Fitting ii) makes sense if we fail to reject H_0: no interaction.

18] If $m=1$, no MSE df, so assume no interaction and set $MSE = MSAB$. Check that response and residual plots are linear with roughly constant variance

§ 6.2

19] K way Anova models have K factors $A_1, \ldots, A_K$ with l_i levels for $i=1,\ldots,K$. Factorial crossing is used! There are $l_1 l_2 \cdots l_K$ treatments. Randomly assign m units per trt (or take random samples of size m).

20] Partial Anova F table eg

factors A, B, ..., L

Source	df	SS	MS	F	pval
K main effects		SS_A	MS_A	F_A	P_A
$\binom{K}{2}$ 2 factor interactions		SS_{AB}	MS_{AB}	F_{AB}	P_{AB}
$\binom{K}{3}$ 3 factor interactions		SS_{ABC}	MS_{ABC}	F_{ABC}	P_{ABC}
⋮					
$\binom{K}{K-1}$ K-1 factor int's					
1 K factor interaction		$SS_{A \cdots L}$ (A…K)	$MS_{A \cdots L}$ (A…K)	$F_{A \cdots L}$ (A…K)	$P_{A \cdots L}$ (A…K)
error		SSE	MSE		

21] Full model includes all K main effects and all $\binom{K}{2}$ 2 way interactions m

22] Sample size $n = 2\prod_{i=1}^{k} l_i$ is

if m=2

minimized by taking $l_i \equiv 2$. see §8.1

23] Rule of thumb Significant interactions tend to involve significant main effects. (keep main effects corresponding to signif int's)

§7.1

1] p.227 A block is a group of k similar or homogenous units. For each of the b blocks, randomly assign the k units to the k treatments.

2] A randomized block design places a constraint on the randomization and can outperform the fixed effects 1 way Anova model.

	trt	1	2		k
k b units		b	b	...	b

m=b

1 way Anova takes kb units and randomly assigns b units to each trt by taking a single random permutation of $1, \dots, kb$

		A				
		1	2	...	k	
block	1	1	1	...	1	← randomize
	2	1	1		1	← randomize
	⋮	⋮	⋮	...	⋮	⋮
	b	1	1	...	1	← randomize
					b units per trt	

The block design uses b random permutations of $1, \dots, k$ to assign units to levels of A = trt's.

3) Know for final, Q10 P229 Anova F test

for the completely randomized block design (CRBD): Factor A has k levels and there are b blocks so kb units.

i) H_0 $\mu_1 = \cdots = \mu_k$ H_A not H_0
ii) F_0 } from output
iii) pval }

same as fixed effects 1way Anova but table is different

iv) If pval $< \delta$ reject H_0, conclude the mean response depends on the level of A.
If pval $\geq \delta$ fail to reject H_0, conclude the mean response does not depend on the level of A

4) Know Anova table for CRBD

Source	df	SS	MS	F	pval
blocks	$b-1$	SSB	MSB	"F_{block}"	"P_{block}"
Treatment	$k-1$	SSTR	MSTR	$F_0 = \frac{MSTR}{MSE}$	pval $= P(F_{k-1,(k-1)(b-1)} > F_0)$
error	$(k-1)(b-1)$	SSE	MSE		

5) P229 Know for final, Q10 Rule of thumb! If $P_{block} \geq 0.1$, blocking was not useful.
If $.05 \leq P_{block} < 0.1$, the usefulness was borderline.
If $P_{block} < .05$, blocking was useful.

ex] 4 specimens of metal are blocks
response = hardness reading
4 types of tips = factor levels = trts
factor = tip type

Source	df	SS	MS	F	pval
blocks	3	82.5	27.50	30.89	0.0000
trt	3	38.5	12.83	14.44	0.0009
error	9	8.0	0.89		

a) Do the test.

i) H_0 $\mu_1 = \cdots = \mu_4$ H_A not H_0

ii) $F_0 = 14.44$

iii) pval = 0.0009

iv) reject H_0, mean hardness depends on tip

b) Was blocking useful?

soln yes, $p_{block} = 0.0000 < 0.05$

6) Since $m \equiv 1$, response, residual and transformation plots look like those for MLR.

