

(30 points)

**SS** 4.12 A consumer products company relies on direct mail marketing pieces as a major component of its advertising campaigns. The company has three different designs for a new brochure and wants to evaluate their effectiveness, as there are substantial differences in costs between the three designs. The company decides to test the three designs by mailing 5000 samples of each to potential customers in four different regions of the country. Since there are known regional differences in the customer base, regions are considered as blocks. The number of responses to each mailing is as follows:

Design	Region			
	NE	NW	SE	SW
1	250	350	219	375
2	400	525	390	580
3	275	340	200	310

- a. Analyze the data from this experiment.
- b. Use the Fisher LSD method to make comparisons among the three designs to determine specifically which designs differ in the mean response rate.
- c. Use the Tukey HSD method to make comparisons among the three designs to determine which designs differ in the mean response rate.

(30 points)

Please perform the randomization test on the Etch Rate Example, data copied below. Obtain your p-value and make your decision.

**TABLE 3.1**

**Etch Rate Data (in Å/min) from the Plasma Etching Experiment**

Power (W)	Observations					Totals	Averages
	1	2	3	4	5		
160	575	542	530	539	570	2756	551.2
180	565	593	590	579	610	2937	587.4
200	600	651	610	637	629	3127	625.4
220	725	700	715	685	710	3535	707.0

(20 points)

Problem 1. Derive the ANOVA partitioning for a Latin Square Design:

$$SS_T = SS_{Treatments} + SS_{Rows} + SS_{Columns} + SS_{Error},$$

where

$$\begin{aligned} SS_T &= \sum_{i,j,k} (y_{ijk} - \bar{y}_{...})^2 \\ SS_{Treatments} &= p \sum_{j=1}^p (\bar{y}_{.j.} - \bar{y}_{...})^2 \\ SS_{Rows} &= p \sum_{i=1}^p (\bar{y}_{i..} - \bar{y}_{...})^2 \\ SS_{Columns} &= p \sum_{k=1}^p (\bar{y}_{..k} - \bar{y}_{...})^2. \end{aligned}$$

Note: please include details about why cross terms vanish.

(30 points)

**SS** 4.25 An industrial engineer is investigating the effect of four assembly methods ( $A, B, C, D$ ) on the assembly time for a color television component. Four operators are selected for the study. Furthermore, the engineer knows that each assembly method produces such fatigue that the time required for the last assembly may be greater than the time required for the first, regardless of the method. That is, a trend develops in the required assembly time. To account for this source of variability, the engineer uses the Latin square design that follows. Analyze the data from this experiment ( $\alpha = 0.05$ ) and draw appropriate conclusions.

Order of Assembly	Operator			
	1	2	3	4
1	$C = 10$	$D = 14$	$A = 7$	$B = 8$
2	$B = 7$	$C = 18$	$D = 11$	$A = 8$
3	$A = 5$	$B = 10$	$C = 11$	$D = 9$
4	$D = 10$	$A = 10$	$B = 12$	$C = 14$