Q.6 Attempt any two:

i. In an investigation into the health and nutrition of two groups of children of different social status the following results are obtained. **5**

		Social Status		
		Poor	Rich	Total
Health	Below Normal	130	20	150
	Normal	102	108	210
	Above Normal	24	96	120
Total		256	224	480

Calculate χ^2 statics for the relation between the health and their social status.

ii. Test whether the two sets of observations indicate samples drawn from the same universe. **5**

I	17	27	18	25	27	29	27	23	17
II	16	16	20	16	20	17	15	21	---

(The value of z at 5% level for 8 and 7 degrees of freedom is 0.6575).

iii. Set up two-way ANOVA table for the following per hectare yield for 4 varieties of wheat on 3 plots. **5**

Plot of land	Yield			
	A	B	C	D
I	3	4	6	6
II	6	4	5	3
III	6	6	4	7

******

Total No. of Questions: 6 *Total No. of Printed Pages:4*

Enrollment No......................................

Faculty of Engineering

End Sem Examination May-2024

CS3EL11 / IT3CO29

Statistical Analysis / Computational Statistics

Programme: B.Tech. Branch/Specialisation: CSE All / IT

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. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. What is the mode of following data- 3, 7, 4, 5, 7, 8, 3, 7, 1, 2. **1**

(a) 3 (b) 7 (c) 5 (d) None of these

ii. The harmonic mean of 4, 8, 16, 32 is ______. **1**

(a) 2.512 (b) 4.523 (c) 8.533 (d) None of these

iii. The probability of throwing a sum of 7 in a single throw with two dice is- **1**

(a) $\frac{1}{6}$ (b) $\frac{2}{3}$ (c) $\frac{5}{6}$ (d) None of these

iv. Probability mass function is defined for ______ random variable. **1**

(a) Discrete (b) Continuous

(c) Both (a) and (b) (d) None of these

v. The variance of binomial distribution is equal to ______. **1**

(a) np (b) npq (c) pq (d) None of these

vi. The total area of exponential distribution is ______. **1**

(a) 0 (b) 1 (c) ∞ (d) None of these

vii. If $4x - 5y = -33$ and $20x - 9y = 107$ are two lines of regression, then the mean values of x and y are- **1**

(a) $\bar{x} = 13$, $\bar{y} = 17$ (b) $\bar{x} = 17$, $\bar{y} = 13$

(c) $\bar{x} = 3$, $\bar{y} = 7$ (d) None of these

viii. The normal equations for the straight line $y = a + bx$ are- **1**

(a) $\sum y = na + b\sum x$

(b) $\sum xy = a\sum x + b\sum x^2$

(c) Both (a) and (b)

(d) None of these

ix. In testing of hypothesis, if calculated value of statistics is less than tabulated value, then null hypothesis is- **1**

(a) Rejected (b) Accepted (c) Can't say (d) None of these

x. Which of the following test is used when the sample size is less than 30? **1**

(a) Chi- Square test (b) F- test
(c) Z- test (d) None of these

Q.2 Attempt any two:

i. Find the missing frequency from the following data: **5**

No. of tablets	No. of persons cured	No. of tablets	No. of persons cured
4-8	11	24-28	9
8-12	13	28-32	17
12-16	16	32-36	6
16-20	14	36-40	4
20-24	?		

It is being given that, 19.9 is the average number of tablets for being cured.

ii. Calculate the standard deviation and coefficient of variance of the following data: **5**

x	0	4	5	8	9	13
f	5	6	1	4	7	2

iii. Compute the mode of the following data: **5**

Mean value	15	20	25	30	35	40	45	50	55
Frequency	2	22	19	14	3	4	6	1	1

Q.3 Attempt any two:

i. In a college, 25%students in Mathematics, 15% students in Physics and 10% students in Mathematics and Physics both are failed. A student is selected at random: **5**

(a) If he is failed in Physics, then find the chance of his failure in Mathematics

(b) If he is failed in Mathematics, then find the chance of his failure in Physics

(c) Find the chance of his failure in Mathematics or Physics.

ii. Define probability density probability. If $f(x) = kx^2$, $0 < x < 1$, has probability density function, determine k and find $P\left(\frac{1}{3} < x < \frac{1}{2}\right)$ and find a if $P(X > a) = 0.05$. **5**

iii. Find $E(x)$, $E(x^2)$ and variance for the following data: **5**

x	8	12	16	20	24
$p(x)$	$\frac{1}{8}$	$\frac{1}{6}$	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{12}$

