SL:

Marks Obtained

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Signature of Examiner

Ans. to the q. no 1 (a)

Yates table to compute the sum of square of components in a 2^3 factorial experiments with 6 blocks:

Treatment combination	total yield	col-1	col-2	col-3	main and Interaction effect	SS
(1)	[1]	$[1]+[a]=x_1$	$x_1+x_2=y_1$	$y_1+y_2=GT$		
a	[a]	$[b]+[ab]=x_2$	$x_3+x_4=y_2$	$y_3+y_4=[A]$	$\frac{[A]}{2^{3-1}\times 6}=\frac{[A]}{24}$	$\frac{[A]^2}{2^3\times 6}=\frac{[A]^2}{48}$
b	[b]	$[c]+[ac]=x_3$	$x_5+x_6=y_3$	$y_5+y_6=[B]$	$\frac{[B]}{24}$	$\frac{[B]^2}{48}$
ab	[ab]	$[bc]+[abc]=x_4$	$x_7+x_8=y_4$	$y_7+y_8=[AB]$	$\frac{[AB]}{24}$	$\frac{[AB]^2}{48}$
c	[c]	$[a]-[1]=x_5$	$x_2-x_1=y_5$	$y_2-y_1=[C]$	$\frac{[C]}{24}$	$\frac{[C]^2}{48}$
ac	[ac]	$[ab]-[b]=x_6$	$x_4-x_3=y_6$	$y_4-y_3=[AC]$	$\frac{[AC]}{24}$	$\frac{[AC]^2}{48}$
bc	[bc]	$[ac]-[c]=x_7$	$x_6-x_5=y_7$	$y_6-y_5=[BC]$	$\frac{[BC]}{24}$	$\frac{[BC]^2}{48}$
abc	[abc]	$[abc]-[bc]=x_8$	$x_8-x_7=y_8$	$y_8-y_7=[ABC]$	$\frac{[ABC]}{24}$	$\frac{[ABC]^2}{48}$

Analysis of Data with 6 Blocks in RBD:

$$y_{ijkl} = \mu + \alpha_i + \beta_j + \gamma_k + (\alpha\beta)_{ij} + (\beta\gamma)_{jk} + (\alpha\gamma)_{ik} + (\alpha\beta\gamma)_{ijk} + \delta_l + e_{ijkl} \; ; \; i=0,1 \quad j=0,1 \quad k=0,1 \quad l=1(1)6$$

$$SS(\text{total}) = \sum_{i=0}^{1}\sum_{j=0}^{1}\sum_{k=0}^{1}\sum_{l=1}^{6} y_{ijkl}^2 - CT \; ; \; CT = \frac{GT^2}{2^3 \times 6}$$

$$SS(\text{Block}) = \frac{\sum_{l=1}^{6} B_l^2}{2^3} - CT$$

$$SSE = SS(\text{total}) - SS(A) - SS(B) - SS(AB) - SS(C) - SS(AC) - SS(BC) - SS(ABC) - SS\text{Block},$$

ANOVA Table:

SV	df	SS	MS	F
Block	$6-1=5$	S_b^2	$\rho_b^2 = \frac{S_b^2}{5}$	ρ_b^2/ρ_e^2
treatment	7	S_t^2	$\rho_t^2 = \frac{S_t^2}{7}$	ρ_t^2/ρ_e^2
A	1	S_A^2	$\rho_A^2 = \frac{S_A^2}{1}$	ρ_A^2/ρ_e^2
B	1	S_B^2	$\rho_B^2 = \frac{S_B^2}{1}$	ρ_B^2/ρ_e^2
AB	1	S_{AB}^2	$\rho_{AB}^2 = \frac{S_{AB}^2}{1}$	ρ_{AB}^2/ρ_e^2
C	1	S_C^2	$\rho_C^2 = \frac{S_C^2}{1}$	ρ_C^2/ρ_e^2
AC	1	S_{AC}^2	$\rho_{AC}^2 = \frac{S_{AC}^2}{1}$	ρ_{AC}^2/ρ_e^2
BC	1	S_{BC}^2	$\rho_{BC}^2 = \frac{S_{BC}^2}{1}$	ρ_{BC}^2/ρ_e^2
ABC	1	S_{ABC}^2	$\rho_{ABC}^2 = \frac{S_{ABC}^2}{1}$	ρ_{ABC}^2/ρ_e^2
Error	$(2^3-1)(6-1)=35$	S_{Error}^2	$\rho_e^2 = \frac{S_{Error}^2}{35}$	
Total	$2^3 \times 6 - 1 = 47$	S_{total}^2		

Inference procedure:

H_0: ~~The main or~~ The treatment combinations are similar

H_1: The treatment combinats are different

$$F_{cal} = \frac{MS(treatment)}{MS(Error)}$$

~~In~~ if $F_{cal} > F_{\alpha, tab}$ then reject the ~~no~~ H_0 at α% level of significance, and we can conclude that treatment combinations are not similar

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Ans. 1 (b)

Yates table for computing SS for 3^2 with 4 replications.

