M48456

41] controlling δ_F increases P(at least one type II error) and there are many procedures for multiple comparisons.

end exam 3 material — begin Quiz 11 material

ch6 1] p213 A two way Anova model has 2 factors A and B and a response Y. A has a levels and B has b levels.

2] Know p 214 Factorial crossing is used: each combination of an A level and a B level is used and called a treatment. There are ab treatments. Randomly assign units into treatments or take random samples from ab populations.

3] p213 The cell means model is

$Y_{ijk} = \mu_{ij} + e_{ijk}$, $i=1,\dots,a$ $j=1,\dots,b$ $k=1,\dots,m$ (n_{ij})

for correct inference: $Y_{ijk} \sim f(y-\mu_{ij})$, a location family with location parameter μ_{ij} and variance σ^2.

$n_{ij} \equiv m$ and sample size $n = abm$

A \ B	1	2	...	b
1	m	m	...	m
2	m	m	...	m
⋮	⋮	⋮	...	⋮
a	m	m	...	m

randomly assign m units per cell or take random samples of size m from each of the ab populations determined by a cell

fitted values $\hat{Y}_{ijk} = \hat{\mu}_{ij} = \overline{Y}_{ij0}$

residuals $r_{ijk} = Y_{ijk} - \hat{Y}_{ijk}$

56.5

4]* Anova table p 215

	Source	df	SS	MS	F	Pval
main effects	A	$a-1$	SSA	MSA	$F_A = MSA/MSE$	$P(F_{a-1,n-ab} > F_A)$
	B	$b-1$	SSB	MSB	$F_B = MSB/MSE$	$P(F_{b-1,n-ab} > F_B)$
interaction	AB	$(a-1)(b-1)$	SSAB	MSAB	$F_{AB} = \frac{MSAB}{MSE}$	$P(F_{(a-1)(b-1),n-ab} > F_{AB})$
	error	$n-ab = ab(m-1)$	SSE	MSE		

5] know If there is an AB interaction, keep both the A and B main effects

p218

6] Know for Final, Q10 4 Step test for AB interaction

i) Ho no interaction HA there is an interaction

ii) FAB } from output

iii) pval

iv) If pval < δ reject Ho and conclude there is an interaction between A and B.

If pval $\geq \delta$ fail to reject Ho and conclude that there is no interaction between A and B.

7] Tests for A and B main effects make the most sense if we fail to reject the test for interaction.

8] Know for Final, Q10 The test for A main effects is

i) Ho $\mu_{10} = \cdots = \mu_{a0}$ HA not Ho

ii) F_A } from output

iii) pval

iv) If pval < δ, reject Ho, conclude the mean response depends on the level of A. If pval $\geq \delta$, fail to reject Ho, conclude the mean response does not depend on the level of A.

9] Know for final, Q10 test for main effects B

i) H_0 $\mu_{01} = \dots = \mu_{0b}$ H_A not H_0

ii) F_B } from output
iii) Pval }

iv) If pval < δ, reject H_0, conclude the mean response depends on the level of B.
If pval ≥ δ, fail to reject H_0, conclude the mean response does not depend on the level of B.

10] The main effects F tests are just like the F test for the fixed effects 1way Anova model. (If there is an AB interaction, failing to reject H_0 for a main effect implies that the main effect is small given that the interaction is in the model.)

So A and B effect Y in a complicated manner

ex] want to improve asphalt pavement
Y = tensile strength, A = type: basalt or silicious,
B = compaction method: static, regular, low or very low

Source	df	SS	MS	F	pval
A	1	1734.0	1734.0	182.53	0.000
B	3	16243.5	5414.0	569.95	0.000
AB	3	1145.0	381.67	40.18	0.000
error	16	152.0	9.50		

a) H_0 no interaction H_A there is an interaction

mnemonic

$F_{AB} = 40.18$
pval = 0
reject H_0, there is an interaction between type of asphalt and compaction method.

57.5

b) Ho $\mu_{i0} = \mu_{20}$ HA not Ho

$F_A = 182.53$

pval = 0.0

reject Ho, mean tensile strength depends on type of asphalt

c) Ho $\mu_{01} = \mu_{02} = \mu_{03} = \mu_{04}$ HA not Ho

$F_B = 569.95$

pval = 0.0

reject Ho, mean tensile strength depends on compaction method.

see ex 6.2.

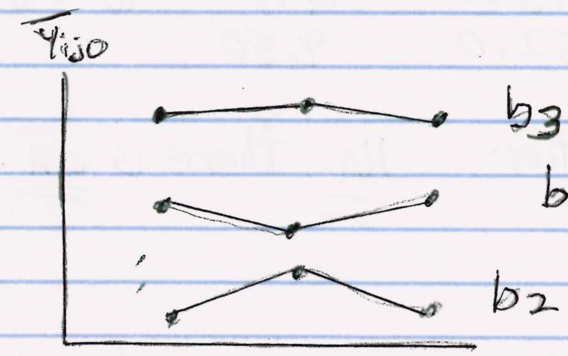
11] Could do a 1way Anova on the ab treatments, but this procedure loses info about A, B and the AB interaction.

p217

12] * Interaction Plot for two way Anova:

put the factor with the most levels on the horiz axis. For each level of the other factor, connect $\overline{Y}_{ij0}$ with line segments

ex]