Q.4 Attempt any two:

i. Derive the mean and variance for normal distribution. **5**

ii. The following data are the number of seeds germinating out of 10 on damp filter for 80 sets of seeds. Fit a binomial distribution to these data: **5**

x	0	1	2	3	4	5	6	7	8	9	10
f	6	20	28	12	8	6	0	0	0	0	0

iii. (a) Define moment generating function for discrete and continuous distribution. **5**

(b) If the probability density function of the random variable x is given by:

$$f(x) = \frac{1}{3}, -1 < x < 2$$

then find its moment generating function.

Q.5 Attempt any two:

i. Write any 5 properties of regression coefficient. **5**

ii. Fit a second degree curve to the following data: **5**

x	0	1	2	3	4
y	-4	-1	4	11	20

iii. Ten students got the following percentage of marks in Economics and Statistics. **5**

Roll No.	1	2	3	4	5	6	7	8	9	10
Marks in Economics	78	36	98	25	75	82	90	62	65	39
Marks in Statistics	84	51	91	60	68	62	86	58	53	47

Calculate the coefficient of correlation.

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Faculty of Engineering

End Sem Examination May-2024

CS3EL11 / IT3CO29

Statistical Analysis / Computational Statistics

Q.1 MCQ.

(i) (b) 7 +1

(ii) (c) 8.533 +1

(iii) (a) $\frac{1}{6}$ +1

(iv) (a) discrete +1

(v) (b) npq +1

(vi) (b) 1 +1

(vii) (a) $\bar{x}=13, \bar{y}=17$ +1

(viii) (c) Both a and b +1

(ix) (b) accepted +1

(x) (d) None of these +1

Q.2 Attempt any two :- (2)

Sol^n (i)

No. of tablets	f	Mid value x	fx
4-8	11	6	66
8-12	13	10	130
12-16	16	14	224
16-20	14	18	252
20-24	? = f_1	22	$22f_1$
24-28	9	26	234
28-32	17	30	510
32-36	6	34	204
36-40	4	38	152
	$90+f_1$		$1772+22f_1$

+3

$$\text{Mean} = \frac{\Sigma fx}{\Sigma f}$$ +1

$$19.9 = \frac{1772+22f_1}{90+f_1}$$

$$f_1 = 9.05$$ +1

☆ We can solve by shortcut or step deviation also.

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Soln Q. 2 (ii)

x	f	fx	$x-\bar{x}$	$(x-\bar{x})^2$	$f(x-\bar{x})^2$
0	5	0	−6	36	180
4	6	24	−2	4	24
5	1	5	−1	1	1
8	4	32	2	4	16
9	7	63	3	9	63
13	2	26	7	49	98
	25	150			382

+2

$$S.D = \sqrt{\frac{\Sigma f(x-\bar{x})^2}{\Sigma f}} \text{ or } \sqrt{\frac{\Sigma fx^2}{\Sigma f} - \left(\frac{\Sigma fx}{\Sigma f}\right)^2}$$ +1

$$\bar{x}\text{ (Mean)} = \frac{\Sigma fx}{\Sigma f} = \frac{150}{25}$$

$$\boxed{\bar{x} = 6}$$ +1

$$S.D = \sqrt{\frac{382}{25}} = \sqrt{15.28}$$

$$= 3.91 \text{ Ans}$$

$$C.V = \frac{\sigma}{\bar{x}} \times 100 = 65.166$$ +1

Soln 2 (iii) We will change the given data into Continuous series.

$$\text{Mode} = l + \frac{f_0 - f_{-1}}{2f_0 - f_{-1} - f_1} \times i$$ +1

Mean value	Class	frequency
15	12.5 – 17.5	2
20	17.5 – 22.5	22
25	22.5 – 27.5	19
30	27.5 – 32.5	14
35	32.5 – 37.5	3
40	37.5 – 42.5	4
45	42.5 – 47.5	6
50	47.5 – 52.5	1
55	52.5 – 57.5	1

