - 5)$$

$$y = 7.25 + 0.95x$$

Marks

[5]

(ii)
Q5

x	y	u = x - 78	v = y - 125	uv	u ²	v ²	
78	125	0	0	0	0	0	
89	137	11	12	132	121	144	
97	156	19	31	589	361	961	
69	112	-9	-13	117	81	169	
59	107	-19	-18	342	361	324	
79	136	1	11	11	1	121	
68	123	-10	-2	20	100	4	
61	108	-17	-17	289	289	289	
$\sum x = 600$	$\sum y = 1004$	$\sum u = -24$	$\sum v = 4$	$\sum uv = 1507$	$\sum u^2 = 1314$	$\sum v^2 = 2012$	[2]

$$\bar{x} = \frac{\sum x}{n} = \frac{600}{8} = 75$$

$$\bar{y} = \frac{\sum y}{n} = \frac{1004}{8} = 125.5$$

$$b_{yx} = \frac{\sum uv - \frac{\sum u \sum v}{n}}{\frac{\sum u^2 - (\sum u)^2}{n}} = 1.217$$

[3]

$$b_{xy} = \frac{\sum uv - \frac{\sum u \sum v}{n}}{\frac{\sum v^2 - (\sum v)^2}{n}} = 0.752$$

[4]

Line of regression of y on x: $y - \bar{y} = b_{yx}(x - \bar{x})$

$$y = 1.217x + 84.225$$

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Line of regression of x on y :

$$x - \bar{x} = b_{xy} (y - \bar{y})$$

$$x = .752y - 19.376$$

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[5]

x	y	R_x	R_y	$d = R_x - R_y$	d^2
68	62	7	6	1	1
64	58	5	4	1	1
75	68	8.5	7.5	1	1
50	45	2	1	1	1
64	81	5	10	-5	25
80	60	10	5	5	25
75	68	8.5	7.5	1	1
40	48	1	2	-1	1
55	50	3	3	0	0
64	70	5	9	-4	16

[3]

$$\sum d^2 = 72$$

$$R_s = 1 - \frac{6}{n(n^2-1)} \left[\sum d^2 + \frac{1}{12} m_1 (m_1^2 - 1) + \frac{1}{12} m_2 (m_2^2 - 1) + \dots \right]$$

$$n(n^2-1)$$

$$= 1 - \frac{6}{10(100-1)} \left[72 + \frac{1}{12} \cdot 3 \cdot (9-1) + \frac{1}{12} \cdot 2 \cdot (4-1) + \frac{1}{12} \cdot 2 \cdot (4-1) \right]$$

$$= 1 - \frac{6}{10(100-1)}$$

$$= 0.545$$

[5]

$$t = \frac{(\bar{x} - \mu)}{\frac{s}{\sqrt{n}}}$$

$$s^2 = \frac{\sum (x - \bar{x})^2}{n-1}$$

[1]

degree of freedom $v = 6 - 1 = 5$

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3

$$x^2 = 12.90$$

$\frac{f_o - f_e}{f_e}$	$(f_o - f_e)^2 / f_e$	$f_o - f_e$	f_o	f_e	χ^2	$\chi^2 / N_{\text{d.o.f}}$	$\chi^2 / N_{\text{d.o.f}}$	$\chi^2 / N_{\text{d.o.f}}$
1	30	10	100	5				
2	25	5	85	1.025				
3	18	-2	4	6.20				
4	10	-10	100	5				
5	82	2	4	0.21				
6	15	-5	25	1.025				

[1]

Null Hypothesis: H_0 : The office is unbiased one.

90

[5]

$$t = \frac{0.25 - 0}{0.28} = 0.659$$

14

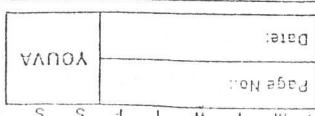
$$159 \cdot 8 = \frac{7}{595} \uparrow = S$$

$$50 \cdot 0 = \frac{30}{6} - x$$

[3]

