

Open Book and Open Notes.

Thanks for your cooperation!

**1(60 Points).** Consider a  $2^3$  factorial experiment all of whose FLCs cannot be run using the same batch of raw material, and two batches are needed to run all the FLCs in one full replicate. The experimenter also decides to run 3 replicates using a total of 6 batches of raw material in order to have residual *df* to conduct F tests at the 5% LOS. (a) In replicate I the AC effect is confounded with blocks, while in both replicates II & III, the ABC interaction is confounded with batches (or blocks). Give a complete ANOVA outline (i.e., list only sources of variation starting with total and their *df*) for this replicated  $2^3$  factorial. (b) The coded data for replicate I are as follows: (1) → 1, a → 6, b → 2, ab → 12, c → -4, ac → 1, bc → -5, abc → 10; in replicate II: (1) = 2, a = 9, b = 6, ab → 9, c → -6, ac → 4, bc → -4, abc → 8. The coded data for replicate III are : (1) → -1, a → 8, b → 3, ab → 10, c → -3, ac → -5, bc → -4, abc = 7. Given that  $y_{\dots} = 66$ , compute the overall  $SS(\text{Replicates}+\text{BLKS})$ , giving its total *df*. (c) Compute  $SS(B)$  and  $SS(A \times C)$ . Given that  $SS_{\text{Residuals}} = 55.8125$ , test the statistical significance of only the B-effect at the 5% level.

**2(40 Points).** (a) Consider the fractional factorial design  $2^{6-3}$  below, where two of the 3 independent generators are  $g_1 = BDF$  and  $g_2 = ABE$ . Fill in the signs under columns (3), (4), (5) and (6) and determine the other 3 FLCs in column (7) in order to obtain the principal block (PB). Please do your work pertaining to Problem 2(a) on this sheet.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
B	D		F=		C=	FLCs of the PB
-	-					(1)
-	-					ace
-	+					cdf
-	+					adef
+	-					bcef
+	-					
+	+					
+	+					

Then, determine the 3<sup>rd</sup> independent generator  $g_3$ . (b) Give the 3 independent contrast functions and use your principal block to generate the block for which  $\xi_1 = 1$ ,  $\xi_2 = 0$ , and  $\xi_3 = 1$ .

Test 3 INS Y 7300 F 2010 Maghsoodloo

(a, 15 points)

ANOVA outline

Source	df
Total	23
Replicates	2
BLKS within Reps	3
A, B, C	3
AB, BxC	2
AC from (II & III)	1
ABC from (I)	1
RES	11

(b, 20 points) Rep. I (AC)

BLK 1: (1), b, ac, abc → 14;  
 BLK 2: a, c, ab, bc → 9

Rep. II (ABC): BLK 1: (1), ab, ac, bc → 11;  
 BLK 2: a, b, c, abc → 17

Rep. III (ABC): BLK 1: → 0;  
 BLK 2: → 15

$$SS(\text{Reps} + \text{Blks}) = \frac{14^2 + 9^2 + 11^2 + 17^2 + 0^2 + 15^2}{4} - \frac{66^2}{24}$$

$$= 46.5$$

(c, 25 points)  $SS_B = \frac{(54 - 12)^2}{24} = 73.50$

$SS(A \times C) = \frac{(24 - 19)^2}{16} = 1.5625$ ;  $MS_{RES} = 5.0739$

$F_0(B) = 73.50 / 5.0739 = 14.486$ ;  $F_{.05, 1, 11} = 4.84$

Reject  $H_0: B_j = 0$ .