+2

Here maximum freq. is 22

~~Mode~~ So, $l = 17.5$, $f_0 = 22$

$f_{-1} = 2$, $f_1 = 19$, $i = 5$ +1

$$\text{Mode} = 17.5 + \frac{22-2}{2(22)-2-19} \times 5$$

$$= 17.5 + \frac{100}{23}$$

$$= 17.5 + 4.347$$

$$= 21.8478$$ +1

Mode $\simeq 21.85$ (approx)

Q.3 Attempt any two :-

Solⁿ 3 (i) Let

E_1 = event of failure in Mathematics

E_2 = " " " " Physics

$n(S) = 100$

∵ 25% Students are failed in Mathematics

So, $n(E_1) = 25$

$$P(E_1) = \frac{n(E_1)}{n(S)} = \frac{1}{4}$$ +0.5

∵ 15% Students are failed in physics

So, $n(E_2) = 15$ +0.5

$$P(E_2) = \frac{n(E_2)}{n(S)} = \frac{3}{20}$$

and 10% Students in both physics & Maths

So, $n(E_1 \cap E_2) = 10$ $\quad P(E_1 \cap E_2) = \frac{10}{100} = \frac{1}{10}$ +1

(i) $P(E_1/E_2) = \frac{P(E_1 \cap E_2)}{P(E_2)} = \frac{1/10}{3/20} = \frac{2}{3}$ Ans +1

(ii) $P(E_2/E_1) = \frac{P(E_1 \cap E_2)}{P(E_1)} = \frac{1/10}{1/4} = \frac{2}{5}$ Ans +1

(iii) $P(E_1 \cup E_2) = P(E_1) + P(E_2) - P(E_1 \cap E_2)$ +1

$= \frac{3}{10}$ Ans

Defn:- Let x be a continuous R.V, then fun^n $f(x)$ is p.d.f. if (i) $f(x) \geq 0$ (ii) $\int_{-\infty}^{\infty} f(x)dx = 1$

6

+2

Soln. 3 (ii) $\because$ $f(x)$ is a p.d.f.

Then

$$\int_a^b f(x)\,dx = 1$$

$$\int_0^1 Kx^2\,dx = 1$$

$$K \frac{x^3}{3}\Big|_0^1 = 1$$

$$\boxed{K = 3}$$

+1

$$P\left(\frac{1}{3} < x < \frac{1}{2}\right) = \int_{1/3}^{1/2} f(x)\,dx$$

$$= \int_{1/3}^{1/2} 3x^2\,dx$$

$$= \left[x^3\right]_{1/3}^{1/2}$$

$$= \frac{1}{8} - \frac{1}{27} = \frac{19}{216}$$

+1

$$P(X > a) = 0.05$$

$$\int_a^{\infty} f(x)\,dx = 0.05$$

$$\int_a^1 3x^2\,dx = 0.05$$

$$\left[x^3\right]_a^1 = 0.05$$

$$1 - a^3 = 0.05$$

+1

$$\boxed{a = (0.95)^{1/3}}$$

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Sol^n 3 (iii)

x	8	12	16	20	24
$p(x)$	$1/8$	$1/6$	$3/8$	$1/4$	$1/12$

$$E(x) = \Sigma x\, p(x)$$

$$= \left(8 \times \frac{1}{8}\right) + \left(12 \times \frac{1}{6}\right) + \left(16 \times \frac{3}{8}\right) + \left(20 \times 1/4\right) + \left(24 \times \frac{1}{12}\right)$$

$$\boxed{E(x) = 16}$$ Ans   +1.5

$$\cancel{E(x^2) = \left(8^2 \times \frac{1}{8}\right)}$$

$$E(x^2) = \Sigma x^2\, p(x)$$

$$= \left(8^2 \times \frac{1}{8}\right) + \left(12^2 \times \frac{1}{6}\right) + \left(16^2 \times \frac{3}{8}\right) + \left(20^2 \times \frac{1}{4}\right) + \left(24^2 \times \frac{1}{12}\right)$$

$$= 8 + 24 + 96 + 100 + 48$$

$$E(x^2) = 276$$ Ans   +1.5

Variance $= E(x^2) - [E(x)]^2$ +1

$= 276 - (16)^2$

$= 276 - 256 = \underline{20}$ +1

Q.4 Attempt any two :- (8)

Sol^n 4 (i) $\because$ $f(x)$ is a p.d.f.

