CBCS SCHEME

USN

BCS/BAD/BAI/BDS301

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mathematics – III for Computer Science Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Mathematics Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

<table>
<tr><th colspan="3">Module – 1</th><th>M</th><th>L</th><th>C</th></tr>
<tr><td>Q.1</td><td>a.</td><td>A random variable x has the following prob. density function for various values of x.
<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><td>7</td></tr>
<tr><td>P(x)</td><td>0</td><td>k</td><td>2k</td><td>2k</td><td>3k</td><td>k^2</td><td>$2k^2$</td><td>$7k^2+k$</td></tr>
</table>
Find the value of k and evaluate $P(x < 6)$, $P(3 < x \le 6)$ and $(x \ge 6)$.</td><td>07</td><td>L2</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>Derive the mean and variance of Poisson distribution.</td><td>06</td><td>L2</td><td>CO2</td></tr>
<tr><td></td><td>c.</td><td>In a certain town the duration of a shower is exponentially distributed with mean 5 minutes. What is the probability that a shower will last for? (i) less than 10 minutes (ii) more than 10 minutes and (iii) between 10 and 12 minutes.</td><td>07</td><td>L3</td><td>CO2</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.2</td><td>a.</td><td>The probability density function of
$$f(x) = \begin{cases} Kx^2, & -3 < x < 3 \\ 0, & \text{elsewhere} \end{cases}$$
Find the value of K and evaluate (i) $P(x < 2)$, $P(x > 1)$ (ii) $P(1 \le x \le 2)$</td><td>07</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>When a coin is tossed 4 times, find the probability of getting (i) exactly one head (ii) atleast three heads and (iii) less than two heads.</td><td>06</td><td>L2</td><td>CO2</td></tr>
<tr><td></td><td>c.</td><td>The marks of 1000 students in an examination follows a normal distribution with mean 70 and S.D 5. Find the number of students whose marks will be (i) less than 65 (ii) more than 75 and (iii) between 65 and 75.</td><td>07</td><td>L2</td><td>CO2</td></tr>
<tr><th colspan="6">Module – 2</th></tr>
<tr><td>Q.3</td><td>a.</td><td>If the joint probability distribution of x and y is given by
$$f(x, y) = \frac{1}{30}(x+y), \text{ for } x = 0, 1, 2, 3 \,;\ y = 0, 1, 2$$
Find (i) $P(x \le 2, y = 1)$ (ii) $P(x > y)$</td><td>07</td><td>L2</td><td>CO2</td></tr>
<tr><td></td><td>b.</td><td>Find the unique fixed probability vector of
$$P = \begin{bmatrix} 0 & 1 & 0 \\ 1/6 & 1/2 & 1/3 \\ 0 & 2/3 & 1/3 \end{bmatrix}$$</td><td>06</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Three boys A, B and C are throwing a ball to each other. A always throw the ball to B. B always throw the ball to A and C is just as likely to throw the ball to A as to B. Find the probability that C has the ball after three throws, if C starts the game.</td><td>07</td><td>L3</td><td>CO3</td></tr>
</table>

OR

Q.4 a. The joint prob. distribution for the following data, find E(x) and E(y). — 07 | L2 | CO2

X \ Y	-2	-1	4	5
1	0.1	0.2	0.0	0.3
2	0.2	0.1	0.1	0

b. Show that the matrix — 06 | L2 | CO3

$$P = \begin{bmatrix} 0 & 0 & 1 \\ 1/2 & 0 & 1/2 \\ 0 & 1 & 0 \end{bmatrix}$$ is a regular stochastic matrix.

c. A gambler's luck follows pattern. If he wins a game the prob. of winning the next game is 0.6. However, if he loses a game, the prob. of losing the next game is 0.7. There is an even chance of the gambler winning the first game. What is the prob. of he winning the second game. — 07 | L3 | CO3

