

Attempt FIVE Questions in all, selecting at least TWO Questions from each Section.
 Use of Calculator and Statistical Tables is allowed.

Section-I

1. a) Define and explain. i) Sampling Design ii) Sampling Frame iii) Sampling Error 6
 b) Draw all possible samples of size 3 without replacement from the population 6,6,6,9,9,12. Find mean of each sample and form sampling distribution of sample means. Verify that i) $\mu_{\bar{x}} = \mu$ and

$$\sigma_{\bar{x}}^2 = \frac{\sigma^2}{n} \left(\frac{N-n}{N-1} \right) \quad 9$$

2. a) Distinguish between stratified random sampling and cluster sampling. 4
 b) Given the population 1,1,1,3,4,5,6,6,6 and 7. Find i) the probability that a random sample of size 36, selected with replacement, will yield a sample mean between 3.26 and 4.74. 11
 ii) The variance of sampling distribution of means for a sample of size 4 selected at random without replacement.

3. a) A random sample x_1, \dots, x_8 is taken from a population with mean μ and variance σ^2 . Consider three possible estimators of μ : 8

$$T_1 = \frac{2x_2 - x_4 + 4x_5 + x_8}{6}, \quad T_2 = \frac{x_2 - x_1}{8}, \quad T_3 = x_5$$

- i) Which of above estimators are unbiased ii) which of above estimators have minimum variance?
 b) Given two random samples of size $n_1 = 9$ and $n_2 = 16$, from two independent normal populations having equal variances with $\bar{x}_1 = 64$, $\bar{x}_2 = 59$, $s_1^2 = 36$ and $s_2^2 = 25$. Find a 95% confidence interval for $\mu_1 - \mu_2$ 7

4. a) Define i) Null Hypothesis ii) Acceptance Region iii) Type - I error 3
 b) Two samples A and B detailed below were taken from two normal populations of standard deviation 2.5. Decide whether the difference of sample means is significant at 0.05 level of significance. 12

A:	16	18	23	26	19	24	25	23	21	22
B:	20	21	23	25	25	27	24	26	24	28

5. a) Hemoglobin levels (Hb) were measured before starting and after one month of a certain therapy. The data obtained is given below. Do the data indicate a significant improvement? 8

Individual No.	1	2	3	4	5	6
Hb level before therapy	12.2	11.3	14.7	11.4	11.5	12.7
Hb level after therapy	13.0	13.4	16.0	13.6	14.0	13.8

- b) The following data represent a random sample of 10 cans of tomatoes, showing their weights 15.4, 16.1, 15.8, 16.4, 16.0, 15.9, 16.7, 16.3, 15.7, 15.7. Test the hypothesis that $\sigma^2 \geq 1.5$ against the alternative $\sigma^2 < 1.5$. Use $\alpha = 0.05$.

Section-II

6. a) A die is tossed 180 times with the following results. 7

x:	1	2	3	4	5	6
f:	20	36	46	35	21	22

Is this a balanced die? Use $\alpha = 0.01$

- b) The table given below shows relation between the performance of students in economics and statistics. 8

Continued Overleaf

Grade in Economics	Grade in Statistics		
	Hish	Medium	Low
High	56	96	28
Medium	48	168	24
Low	16	86	78

Test the hypothesis that performance in economics is independent of the performance in statistics.
Use $\alpha = 0.05$

7. a) What are the assumptions to carry out one way analysis of variance. 3
b) Determinations are made on the yield using three different methods M_1 , M_2 and M_3 12

Methods	Observations
M_1	4, 9, 10, 11, 17, 19
M_2	6, 8, 10, 11, 12, 12, 15
M_3	9, 13, 15, 20, 23

Do the methods differ significantly at $\alpha = 0.05$.

8. The following data refer to three methods of hardening steel, which are referred to as A, B and C. A strip of steel was cut into 18 pieces and treatments (hardening methods) were allocated at random, forming six complete blocks. The layout of experiment is given below. 15

A	B	C	C	B	A	A	C	B
813	647	713	814	759	795	705	652	598

A	C	B	B	A	C	A	B	C
774	617	559	580	687	539	581	480	437

- a) Perform two way analysis of variance and test the significance of treatments.
b) What would have been the result if no blocking has been done?
9. a) In a linear regression problem, following results were obtained. 8
 $\hat{y} = 12.13 - 0.1608x$, $\bar{\alpha} (y - \hat{y})^2 = 1160$, $\bar{\alpha} (x - \bar{x})^2 = 1300$, $n = 24$
Assuming normality compute 95% confidence interval for the population regression coefficient β .
b) From a random sample of 25 sets of observations from a normal population $r_{12.34} = 0.48$. Test the hypothesis that corresponding partial correlation coefficient in the population is zero at 5% level of significance. 7
10. a) Use sign test to test the hypothesis that the median of the population from which the following random sample is obtained is 30 against the alternative that it is not 30. 7
27, 39, 30, 22, 32, 24, 25, 29, 26.
b) Given the following sample observations from a population. 2.55, 4.62, 2.93, 2.46, 1.95, 4.60, 3.11 and 0.90. 8

Test the hypothesis that the median of the population is 2.00 against the alternative that it is not using Wilcoxon signed-rank test.