$$\text{Mean} = \int_{-\infty}^{\infty} x \cdot f(x)\, dx \qquad +1$$

$$= \int_{-\infty}^{\infty} \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \cdot x\, dx$$

Putting $t = \frac{x-\mu}{\sigma\sqrt{2}} \Rightarrow dx = \sigma\sqrt{2}\, dt$

$$\text{Mean} = \frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{\infty} e^{-t^2} (t\sigma\sqrt{2}+\mu)\sigma\sqrt{2}\, dt$$

$$= \frac{1}{\sigma\sqrt{2\pi}}\left[2\sigma^2 \int_{-\infty}^{\infty} e^{-t^2} t\, dt + \mu\sigma\sqrt{2}\int_{-\infty}^{\infty} e^{-t^2} dt\right] \quad +1$$

$$\left[\because \int_{-\infty}^{\infty} e^{-t^2} t\, dt = 0 \ \& \int_{-\infty}^{\infty} e^{-t^2} dt = \sqrt{\pi}\right]$$

$$\text{Mean} = \frac{1}{\sigma\sqrt{2\pi}}\left[2\sigma^2 \times 0 + \mu\sigma\sqrt{2}\times\sqrt{\pi}\right]$$

$$= \frac{1}{\sigma\sqrt{2\pi}} \times \mu\sigma\sqrt{2}\times\sqrt{\pi}$$

$$\boxed{\text{Mean} = \mu} \qquad +0.5$$

$$\text{Variance} = \int_{-\infty}^{\infty} (x-\text{mean})^2 f(x)\, dx \qquad +1$$

$$= \int_{-\infty}^{\infty} (x-\mu)^2 \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} dx$$

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Put $t = \dfrac{x-\mu}{\sigma\sqrt{2}} \Rightarrow dx = \sigma\sqrt{2}\,dt$

$$Var. = \frac{1}{\sigma\sqrt{2\pi}}\int_{-\infty}^{\infty} e^{-t^2}(t\sigma\sqrt{2})^2\,\sigma\sqrt{2}\,dt$$

$$= \frac{2\sigma^3\sqrt{2}}{\sigma\sqrt{2\pi}}\int_{-\infty}^{\infty} e^{-t^2}t^2\,dt$$ +1

$$= \frac{2\sigma^2}{\sqrt{\pi}}\int_{-\infty}^{\infty}(te^{-t^2})\,t\,dt$$

$$Var. = \frac{2\sigma^2}{\sqrt{\pi}}\left[0 + \frac{1}{2}\int_{-\infty}^{\infty} e^{-t^2}dt\right]$$

$$\because \int_{-\infty}^{\infty} e^{-t^2}dt = \sqrt{\pi}$$

$$Var = \frac{2\sigma^2}{\sqrt{\pi}} \times \frac{1}{2} \times \sqrt{\pi}$$

+0.5

$$\boxed{Var = \sigma^2}$$

Sol^n 4 (ii)

x	0	1	2	3	4	5	6	7	8	9	10
f	6	20	28	12	8	6	0	0	0	0	0

$n = 10, \; N = \Sigma f = 80$

$$\text{Mean} = \frac{\Sigma f x}{\Sigma f} = \frac{174}{80} = 2.175$$ +1

But mean $= np$

$$10p = \frac{174}{80}$$

$$\Rightarrow p = \frac{174}{800} \Rightarrow \boxed{p = 0.2175}$$ +0.5

Now, $q = 1 - p = \underline{0.7825}$ +0.5

Expected frequency is given by

$$= N \times {}^nC_r \, q^{n-r} p^r$$ +1

$$= 80 \times {}^nC_r (0.7825)^{n-r} (0.2175)^r$$

r	$N \times {}^nC_r q^{n-r} p^r$	Approx.
$r=0$	6.9	7
1	19.1	19
2	24.0	24
3	17.8	18
4	8.6	9
5	2.9	3
6	0.7	1
7	0.1	0
8	0	0
9	0	0
10	0	0
		81

+2

Solⁿ 4 (iii) MGF for continuous distribution

$$M(t) = \int_a^b e^{tx} f(x)\, dx \qquad +1.5$$

where the integral is a fuctⁿ of the parameter t only.