Module – 3

Q.5 a. Define (i) Null hypothesis (ii) A statistic (iii) Standard error (iv) Level of significance (v) Test of significance. — 07 | L1 | CO4

b. A coin was tossed 400 times and head turned up 216 times. Test the hypothesis that the coin is unbiased at 5% LOS. — 06 | L3 | CO4

c. In a city A 20% of a random sample of 900 school boys had a certain slight physical defect. In another city B, 18.5% of a random sample of 1600 school boys had the same defect. Is the difference between the proportions significant at 5% significance level? — 07 | L3 | CO5

OR

Q.6 a. Explain the following terms: — 07 | L1 | CO4

(i) Type-I and Type-II errors
(ii) Statistical hypothesis
(iii) Critical region
(iv) Alternate hypothesis

b. The average marks in Engg. Maths of a sample of 100 students was 51 with S.D 6 marks. Could this have been a random sample from a population with average marks 50? — 06 | L2 | CO5

c. One type of aircraft is found to develop engine trouble in 5 flights out of a total of 100 and another type in 7 flights out of a total of 200 flights. Is there a significance difference in the two types of aircrafts so far as engine defects are concerned? Test at 0.05 significance level. — 07 | L3 | CO4

Module – 4

Q.7 a. State central limit theorem. Use the theorem to evaluate $P(50 < \bar{x} < 56)$ where $\bar{x}$ represents the mean of a random sample of size 100 from an infinite population with mean $\mu = 53$ and variance $\sigma^2 = 400$. — 07 | L2 | CO4

b. Suppose that 10, 12, 16, 19 is a sample taken from a normal population with variance 6.25. Find 95% confidence interval for the population mean. Given that Z(0.15) = 0.0596. — 06 | L2 | CO5

c. Fit a Poisson distribution to the following data and test for goodness of fit at 5% LOS. — 07 | L3 | CO5

x	0	1	2	3	4
f	419	352	154	56	19

OR

			Marks	Level	CO
Q.8	a.	Height of a random sample of 50 college student showed a mean of 174.5 cms and a S.D 6.9 cms. Construct 99% confidence limits for the mean height of all college students.	07	L2	CO4
	b.	A random sample of 10 boys had the following I.Q : 70, 120, 110, 101, 88, 83, 95, 98, 107, 100. DO these data support the assumption of a population mean I.Q of 100 (at 5% LOS)?	06	L3	CO5
	c.	The theory predicts the propositions of beans in the four groups, G_1, G_2, G_3, G_4 should be in the ratio 9 : 3 : 3 : 1. In experiment with 1600 beans the numbers in the groups were 882, 313, 287 and 118. Does the experimental support the theory.	07	L3	CO5

Module – 5

Q.9 a. The varieties of wheat A, B, C were shown in four plots each and the following yields in quintals per acre were obtained. (10, L3, CO6)

A	8	4	6	7
B	7	6	5	3
C	2	5	4	4

Test the significance of difference between the yields of varieties, given that 5% tabulated value of F = 4.26 with (2, 9) d.f. Set up one-way ANOVA and using direct method.

b. Present your conclusion after doing ANOVA to the following results of the Latin-square design conducted in respect of five fertilizers which were used on plots of different fertility. (10, L3, CO6)

A(16)	B(10)	C(11)	D(9)	E(9)
E(10)	C(9)	A(14)	B(12)	D(11)
B(15)	D(8)	E(8)	C(10)	A(18)
D(12)	E(6)	B(13)	A(13)	C(12)
C(13)	A(11)	D(10)	E(7)	B(14)

OR

Q.10 a. Set up two-way ANOVA table for the data given below, using coding method subtracting 40 from the given numbers. (10, L3, CO6)

Pieces of land	Treatment			
	A	B	C	D
P	45	40	38	37
Q	43	41	45	38
R	39	39	41	41

b. There are three main brands of a certain power. A set of its 120 sales is examined and found to be allocated among four groups (A, B, C, D) and brands (I, II, III) as follows: (10, L3, CO6)

Brands	Groups			
	A	B	C	D
I	0	4	8	15
II	5	8	13	6
III	18	19	11	13

Is there any significant difference in brands preference? Answer at 5% level, using one-way ANOVA. Take 10 as the code value to subtract it from all given values.