49.5000

x	$x - \bar{x}$	$(x - \bar{x})^2$	$\sum x$	$\sum (x - \bar{x})$	$\sum (x - \bar{x})^2$
1	-4.00	16.00	18.00	-4.00	16.00
2	-3.00	9.00	20.00	-3.00	9.00
3	-2.00	4.00	21.00	-2.00	4.00
4	-1.00	1.00	22.00	-1.00	1.00
5	0.00	0.00	23.00	0.00	0.00
6	1.00	1.00	24.00	1.00	1.00
7	2.00	4.00	25.00	2.00	4.00
8	3.00	9.00	26.00	3.00	9.00
9	4.00	16.00	27.00	4.00	16.00
10	5.00	25.00	28.00	5.00	25.00
11	6.00	36.00	29.00	6.00	36.00
12	7.00	49.00	30.00	7.00	49.00
13	8.00	64.00	31.00	8.00	64.00
14	9.00	81.00	32.00	9.00	81.00
15	10.00	100.00	33.00	10.00	100.00
16	11.00	121.00	34.00	11.00	121.00
17	12.00	144.00	35.00	12.00	144.00
18	13.00	169.00	36.00	13.00	169.00
19	14.00	196.00	37.00	14.00	196.00
20	15.00	225.00	38.00	15.00	225.00
21	16.00	256.00	39.00	16.00	256.00
22	17.00	289.00	40.00	17.00	289.00
23	18.00	324.00	41.00	18.00	324.00
24	19.00	361.00	42.00	19.00	361.00
25	20.00	400.00	43.00	20.00	400.00
26	21.00	441.00	44.00	21.00	441.00
27	22.00	484.00	45.00	22.00	484.00
28	23.00	529.00	46.00	23.00	529.00
29	24.00	576.00	47.00	24.00	576.00
30	25.00	625.00	48.00	25.00	625.00
31	26.00	676.00	49.00	26.00	676.00
32	27.00	729.00	50.00	27.00	729.00
33	28.00	784.00	51.00	28.00	784.00
34	29.00	841.00	52.00	29.00	841.00
35	30.00	900.00	53.00	30.00	900.00
36	31.00	961.00	54.00	31.00	961.00
37	32.00	1024.00	55.00	32.00	1024.00
38	33.00	1089.00	56.00	33.00	1089.00
39	34.00	1156.00	57.00	34.00	1156.00
40	35.00	1225.00	58.00	35.00	1225.00
41	36.00	1300.00	59.00	36.00	1300.00
42	37.00	1376.00	60.00	37.00	1376.00
43	38.00	1456.00	61.00	38.00	1456.00
44	39.00	1536.00	62.00	39.00	1536.00
45	40.00	1620.00	63.00	40.00	1620.00
46	41.00	1708.00	64.00	41.00	1708.00
47	42.00	1792.00	65.00	42.00	1792.00
48	43.00	1880.00	66.00	43.00	1880.00
49	44.00	1972.00	67.00	44.00	1972.00
50	45.00	2068.00	68.00	45.00	2068.00
51	46.00	2168.00	69.00	46.00	2168.00
52	47.00	2272.00	70.00	47.00	2272.00
53	48.00	2380.00	71.00	48.00	2380.00
54	49.00	2492.00	72.00	49.00	2492.00
55	50.00	2608.00	73.00	50.00	2608.00
56	51.00	2728.00	74.00	51.00	2728.00
57	52.00	2852.00	75.00	52.00	2852.00
58	53.00	2980.00	76.00	53.00	2980.00
59	54.00	3112.00	77.00	54.00	3112.00
60	55.00	3248.00	78.00	55.00	3248.00
61	56.00	3388.00	79.00	56.00	3388.00
62	57.00	3532.00	80.00	57.00	3532.00
63	58.00	3679.00	81.00	58.00	3679.00
64	59.00	3829.00	82.00	59.00	3829.00
65	60.00	3982.00	83.00	60.00	3982.00
66	61.00	4138.00	84.00	61.00	4138.00
67	62.00	4297.00	85.00	62.00	4297.00
68	63.00	4460.00	86.00	63.00	4460.00
69	64.00	4626.00	87.00	64.00	4626.00
70	65.00	4795.00	88.00	65.00	4795.00
71	66.00	4967.00	89.00	66.00	4967.00
72	67.00	5142.00	90.00	67.00	5142.00
73	68.00	5320.00	91.00	68.00	5320.00
74	69.00	5501.00	92.00	69.00	5501.00
75	70.00	5685.00	93.00	70.00	5685.00
76	71.00	5872.00	94.00	71.00	5872.00
77	72.00	6062.00	95.00	72.00	6062.00
78	73.00	6254.00	96.00	73.00	6254.00
79	74.00	6448.00	97.00	74.00	6448.00
80	75.00	6644.00	98.00	75.00	6644.00
81	76.00	6842.00	99.00	76.00	6842.00
82	77.00	7042.00	100.00	77.00	7042.00



M	T	W	T	F	S	S
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Calculated value of $\chi^2 \neq$ tabulated value of χ^2

So reject the null hypothesis

\Rightarrow the dice is biased one.

Marks

[5]

$$\text{Given } n_1 = 9, n_2 = 8$$

$$v_1 = 9-1=8$$

$$v_2 = 8-1=7$$

[1]

$$\bar{x} = \frac{\sum x}{n_1} = \frac{210}{9} = 23.33$$

$$\bar{y} = \frac{\sum y}{n_2} = \frac{141}{8} = 17.625$$

H_0 : Two population variance are same.

x	x - \bar{x}	$(x - \bar{x})^2$	y	y - \bar{y}	$(y - \bar{y})^2$
17	-6.33	40.0689	16	-1.625	2.6406
27	3.67	13.4689	16	-1.625	2.6406
18	-5.33	28.4089	20	2.375	5.6406
25	1.67	2.7889	16	-1.625	2.6406
27	3.67	13.4689	20	2.375	5.6406
29	5.67	32.1489	17	-0.625	0.3906
27	3.67	13.4689	15	-2.625	6.8906
23	-0.33	0.1089	21	3.375	11.3906
17	-6.33	40.0689			
210		184.0001	141		37.8748

[3]

$$s_1^2 = \frac{\sum (x - \bar{x})^2}{n_1 - 1} = 23$$

$$s_2^2 = \frac{\sum (y - \bar{y})^2}{n_2 - 1} = 5.4107 ; s_1^2 > s_2^2$$

$$Z = \frac{1}{2} \log_e \frac{s_1^2}{s_2^2} = 0.7236$$

[5]

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calculated value of $z \neq$ tabulated value
of z

So reject the Null hypothesis
so the two variance are not same. [5]