M.G.F for discrete ~~con~~ distribution

M.g.f ~~for a~~ of a random variable x about a ~~point a~~ origin is defined as

$$M_a(t) = E\left[e^{t(x-\cancel{a})}\right] \qquad +1.5$$

$$= \sum_i e^{t(x_i-\cancel{a})} p_i$$

where, t is a parameter which takes only real values.

$$M.g.f = E(e^{tx}) = \int_a^b e^{tx} f(x)\, dx \qquad +1$$

$$= \int_{-1}^{2} \frac{1}{3} e^{tx} dx$$

$$= \frac{1}{3}\left[\frac{e^{tx}}{t}\right]_{-1}^{2}$$

$$= \frac{1}{3t}\left[e^{2t} - e^{-t}\right]$$

or

$$M(t) = \frac{\left[3t + 3\frac{t^2}{2} \cdots\right]}{3t} = \boxed{1 + \frac{t}{2} + \cdots} \qquad +2$$

Q.5 Attempt any two! -

Sol^n 5 (i) Properties of Regression Coefficient

(i) The coefficient of correlation is the geometric mean of the coefficient of regression $\left[r = \pm\sqrt{b_{xy} \times b_{yx}}\right]$ +1

(ii) If one of the regression coefficient is greater than unity, then the other is less than unity. +1
$b_{yx} > 1 \Rightarrow b_{yx} < 1$ or viceversa

(iii) Both regression coefficient and correlation coefficient are of same sign. +1

(iv) Regression coefficients are independent of change of origin but not of scale. +1

(v) Arithemetic mean of the regression coefficient is greater than the correlation coefficient. +1

☆ Other property can also be considered.
$r = 0$, lines are perpendicular
$r = \pm 1$, lines are identical.

Sol^n 5 (ii). Let the equ^n of the 2nd degree curve be

$$y = a + bx + cx^2$$

Then the normal equ^n are

$$\Sigma y = na + b\Sigma x + c\Sigma x^2 \qquad +2$$

$$\Sigma xy = a\Sigma x + b\Sigma x^2 + c\Sigma x^3$$

$$\Sigma x^2 y = a\Sigma x^2 + b\Sigma x^3 + c\Sigma x^4$$

x	y	xy	x^2	x^2y	x^3	x^4
0	-4	0	0	0	0	0
1	-1	-1	1	-1	1	1
2	4	8	4	16	8	16
3	11	33	9	99	27	81
4	20	80	16	320	64	256
$\Sigma x = 10$	30	120	30	434	100	354

+2

$$30 = 5a + 10b + 30c$$
$$120 = 10a + 30b + 100c$$
$$434 = 30a + 100b + 354c$$

On solving, we get

$$a = -4, \quad b = 2, \quad c = 1$$

Thus, $\boxed{y = -4 + 2x + x^2}$ +1

Sol^n 5 (iii)

x	y	$X = x - 65$	$Y = y - 66$	X^2	Y^2	XY
78	84	13	18	169	324	234
36	51	-29	-15	841	225	435
98	91	33	25	1089	625	825
25	60	-40	-6	1600	36	240
75	68	10	2	100	4	20
82	62	17	-4	289	16	-68
90	86	25	20	625	400	500
62	58	-3	-8	9	64	24
65	53	0	-13	0	169	0
39	47	-26	-19	676	361	494
650	660	0	0	5398	2224	2704

+2

Let the marks of two subjects be denoted by x & y.
Then

Mean for x marks $= \frac{650}{10} = 65$ +1

Mean for y marks $= \frac{660}{10} = 66$ +1

$$r = \frac{\Sigma(x-\bar{x})(y-\bar{y})}{\sqrt{\Sigma(x-\bar{x})^2 \times \Sigma(y-\bar{y})^2}} \text{ or } \frac{n\Sigma xy - \Sigma x \Sigma y}{\sqrt{n\Sigma x^2 - (\Sigma x)^2}\sqrt{n\Sigma y^2 - (\Sigma y)^2}}$$

$$r = \frac{2704}{\sqrt{5398 \times 2224}} = 0.78$$ +1

Any

* rank can also be find by ~~Rank~~ Spear'sman rank method.

Q-6 Attempt any two.