* * * * *

Q.No.	Solution and Scheme	Marks
1 a)	By the def^n of p.d.f.	
	$p(x) \geq 0$, & $\Sigma p(x) = 1$ ie $k \geq 0$	
	$10k^2 + 9k - 1 = 0 \Rightarrow k(10k+9) - 1 = 0$	
	$k = -1$ or $k = 0.1$	1m
	i) $P(X<6) = p(0)+p(1)+p(2)+p(3)+p(4)+p(5)$	
	$P(X<6) = 0.81$	2m
	ii) $p(3<X\leq 6) = p(4)+p(5)+p(6) = 0.33$	2m
	iii) $P(X\geq 6) = p(6)+p(7) = 0.19$	2m
		6m
b)	$\text{Mean}(\mu) = \sum_{x=0}^{\infty} x\,p(x)$	
	$= \sum_{x=0}^{\infty} x \frac{\mu^x e^{-\mu}}{x!} = \sum_{x=1}^{\infty} \frac{\mu^x e^{-\mu}}{(x-1)!}$	
	$= \mu e^{-\mu} \sum_{x=1}^{\infty} \frac{\mu^{x-1}}{(x-1)!}$	
	$= \mu e^{-\mu}\left[1 + \frac{\mu}{1} + \frac{\mu^2}{2!} + \frac{\mu^3}{3!} + \cdots\right]$	
	$= \mu e^{-\mu} . e^{\mu}$	
	$\boxed{\text{Mean} = \mu}$	2M
	$\text{Variance}(V) = \sum_{x=0}^{\infty} x^2 p(x) - \mu^2 \longrightarrow (1)$	
	consider $\sum_{x=0}^{\infty} x^2 p(x) = \sum_{x=0}^{\infty} [x(x-1)+x] \frac{\mu^x e^{-\mu}}{x!}$	
	$= \sum_{x=2}^{\infty} \frac{\mu^x e^{-\mu}}{(x-2)!} + \sum_{x=1}^{\infty} \frac{\mu^x e^{-\mu}}{(x-1)!}$	
	$= \mu^2 e^{-\mu} \sum_{x=2}^{\infty} \frac{\mu^{x-2}}{(x-2)!} + \mu$	

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Q.No.	Solution and Scheme	Marks
	$\sum x^2 p(x) = \mu^2 e^{-\mu}\left[1+\frac{\mu}{1!}+\frac{\mu^2}{2!}+\cdots\right]+\mu$	
	$= \mu^2+\mu$	
	From Eqn (1)	
	$V = \mu^2+\mu-\mu^2$	
	$\boxed{V=\mu}$	4m (6m)
c)	Given $\lambda = 1/5$	
	$\therefore f(x) = \begin{cases} \frac{1}{5}e^{-x/5}, & x>0 \\ 0 & x<0 \end{cases}$	1m
	i) $P(x<10) = \int_0^{10} f(x)\,dx = \int_0^{10} \frac{1}{5}e^{-x/5}\,dx = 0.864$	2m
	ii) $P(x\geq 10) = \int_{10}^{\infty} \frac{1}{5}e^{-x/5}\,dx = e^{-2} = 0.1353$	2m
	iii) $P(10<x<12) = \int_{10}^{12} \frac{1}{5}e^{-x/5}\,dx = 0.0446$	2m (7m)
2 a)	By the defn of p.d.f $f(x)\geq 0$ & $\int_{-\infty}^{\infty} f(x)\,dx = 1$	
	ie $k\geq 0$ & $\int_{-3}^{3} kx^2\,dx = 1$	
	ie $k\left[\frac{x^3}{3}\right]_{-3}^{3} = 1 \Rightarrow k\left[\frac{9\times 3}{3}+\frac{9\times 3}{3}\right]$	
	$\Rightarrow k = 1/18$	1m
	i) $P(X<2) = \int_{-3}^{2} f(x)\,dx = \int_{-3}^{2} \frac{x^2}{18}\,dx = \frac{35}{54}$	2M

