

Question 1. [6 Marks]

a) Complete the following ANOVA Table

SOURCE	DF	SS	MS	F
TREATMENTS	4	8.4		6.4
Blocks				
ERROR				
TOTAL	19	18.3375		

b) What decision should be made about the equality of the population treatments means at  $\alpha = 0.01$ ?

c) Was blocking beneficial? Use  $\alpha = 0.01$ .

Question 2. [10 Marks]. Let  $X_1, X_2, \dots, X_n$  be a random sample from a Normal population with mean 0 and variance  $\theta$ .

a) Show that the maximum likelihood estimator of  $\theta$  is

$$\hat{\theta} = \frac{1}{n} \sum_{i=1}^n X_i^2.$$

b) Show that  $\hat{\theta}$  is an unbiased estimator of  $\theta$ .

c) Show that  $\hat{\theta}$  is an efficient estimator of  $\theta$ .

Question 3. [6 Marks] To compare the commuting patterns of the residents of two Cities, two independent random samples were selected. The resulting data is summarized below.

City	Sample size	# of persons commuting by own car
A	300	141
B	300	123

a) Construct a 99% Confidence Interval for the difference between the populations proportions.

b) Based on the *CI* of Part a), can we conclude, at  $\alpha = 0.01$ , that the populations proportions are unequal.

Question 4. [10 Marks] The following data is obtained in a study of age and systolic blood pressure of 6 randomly selected patients.

Patient	1	2	3	4	5	6
$x$	43	48	56	61	67	70
$y$	128	120	135	143	141	152

Note that  $\sum x = 345$ ,  $\sum x^2 = 20399$ ,  $\sum y = 819$ ,  $\sum y^2 = 112443$ , and  $\sum xy = 47634$ .

a) Find the least square regression equation of  $y$  on  $x$ .

b) At  $\alpha = 0.05$ , test

$$H_0 : \beta = 0 \text{ against } H_1 : \beta > 0.$$

c) Let  $\rho$  be the population correlation coefficient. At  $\alpha = 0.05$ , test

$$H_0 : \rho = 0 \text{ against } H_1 : \rho \neq 0.$$

Question 5. [10 Marks] [Each part of this question is worth 5 Marks]

a) Two independent random samples from normal populations resulted in

Sample	size	Standard deviation
1	16	4.3
2	18	2.3

At  $\alpha = 0.05$ , test

$$H_0 : \sigma_1 = \sigma_2 \text{ against } H_1 : \sigma_1 > \sigma_2.$$

b) A study to determine whether jogging and blood pressure are related. A random sample of 210 individuals are classified as given below

		Jogging status		TOTAL
		Joggers	Nonjoggers	
Blood pressure	Low	34	15	49
	Moderate	57	63	120
	High	21	20	41
	TOTAL	112	98	210

Test at  $\alpha = 0.05$  whether jogging and blood pressure are independent.

Question 6. [8 Marks] A random sample of 7 students participated in a mathematics review program. Their skill levels in Mathematics were measured before and after the program. The results are given below.

Student	1	2	3	4	5	6	7	Total
Before	77	90	70	66	63	77	70	
After	81	88	75	68	68	81	73	

At  $\alpha = 0.1$  test the claim that ( $H_1$ ) the program is effective in increasing Mathematics skills.