Sol^n 6 (i) Expected frequencies

	Poor	Rich.	Total.
Below normal	$\frac{256 \times 150}{480} = 80$	$\frac{224 \times 150}{480} = 70$	150
Normal.	$\frac{256 \times 210}{480} = 112$	$\frac{224 \times 210}{480} = 98$	210
Above normal	$\frac{256 \times 120}{480} = 64$	$\frac{224 \times 120}{480} = 56$	120
	256	224	480

+2

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Sol^n 8 (iii)

Marks in Economics	R_x	Marks in Statistics	R_y	$d = R_x - R_y$	d^2
78	4	84	3	1	1
36	9	51	9	0	0
98	1	91	1	0	0
25	10	60	6	4	16
75	5	68	4	1	1
82	3	62	5	-2	4
90	2	86	2	0	0
62	7	58	7	0	0
65	6	53	8	-2	4
39	8	47	10	-2	4
					30

+2

rank correlation coefficient

$$(r) = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$$ +1

$n = 10$

$$r = 1 - \frac{6 \times 30}{10(10^2-1)}$$ +1

$$r = 1 - \frac{180}{990}$$

$r = 1 - 0.1818$

$$\boxed{r = 0.8181}$$ +1

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sol^n 6 (i)

Degree of freedom $= (3-1)(2-1) = 2$ +1

Calculation of Chi-Square

Observed value (O)	Expected value (E)	(O-E)	$(O-E)^2$	$\frac{(O-E)^2}{E}$
130	80	50	2500	31.25
102	112	-10	100	0.89
24	64	-40	1600	25
20	70	-50	2500	35.71
108	98	10	100	1.02
96	56	40	1600	28.57
				122.44

+1

$$\chi^2 = \Sigma \left[\frac{(O-E)^2}{E}\right]$$ +1

$$\boxed{\chi^2 = 122.44}$$ Ans +1

Sol^n 6 (ii) Given that

$n_1 = 9$

with dof $= n_1 - 1 = 8$

Mean $(\bar{x}) = \frac{\Sigma x}{n_1} = \frac{210}{9}$

$\bar{x} = 23.33$

$n_2 = 8$

dof $= 8 - 1 = 7$

$\bar{y} = \frac{\Sigma y}{n_2} = \frac{141}{8}$ +1

$\bar{y} = 17.625$

Step 1 Null hypothesis → Two population variances are same i.e. $\sigma_1^2 = \sigma_2^2$ +0.5

Step 2 Calculation of Z-statistics

I observation			II observation		
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			37.8748

+1.5

$$s_1^2 = \frac{\Sigma(x-\bar{x})^2}{n_1-1} = \frac{184.0001}{8} = 23$$

$$S_2^2 = \frac{\Sigma(y-\bar{y})^2}{n_2-1} = \frac{37.8748}{7} = 5.4107$$

$\because S_1^2 > s_2^2$

$$Z = \frac{1}{2}\log_e\left(\frac{S_1^2}{S_2^2}\right)$$ +1

$$Z = \frac{1}{2}\log_e(4.2508)$$

$$\boxed{Z = 0.7236}$$ +0.5

∵ tabulated value < Calculated value

$0.6575 < 0.7236$

So, null hypothesis is rejected.

⇒ two variances are not same. +0.5

Soln 6 (iii)

Plot of land	Yield A	B	C	D	Total
I	3	4	6	6	19
II	6	4	5	3	18
III	6	6	4	7	23
Total	15	14	15	16	60

Using analysis of variance technique we have.

Correction factor = $C = \frac{T^2}{N} = \frac{60^2}{12}$ +1

$C = 300$

Sum of squares betn columns

$SSC = \frac{15^2 + 14^2 + 15^2 + 16^2}{3} - 300$ +1

$\boxed{SSC = 0.67}$

Sum of squares betⁿ rows

$$SSR = \frac{19^2 + 18^2 + 23^2}{4} - 300 \qquad +1$$

$$\boxed{SSR = 3.5}$$

Total sum of squares of deviation

~~SST = (sum of all the elements) - 300~~
~~= 32 +~~

$$SST = (3^2 + 4^2 + 6^2 + 6^2 + 6^2 + 4^2 + 5^2 + 3^2 + 6^2 + 6^2 + 4^2 + 7^2) - 300$$

$$SST = 320 - 300 = 20 \qquad +1$$

∴ Errors sum of squares

$$SSE = SST - (SSR + SSC) \qquad +1$$
$$= 15.83$$ Ans