Q.No.	Solution and Scheme	Marks
	ii) $P(x>1) = \int_1^3 f(x)\,dx = \int_1^3 \frac{x^2}{18}\,dx = \frac{13}{27}$	2m
	iii) $P(1 \le x \le 2) = \int_1^2 f(x)\,dx = \int_1^2 \frac{x^2}{18}\,dx = \frac{7}{27}$	2m 7m
b)	Given $n=4$, By Binomial distribution $P(x) = nC_x p^x q^{n-x}$ where $p=\frac{1}{2}, q=\frac{1}{2}$ $\therefore P(x) = 4C_x (1/2)^x (1/2)^{4-x}$ $P(x) = 4C_x (1/2)^4$	1m
	$\therefore$ i) Exactly one head $P(x=1) = 4C_1 (1/2)^4 = 0.25$	1m
	ii) Atleast 3 heads $P(x \geq 3)$ $P(x \geq 3) = P(3)+P(4) = 0.9375$	2m
	iii) Less than 2 heads. $P(x<2) = 1-[P(0)+P(1)] = 0.6875$	2m 6m
c)	By the given data $\mu = 70$, $\sigma = 5$ S.n.v. $= z = \frac{x-\mu}{\sigma} = \frac{x-70}{5}$	1m
	i) Less than 65 when $x=65$, $z = \frac{65-70}{5} = -1$ $\therefore P(x<65) = P(z<-1) = 0.5 - \phi(1)$ $= 0.1587$ The no. of students $= 1000 \times 0.1587 = 159$	2m

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Q.No.	Solution and Scheme	Marks
	ii) More than 75 $\therefore x = 75 \Rightarrow z = \frac{75-70}{5} = \frac{5}{5} = 1.$ $P(x>75) = P(z>1) = 0.5 - \phi(1) = 0.1587$ $\therefore$ The no. of students are $= 1000 \times 0.1587 = 159.$	2m
	iii) Between 65 & 75 $P(65 < x < 75) = P(-1 < z < 1) = 2\phi(1)$ $= 0.683$ $\therefore$ The number of students $= 1000 \times 0.683 = 683.$	2m 7m
5 a)	The Joint prob. distribution table is	

y \ x	0	1	2	3
0	0	1/30	2/30	3/30
1	1/30	2/30	3/30	4/30
2	2/30	3/30	4/30	5/30

1m

i) $P(X \le 2, Y = 1) = \frac{6}{30} = 1/5$ — 2m

ii) $P(X > 2, Y \le 1) = 7/30$ — 2M

iii) $P(X > Y) = \frac{1}{30} + \frac{2}{30} + \frac{3}{30} + \frac{3}{30} + \frac{4}{30} + \frac{5}{30}$

$= \frac{18}{30}$ — 2m

7m

Q.No.	Solution and Scheme	Marks
3 b)	Let $v=(x,y,z)$ be the unique fixed prob. vector where $x+y+z=1$	1m
	$vP = v$	
	$(x,y,z)\begin{bmatrix} 0 & 1 & 0 \\ 1/6 & 1/2 & 1/3 \\ 0 & 2/3 & 1/3 \end{bmatrix} = (x,y,z)$	1m
	$\left[\frac{1}{6}y,\ x+\frac{1}{2}y+\frac{2}{3}z,\ \frac{1}{3}y+\frac{1}{3}z\right] = (x,y,z)$	
	$\Rightarrow y=6x,\ x+\frac{1}{2}y+\frac{2}{3}z=y,\ \frac{1}{3}y+\frac{1}{3}z=z$	2m
	Solving by using the condition $x+y+z=1$	
	$\therefore x=\frac{1}{10},\ y=\frac{6}{10},\ z=\frac{3}{10}$	2m
		6m
c)	Given $P=\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 1/2 & 1/2 & 0 \end{bmatrix}$	
	$P^2=\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 1/2 & 1/2 & 0 \end{bmatrix};\ P^3=\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 1/2 & 1/2 & 0 \end{bmatrix}$	3M
	$P^3 = P^{(0)}P^{(3)}$	
	$=[0\ \ 0\ \ 1]\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 1/2 & 1/2 & 0 \end{bmatrix} = [1/2, 1/2, 0]$	3m
	$=[P_A^{(3)}, P_B^{(3)}, P_C^{(3)}]$	
	$\therefore$ The probability that 'C' has the ball after 3rd throw is $P_C^{(3)}=0$	1m
		7m

