Type: DES

Q1. The sample values 0.46, 0.38, 0.61, 0.82, 0.59, 0.53, 0.72, 0.44, 0.59, 0.60 are from a population having probability density function $f(x;\theta) = (1+\theta)x^{\theta},\ 0 < x < 1, \theta > 0$. Find the maximum likelihood estimate of the parameter θ. (3)

Q2. The intelligence quotients (IQ) of a random sample of ten boys are 70, 120, 110, 101, 88, 83, 95, 98, 107, 100. Do these data support the assumption of a population mean IQ of 100? Test this at 5% level of significance. Also find a 95% confidence interval for the mean of the population. (3)

Q3. Fit a Poisson distribution to the following famous data on the number of deaths that resulted per year in an army corps for 10 Prussian cavalry army corps over a period of 20 years from being kicked by a horse. The total number of sampling units here is therefore 200. Apply the chi-squared test to see whether the Poisson assumption is substantiated. Test at 5% level of significance. The probability mass function of a random variable following Poisson distribution is given by $P[X = x] = \frac{\lambda^x e^{-\lambda}}{x!}, x = 0,1,2,\dots,\lambda > 0$.

No. of deaths during the year	0	1	2	3	4
Observed frequency	109	65	22	3	1

(4)

Q4. In an experiment with flowers of a certain species, theory predicts that there should be four flower types in the ratios 9:3:3:1. If an experiment produced the frequencies 120, 50, 40, 10 for these four types, is it compatible with the theory? Test at 5% level of significance. (3)

Q5. Estimate the missing observation in the following Latin squares design.

A (12)	**C** (19)	**B** (10)	**D** (8)
C (18)	**B** (12)	**D** (6)	**A (x)**
B (22)	**D** (10)	**A** (5)	**C** (21)
D (12)	**A** (7)	**C** (27)	**B** (17)

(3)

Q6. The following table gives the layout and the results of a factorial design laid out in four blocks. The purpose of the experiment is to determine the effect of the three kinds of fertilizers namely, Nitrogen N, Potash K and Phosphate P on potato crop yield.

Block 1	nk (29)	kp (39)	p (31)	np(37)	1(10)	k (26)	n (10)	nkp (45)
Block 2	kp (40)	p (32)	k (27)	nk (30)	n (89)	nkp (44)	np (33)	1(10)
Block 3	p (32)	1(87)	np (32)	kp (42)	nk (33)	k (27)	n (12)	nkp (47)
Block 4	np (36)	nk (27)	n (10)	p (32)	k (30)	1(13)	nkp (43)	kp (43)

Compute the factorial effects total using Yates' method. (4)

Q7. For the artificial data given below, write the incidence matrix.

Block No.	Treatment (response)			
1	A(3)	C(10)	A(4)	B(8)
2	B(8)	D(11)	C(12)	B(8)
3	C(12)	A(7)	C(11)	D(13)
4	D(15)	B(10)	A(7)	D(13)

(2)

Q8. For the design in the table below, determine whether or not, it is a balanced incomplete block design.

Block	Treatments		
I	1	3	8
II	2	4	1
III	3	5	2
IV	4	6	3
V	5	7	4
VI	6	8	5
VII	7	1	6
VIII	8	2	7

. (3)

Q9. The following observations are drawn sequentially from $N(\theta, 1)$.

1, 0, 0.6, 0.7, -0.3, 1, 2, 3, 1, 4, 1, 0.7, -0.65, -1.2, 1.7, -1.4, -0.6, 1, 0, 0, 1.1, 1.6, -0.69, -0.62, 0.7, -0.7, 0.23, 0.12, 0.26.

Test the hypothesis $H_0: \theta = 0 \; vs \; H_1: \theta = 1$ with strength (0.05, 0.05)

The normal probability density function is given by

$f(x; \mu, \sigma) = \frac{1}{\sigma\sqrt{2\pi}} exp\left(\frac{-1(x-\mu)^2}{2\sigma^2}\right), -\infty < x < \infty, -\infty < \mu < \infty, \sigma > 0$. $R_m = \frac{P(.|H_1)}{P(.|H_0)}$.

The boundary points (A, B) for the SPRTP of strength (α, β) are $A = \frac{1-\beta}{\alpha}$ and $B = \frac{\beta}{1-\alpha}$

. (5)

Q10. A $3 \times 4 \times 5$ full factorial experiment with two replicates is planned.

Determine how many degrees of freedom will there be for each term in the model if it includes main effects, two factor interactions and three factor interactions.

Find the number of degrees of freedom corresponding to the error.

Determine the number of degrees of freedom corresponding to the error if we omit the three factor interaction from the model. (2)

Q11. Find all the orthogonal contrasts of the sources of variation in the following design.

Treatments	**Irrigation levels**		
	L_1	L_2	L_3
T_1	y_{11}	y_{12}	y_{13}
T_2	y_{21}	y_{22}	y_{23}

. (3)

Q12. A test was given to five students taken at random from the fifth class of three schools of a town. The individual scores are as follows.

School 1	9	7	6	5	8
School 2	7	4	5	4	5
School 3	6	5	6	7	6

Stating clearly the hypothesis and the assumptions, carry out the analysis of variance for the above data and state your conclusions based on 1% level of significance. (5)

Q13. The following is the association scheme of a particular design with 10 treatments labelled 1, 2, 3, …, 10. Identify the association type and find all the parameters of the design after determining the first and second associates of all the treatments, and pairing each treatment with its first associate, once.

*	1	2	3	4
1	*	5	6	7
2	5	*	8	9
3	6	8	*	10
4	7	9	10	*

(2)

Q14. For the design in the table below, draw the connectivity graph and determine whether the design is connected.

Block	Treatments		
I	1	3	5
II	2	4	6
III	3	5	7
IV	4	6	8
V	5	7	1
VI	6	8	2
VII	7	1	3
VIII	8	2	4

. (3)

Q15. Three varieties of coal were analysed by four chemists and the ash content in the varieties were found to be as follows. Do the varieties differ significantly in their ash content? Test at 5% level of significance.

Varieties	Chemists			
	1	2	3	4
A	8	5	5	7
B	7	6	4	4
C	3	6	5	4

(5)