

Show all pertinent work. Be neat.

Part I (Each correct answer in problems 1 – 3 is worth 4 points.)

Suppose we have the following estimated treatment means in a two-factor (fixed levels) study with equal sample sizes ($n = 5$).

		<u>Factor B</u>	
		1	2
<u>Factor A</u>	1	30	50
	2	95	115
	3	55	75

1. Is there significant evidence of interaction? Justify your answer.

2. Specify two sums of squares which **cannot** be obtained from the information in the table above.

(Circle two:) SSTO SSTR SSE SSA SSB SSAB

3. Provide unbiased point estimates for the following parameters.

parameter estimate

$\mu_{..}$

μ_{12}

μ_{31}

$\mu_{.2}$

$\mu_{3.}$

α_1

β_2

$(\alpha\beta)_{12}$

Part I (continuation...)

4. (10 points). Complete the following ANOVA table based on the earlier information and the additional information contained in the table.

ANALYSIS OF VARIANCE response			
SOURCE	DF	SS	MS
TREATMENT	5	24500	_____
factA _{lv1}	_____	21500	10750
factB _{lv1}	1	3000	3000
INTERACTION	2	_____	_____
ERROR	24	2446	102
TOTAL	_____	26946	

5. (20 points.) Pairwise comparisons of factor level means are desired with family confidence coefficient of .90. Use either (i) the Bonferroni method directly (with $g = 4$);
or (ii) the Bonferroni method in conjunction with the Tukey method.

Results

Confidence intervals:

$$\leq \mu_2 - \mu_1 \leq$$
$$\leq \mu_2 - \mu_3 \leq$$
$$\leq \mu_3 - \mu_1 \leq$$
$$\leq \mu_2 - \mu_1 \leq$$

Part II (30 points.)

Fill in the blanks or circle the most appropriate answer in the problems below.

6. A plot of estimated treatment means that exhibits non-parallel curves for different factor levels indicates the presence of _____ .
7. If no interaction exists, factor effects are called (a) multiplicative (b) additive (c) divisive
8. The study in Part I is an example of a (a) fractional factorial study (b) complete factorial study .
9. In a two-factor study, if factor A has main effects, then factor B must have main effects.
True False
10. In a two-factor study, the sum of the estimated main effects for each factor is always zero.
True False
11. If the sum of all estimated interactions is zero, then $SSAB = 0$.
True False
12. If a simple transformation of Y removes most interaction effects and makes them unimportant, then the interactions are called (a) transformable (b) nontransformable .
13. The F test that is recommended to be done first in a two-factor study is the test for (a) factor A main effects (b) factor B main effects (c) interaction effects
14. Factor effects can always be detected by an F test.
True False
15. The Kimball inequality provides an (a) upper bound (b) lower bound on the family level of significance for the three F tests for interaction and main effects.
16. If $\alpha_1 = \alpha_2 = \alpha_3 = .05$ is the significance level for the three F tests referred to above, the Kimball significance bound is _____, whereas the Bonferroni bound is _____.
17. If important nontransformable interactions are detected in a two-factor study, then multiple pairwise comparisons of (a) factor level means (b) treatment means is recommended to analyze factor effects.
18. If greater power is desired in detecting differences in a two-factor study, one could (a) increase sample sizes (b) decrease sample sizes .
19. For a two-factor study, $SSTR = SSA + SSB + SSAB$. True False