Q.No.	Solution and Scheme	Marks

4 a) Marginal distribution of x & y is

x_i	1	2
$f(x_i)$	0.6	0.4

y_j	-2	-1	4	5
$g(y_j)$	0.3	0.3	0.1	0.3

$E(X) = \Sigma x f(x_i) = 1 \times 0.6 + 2 \times 0.4 = 1.4$

$E(Y) = \Sigma y_j g(y_j) = (-2)\times 0.3 + (-1)\times 0.3 + 4\times 0.1 + 5\times 0.3$
$= 1$

$E(XY) = \Sigma(x_i y_j P_{ij}) = 0.9$

$\sigma_x = \sqrt{E(X^2) - \mu_x^2} = 0.9, \quad \sigma_y = 3.1$

$\text{cov}(X,Y) = E(X,Y) - E(X)E(Y)$
$= 0.9 - (1.4)(1)$
$= -0.5$

b) Given $P = \begin{bmatrix} 0 & 0 & 1 \\ 1/2 & 0 & 1/2 \\ 0 & 1 & 0 \end{bmatrix}$

$P^2 = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 1/2 & 1/2 \\ 1/2 & 0 & 1/2 \end{bmatrix}$; $P^3 = \begin{bmatrix} 1/2 & 0 & 1/2 \\ 1/4 & 1/2 & 1/4 \\ 0 & 1/2 & 1/2 \end{bmatrix}$

$P^4 = \begin{bmatrix} 0 & 1/2 & 1/2 \\ 1/4 & 1/4 & 1/2 \\ 1/4 & 1/2 & 1/4 \end{bmatrix}$; $P^5 = \begin{bmatrix} 1/4 & 1/2 & 1/4 \\ 1/8 & 1/2 & 3/8 \\ 1/4 & 1/4 & 1/2 \end{bmatrix}$

$\because P^5$ all the entries are positive.

$\therefore$ 'P' is a regular stochastic matrix

Q.No. | **Solution and Scheme** | **Marks**

4 c) Given that

$$P = \begin{bmatrix} 0.6 & 0.4 \\ 0.3 & 0.7 \end{bmatrix} = \frac{1}{10}\begin{bmatrix} 6 & 4 \\ 3 & 7 \end{bmatrix}$$ 1m

The probability of winning 1st game is 1m

$$P^{(0)} = (1/2, 1/2)$$

$$\therefore P^{(1)} = P^{(0)} P = \frac{1}{2}(1, 1) \times \frac{1}{10}\begin{bmatrix} 6 & 4 \\ 3 & 7 \end{bmatrix}$$ 3m

$$P^{(1)} = \left(\frac{9}{20}, \frac{11}{20}\right)$$

Hence the probability of winning the second game is $9/20$ // 2m

7m

5

a) Definitions

i) Null Hypothesis : The hypothesis which is formulated for the purpose of it's rejection under the assumption that it is true is called Null hypothesis.

ii) Statistics : The estimation of Mean, S.D. variance is called statistics. 1m

iii) Standard Error : The ~~S.E~~ standard deviation of sampling distribution is called standard error. 2m

iv) Level of Significance : The probability level below which the hypothesis is rejected is called level of significance. 2m