Treatment combination	Yield total	col-1	col-2	col-3	Main and Interaction effect	Divisor	SS
00	x_1	$x_1+x_2+x_3=y_1$	$y_1+y_2+y_3=z_1$	$z_1+z_2+z_3$ $=GT$	G	9×4 $=36$	
10	x_2	$x_4+x_5+x_6$ $=y_2$	$y_4+y_5+y_6=$ z_2	$z_4+z_5+z_6$ $=[A_l]$	A_l	6×4 $=24$	$\frac{[A_l]^2}{24}$
20	x_3	$x_7+x_8+x_9$ $=y_3$	$y_7+y_8+y_9$ $=z_3$	$z_7+z_8+z_9$ $=[A_q]$	A_q	18×4 $=72$	$\frac{[A_q]^2}{72}$
01	x_4	$x_3-x_1=y_4$	$y_3-y_1=$ z_4	z_3-z_1 $=[B_l]$	B_l	6×4 $=24$	$\frac{[B_l]^2}{24}$
11	x_5	$x_6-x_4=y_5$	y_6-y_4 $=z_5$	z_6-z_4 $=[A_lB_l]$	A_lB_l	$4r$ $=16$	$\frac{[A_lB_l]^2}{16}$
21	x_6	$x_9-x_7=y_6$	y_9-y_7 $=z_6$	z_9-z_7 $=[A_qB_l]$	A_qB_l	$12r$ $=48$	$\frac{[A_qB_l]^2}{48}$
02	x_7	$x_3-2x_2+x_1$ $=y_7$	$y_3-2y_2+y_1$ $=z_7$	$z_3-2z_2+z_1$ $=[B_q]$	B_q	$18r$ $=72$	$\frac{[B_q]^2}{72}$
12	x_8	$x_6-2x_5+x_4$ $=y_8$	$y_6-2y_5+y_4$ $=z_8$	$z_6-2z_5+z_4=$ $[A_lB_q]$	A_lB_q	$12r$ $=48$	$\frac{[A_lB_q]^2}{48}$
22	x_9	$x_9-2x_8+x_7$ $=y_9$	$y_9-2y_8+y_7$ $=z_9$	$z_9-2z_8+z_7$ $=[A_qB_q]$	A_qB_q	$36r$ $=144$	$\frac{[A_qB_q]^2}{144}$

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Analysis of data in CRD!

Model: $y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + e_{ijk}$; $i = 0,1,2$; $j = 0,1,2$; $k = 1(1)4$

$$SS(\text{total}) = \sum_{i=0}^{2}\sum_{j=0}^{2}\sum_{k=1}^{4} y_{ijk}^2 - CT \quad ; \quad CT = \frac{GT^2}{3^2 \times 4}$$

~~SS(B~~

$SSE) = SS\,total - SS(A_l) - SS\,A_q - SS(B_l) - SS(A_l B_l)$
$- SS(A_l B_q) - SS(A_q B_q)$
$- SS(A_q B_l) - SS(B_q)$

ANOVA table:

SV	df	SS	MS	F
treatment	8	S_t^2	σ_t^2	σ_t^2/σ_e^2
A_l	1	$S^2_{A_l}$	$\sigma^2_{A_l}$	$\sigma^2_{A_l}/\sigma^2_e$
A_q	1	$S^2_{A_q}$	$\sigma^2_{A_q}$	$\sigma^2_{A_q}/\sigma^2_e$
B_l	1	$S^2_{B_l}$	$\sigma^2_{B_l}$	$\sigma^2_{B_l}/\sigma^2_e$
$A_l B_l$	1	$S^2_{A_l B_l}$	$\sigma^2_{A_l B_l}$	$\sigma^2_{A_l B_l}/\sigma^2_e$
$A_q B_l$	1	$S^2_{A_q B_l}$	$\sigma^2_{A_q B_l}$	$\sigma^2_{A_q B_l}/\sigma^2_e$
B_q	1	$S^2_{B_q}$	$\sigma^2_{B_q}$	$\sigma^2_{B_q}/\sigma^2_e$
$A_l B_q$	1	$S^2_{A_l B_q}$	$\sigma^2_{A_l B_q}$	$\sigma^2_{A_l B_q}/\sigma^2_e$
$A_q B_q$	1	$S^2_{A_q B_q}$	$\sigma^2_{A_q B_q}$	$\sigma^2_{A_q B_q}/\sigma^2_e$
error	$3^2(4-1)=27$	S_e^2	σ_e^2	
total	$3^2\times 4-1 = 35$	S^2_{total}		

Ans. 1 (c)

(i) The appropriate model is CRD (completely randomized design) of 2^2 factorial experim

model:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + e_{ijk} \quad ; \quad i = 0,1 \quad j = 0,1 \quad k = 1(1)2$$

since all treatments are allocated randomly in each experimental plot ~~so it is~~ and there is replications ~~of treat~~ and no blocks so it is CRD model appropriate.

(ii)

Using Yates method:

Treatment combination	Yield total	col-1	col-2	Main and Interaction effect/Effect	$SS = \frac{(\text{Effect total})^2}{2^2 \times 2}$
(1)	48	108	256	$\frac{256}{2^{2-1} \times 2} = 64$	[illegible]
Z	60	148	-4	-1	2
k	42	12	40	10	200
zk	66	-16	-28	-7	98

$$SS(total) = \sum_{i=1}^{4} \sum_{j=1}^{1} \sum_{k=1}^{2} y_{ijk}^2 - CT$$

$$= 8568 - \frac{(GT)^2}{2^2 \times 2}$$

$$= 376$$

$$SSE = SStotal - SS(Z) - SS(K) - SS(ZK)$$

$$= 376 - 2 - 200 - 98$$

$$= 76$$

ANOVA table:

SV	df	SS	MS	F
Treatment	3	300	100	5.26
Z	1	2	2	0.11
K	1	200	200	10.53
ZK	1	98	98	5.16
Error	$2^2(2-1)=4$	76	19	
total	$2^2\times 2-1=7$	376		

(iii) Inferance procedure:

Ho: treament combinations are similar

H1: treatment combination are different

$$F = \frac{MS(\text{treatment})}{\cancel{SSE}\ MS(\text{error})}$$

$$= \frac{100}{19} = 5.26$$

~~$F_{0.05,3,4} =$~~ $F_{0.05,3,4} = 10.13$

if ~~F_{α},~~ $F_{cal} < F_{0.05,3,4}$, then we may not reject the Ho and we conclude that treatment combinations are similar.