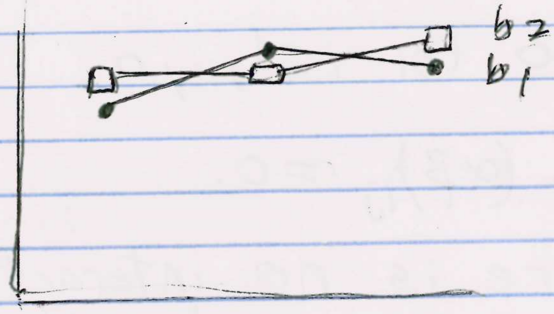


use line segments to join means with the same B level

13] If there is no interaction, the "curves" will be roughly parallel.
For small $m \equiv n_{ij}$, "not crossing" may be adequate. "Crossing curves" suggests interaction unless the 2 curves are

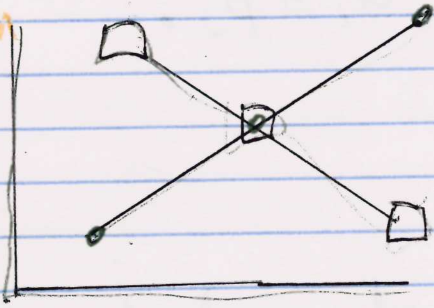
nearly the same. The interaction plot is useful if the conclusions for the plot agree with those for the F test for no interaction.

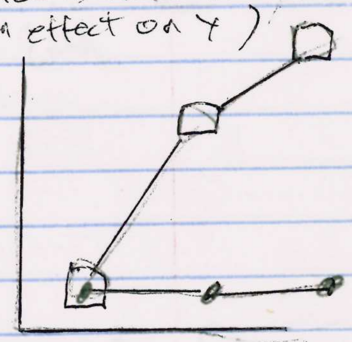
Software "fills space" so won't look like this plot. So need to look at the values on the y axis.

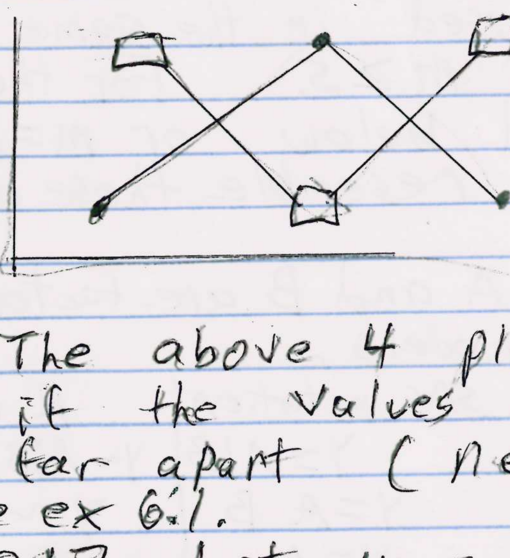


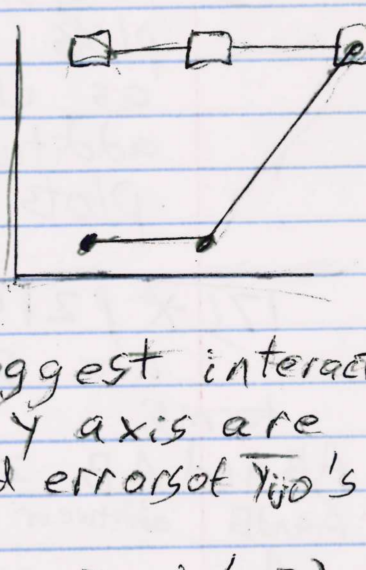
If levels b_1 and b_2 give $\approx$ the same mean response for each level of A, then the curves should be close and may cross, but there is no interaction (and the 2 levels have $\approx$ the same mean effect on Y)

interaction but tests for main effects may fail to reject Ho









The above 4 plots suggest interaction if the values on the Y axis are far apart (need std errors of $\bar{Y}_{ij0}$'s). see ex 6.1.

14) p 217 Let $\mu_{ij} = \mu_{00} + \alpha_i + \beta_j + (\alpha\beta)_{ij}$.

The A main effects $\alpha_i = \mu_{i0} - \mu_{00}$

B $\beta_j = \mu_{0j} - \mu_{00}$.

over parameterized model $\sum_i \alpha_i = 0 \quad \sum_j \beta_j = 0$ The interaction parameters $(\alpha\beta)_{ij} = \mu_{ij} - \mu_{i0} - \mu_{0j} + \mu_{00}$

$\sum_i (\alpha\beta)_{ij} = 0$ for $j = 1, \ldots, b$

$\sum_j (\alpha\beta)_{ij} = 0$ for $i = 1, \ldots, a$.

so $\sum_i \sum_j (\alpha\beta)_{ij} = 0$.

15) If there is no interaction, all $(\alpha\beta)_{ij} = 0$ and the factor effects are additive:

$$\mu_{ij} = \mu_{00} + \alpha_i + \beta_j.$$

16) Response, residual, and transformation plots are used in the same way as ch 5 if $m \geq 5$. For the additive model below or $m = 1$, the plots often resemble those of MLR.

17) * p 214 If A and B are factors, there are several models.

terms:	model	SAS notation	R notation
i) A, B and AB	2 way Anova	Y = A|B	Y ~ A:B or Y ~ A+B+A*B
ii) A and B	additive or main effects	Y = A B	Y ~ A + B
iii) A	one way for A	Y = A	Y ~ A
iv) B	one way for B	Y = B	Y ~ B
v) none	null	?	Y ~ 1

one

For the null model, the Y_{ijk} are iid and $\bar{Y}_{000} = \hat{\mu}_{00}$.