Q.No.	Solution and Scheme	Marks
	v) Test of significance The procedure which enables us to decide whether to accept or reject the Null hypothesis is called Test of significance.	2m 7m
b)	Let H_0: The coin is unbiased one. $\therefore p = 1/2,\ q = 1/2$	1m
	Expected number of heads $= np = 400 \times \frac{1}{2} = 200$ Observed number of heads $= 216$	2m
	$\therefore Z = \frac{x - \bar{x}}{\sqrt{npq}} = \frac{216 - 200}{\sqrt{400 \times \frac{1}{2} \times \frac{1}{2}}}$	2m
	$\boxed{z = 1.6}$ $\therefore$ The Null hypothesis is Accepted	1m 6m
c)	Given $P_1 = \frac{20}{100} = \frac{1}{8} = 0.2$ $P_2 = \frac{18.5}{100} = 0.185$	2m
	$\therefore P = \frac{n_1 P_1 + n_2 P_2}{n_1 + n_2} = \frac{180 + 296}{900 + 1600} = 0.19$	2m
	$e^2 = 0.00027 \Rightarrow e = 0.016$	1m
	$\therefore z = \frac{P_1 - P_2}{e} = \frac{0.015}{0.016} = \frac{15}{16} = 0.94.$	2m 7m

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Q.No.	Solution and Scheme	Marks
6 a)	i) Type-1 and Type-2 Error If the hypothesis is true and we reject the hypothesis then the error occuring is called Type-1 Error. If the hypothesis is false & we accept it then it is called Type-2 Error.	2m
	ii) Statistical hypothesis A statistical hypothesis is a statement about the population parameter.	1m
	iii) Critical region : A region which amounts to the rejection of Null hypothesis is called critical region.	2m
	iv) Alternate Hypothesis : Any hypothesis other than Null hypothesis is called alternate hypothesis.	2m 7m
b)	By the given data $\bar{x}=51$, $\mu=50$, $\sigma=6$, $n=100$	1m
	$z=\frac{\bar{x}-\mu}{\sigma/\sqrt{n}} = \frac{51-50}{6}\times 10 = 1.67$	2m
	$\therefore Z_{cal}=1.67 < Z_{0.05}=1.96$	1m
	$\therefore$ Hypothesis is accepted and the sample is drawn from the population mean 50.	2m 6m
c)	$P_1=0.05$, $P_2=0.035$	1m
	H_0: There is no significance difference between two types of Aircrafts.	
	$P=\frac{5+7}{100+200}=\frac{12}{300}=0.04$, $q=0.96$	2m
	$z=\frac{P_1-P_2}{\sqrt{\left(\frac{1}{n_1}+\frac{1}{n_2}\right)pq}} = \frac{0.05-0.035}{\sqrt{(0.04)(0.96)\left(\frac{1}{100}+\frac{1}{200}\right)}} = 0.625$	2m
	$\therefore$ The Null hypothesis is accepted at 5% level of significance.	2m 7m

Q.No.	Solution and Scheme	Marks
7 a)	Statement	
	If $\bar{x}$ is the mean of random sample of size 'n' taken from a population with mean μ & finite variance σ^2, then the limiting form of distribution of $z = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}}$ as $n \to \infty$ is the standard normal distribution $N(z, 0, 1)$	2m
	$z = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}} = \frac{\bar{x}-53}{20} \times 10$	1m
	When $\bar{x} = 50 \Rightarrow z = -0.15$	
	when $\bar{x} = 56 \Rightarrow z = 0.15$	3m
	$P(50 < \bar{x} < 56) = 2(0 < z < 0.15) = 0.1192$	1m
		7m
b)	$\bar{x} = \frac{10+12+16+19}{4} = 14.25$, $\sigma^2 = 6.25$, $n = 4$	2M
	The 95% confidence interval is	
	$\mu = \bar{x} \pm (1.96)\frac{\sigma}{\sqrt{n}} = 14.25 \pm 1.96\left(\frac{2.5}{2}\right)$	3m
	$= 14.25 \pm 2.45, = 11.8, 16.7$	1m
		6M
c)	Mean (m) $= \frac{\Sigma f x_i}{\Sigma f} = \frac{904}{1000} = 0.904$	1m
	$e^{-m} = e^{-0.904} = 0.4049$	
	$\therefore P(x) = \frac{m^x e^{-\mu}}{x!} = \frac{(0.4049)(0.904)^x}{x!}$ for $x = 0, 1, 2, 3, 4$	1m
	The theoretical frequencies are $= 1000 \times P(x)$	
	<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Ei</td><td>406.2</td><td>366</td><td>165.4</td><td>49.8</td><td>12.6</td></tr><tr><td>Oi</td><td>419</td><td>352</td><td>154</td><td>56</td><td>19</td></tr></table>	3M
	$\chi^2 = \sum_{i=1}^{4} \frac{(O_i - E_i)^2}{E_i} = 5.748$	1m
	$\therefore \chi^2 = 5.748 < 7.82$ for 4 d.f.	
	$\therefore$ The poisson distribution fits for the data.	1m
		7m

Q.No.	Solution and Scheme	Marks
8 a)	The 99% confidence limit for the population	
	$\mu = \bar{x} \pm 2.58\left(\frac{\sigma}{\sqrt{n}}\right)$	2m
	$= 174.5 \pm 2.58\left(\frac{6.9}{\sqrt{50}}\right)$	2m
	$= 174.5 \pm 2.53$	3m
	$\mu = (171.97, 177.03)$	7m
b)	$\bar{x} = 97.2$, $s = 13.54$	2M
	$t = \frac{\bar{x}-\mu}{\sigma/\sqrt{n}} = \frac{97.2-100}{13.54/\sqrt{9}}$	
	$\lvert t \rvert = \lvert -0.62 \rvert = 0.62$	2m
	$\therefore t_{cal} = 0.62 < t_{0.5} = 2.26$	2m
	$\therefore$ The hypothesis is accepted.	6m
c)	Let us assume the hypothesis that these figures the ratio 9:3:3:1	
	The expected frequencies are	2m
	$\frac{9}{16}\times1600,\ \frac{3}{16}\times1600,\ \frac{3}{16}\times1600,\ \frac{1}{16}\times1600$	1m
	ie 900, 300, 300, 100	
	$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i} = 4.73$	2m
	$\therefore \chi^2_{cal} = 4.73 < 7.815$ for 3 degree of freedom	2m
	$\therefore$ The hypothesis is accepted.	7m
9 a)	Let H_0: There is no significant difference between the yield of varities.	1M
	Let $A = x_1$ samples, $B = x_2$ samples, $C = x_3$.	
	$\bar{x}_1 = \frac{\sum x_i}{n_1} = 6.25$, $\bar{x}_2 = \frac{\sum x_2}{n_2} = 5.25$, $\bar{x}_3 = \frac{\sum x_3}{n_3} = 3.75$	2m

Q.No.	Solution and Scheme	Marks
6 a)	i) ~~Type 1 and Type 2 Error~~	
	$\bar{x} = \dfrac{\bar{x}_1 + \bar{x}_2 + \bar{x}_3}{3} = 5.08$	1m
	$SSB = \sum_{i=1}^{3} n_i (\bar{x}_i - \bar{x})^2 = 12.68$ For $V_1 = k-1 = 2$ d.f.	1m
	$MSB = \dfrac{SSB}{V_1} = 6.34$	1M
	$SSW = \sum_{i=1}^{k} (x_1 - \bar{x}_1)^2 + \sum (x_2 - \bar{x}_2)^2 + \sum (x_3 - \bar{x}_3)^2$	1m
	$= 22.22$	
	$\vartheta_2 = N - k = 12 - 3 = 9$ $MSW = \dfrac{SSW}{V_2} = 2.47$	

Source of variation	S.S	d.f.	M.S.	F-Test
Between samples	12.68	2	6.34	$F = \dfrac{6.34}{2.47}$
Within Samples	22.22	9	2.47	$= 2.57$

2m

$\therefore F_{cal} = 2.57 < F_{tab} = 4.26$ with $(2, 9)$ d.f. at 5% level

$\therefore$ Ho is accepted & we conclude that the difference is not significant. 1m

10m

b) Let A - Fertilizer B - Fertilizer code

		Fertilizer A					Total B	Σx^2
Fertilizer B	1	5	-1	0	-2	-2	0	1
	2	-1	-2	3	1	0	1	34
	3	4	-3	-3	-1	7	4	15
	4	1	-5	2	2	1	1	84 35
	5	2	0	-1	-4	3	0	30
Total (A)		11	11	1	-4	9	$\Sigma x = 6$	198
Σx^2		47	39	23	26	63	198	

3M

Total sum of squares $= \Sigma X^2 - \frac{(\Sigma X)^2}{N} = 198 - 1.44 = 196.56$ 1m

$SSC = \frac{(11)^2}{5} + \frac{(-11)^2}{5} + \frac{12}{5} + \frac{4^2}{5} + \frac{9^2}{5} - \frac{(6)^2}{25} = 66.56$ 1m

$SSR = \frac{0^2}{5} + \frac{1^2}{5} + \frac{4^2}{5} + \frac{1^2}{5} + \frac{0^2}{5} - \frac{(6)^2}{25} = 2.16$ 1m

$SSW = \frac{17^2}{5} + \frac{9^2}{5} + \frac{0^2}{5} + \frac{5^2}{5} + \frac{15^2}{5} - \frac{(6)^2}{25} = 122.56$ 1m

Error $= 196.56 - (66.56 + 2.16 + 122.56) = 5.28$

$\therefore$ F-ratio $F_1 = 269.6$

$F_2 = 37.8$ 2m

$F_3 = 1.2$

F_1, F_2 are rejected

$F_{3cal} = 1.2 < F_{tab} = 3.26$ with $(4, 12)$ d.f. 1m

$\therefore H_0$ is accepted. 10m

10

a) Here $N = 12$, Take 40 as a code.

Treatment / Pieces of land	A	B	C	D	Total
P	5	0	-2	-3	0
Q	3	1	5	-2	7
R	-1	-1	1	1	0
Total	7	0	4	-4	7

3m

$SSC = 22.92$, $C.F = \frac{T^2}{N} = 4.08$ 1m

For $\nu_1 = C - 1 = 4 - 1 = 3$, $SSR = 8.17$ 1m

For $\nu_2 = R - 1 = 3 - 1 = 2$ $SST = 76.92$ $d.f = N - 1 = 12 - 1 = 11$ 1m

$SSE = SST - (SSC + SSR) = 45.83$ $d.f = 6$ 1m

Source of variation	SS	d.f	M.S	F-test
SSC	22.92	3	7.64	$F_1 = 1$
SSR	8.17	2	4.09	$F_2 = 0.54$
SSE	45.83	6	7.64	
SST	769.2	11		

3m

Q.No.	Solution and Scheme	Marks
	H_0 is accepted.	1M
10 b)	$T=0, \; N=12, \; C.T=0 \quad SST=374, \quad SSB=168.5$	2M
	For $\nu_1 = 2$ and $\nu_2 = 9$ d.f	1M
	$SSW = SST - SSB = 84.25$	
	$MSW = 22.83$	1M

ANOVA Table

Source of variation	S.S.	d.f	M.S.	F-test
Between Sample	168.5	2	84.25	3.69
within sample	205.5	9	22.83	

3M

$\therefore F_{cal} = 3.69 < 4.26 = F_{tab}$ with $(2, 9)$ d.f.

$\therefore H_0$ is accepted

We conclude that there is no significant difference

3M

10M

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