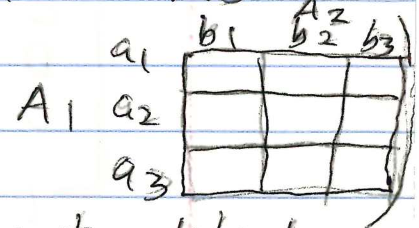
7] * p234 The 3 basic principles of DOE are

i) Use <u>randomization</u> to assign units to trts.

ii) Use <u>factorial crossing</u> to compare 2 or more factors and their interactions in the same expt: if $A_1, \ldots, A_J$ are factors with

l_i levels, then there are $\underbrace{l_1}_{A_1} \underbrace{l_2}_{A_2} \cdots \underbrace{l_J}_{A_J}$ treatments where a treatment has one level from each factor

(cross the factors to make 9 trts →



iii) __Blocking__: Divide units into blocks of similar homogeneous units. Within each block, randomly assign units to treatments. "Similar" means units are likely to have similar values of the response.

8] Randomization, factorial crossing and blocking can be used to create many DOE models.

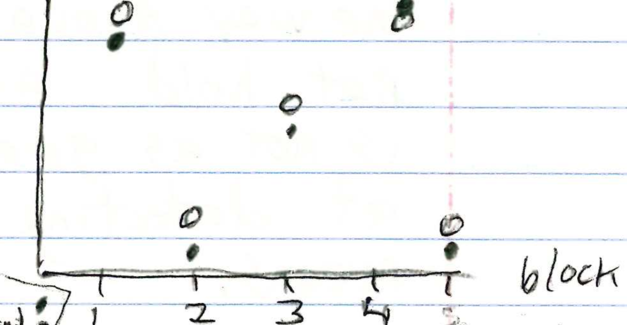
9] * p229 The block response scatterplot plots blocks vs the response. The plot will have b dot plots of size k with symbols corresponding to treatments. Dot plots with clearly different means suggest that blocking was useful. A symbol pattern within the blocks suggests that the response depends on the factor.

ex shoe wear on 5 year olds

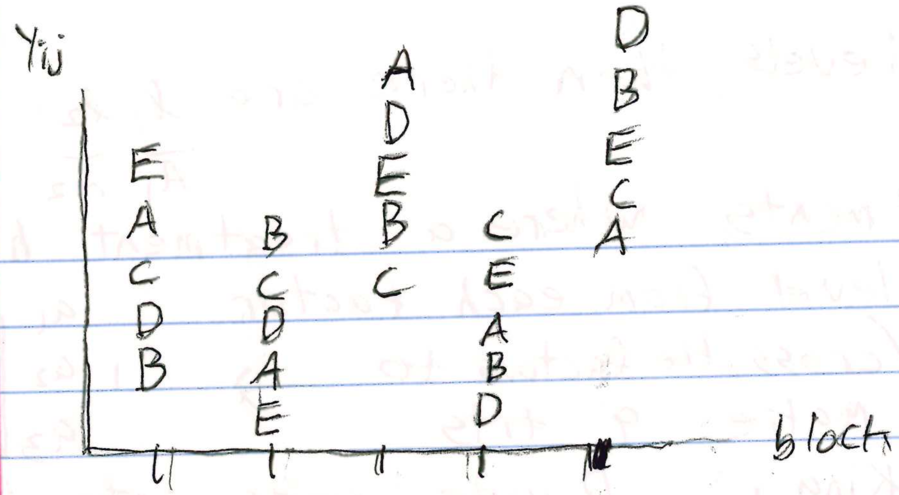
The dot plots differ and o is usually higher than •.

A block is a 5 year old.

2 units left and right foot. trt = brand •, o



ex]



Here blocks seem useful but there is no apparent symbol pattern: eg don't always have A and B highest and C and E lowest.

See ex 7.3 where A is usually highest. In this ex., there may be a block treatment interaction, which is not allowed in a CRBD.

10] If blocking is not useful, one way Anova MSE df = k−1, n−k compared to CRBD MSE df = k−1, (k−1)(b−1) where (k−1)(b−1) = n−k−b+1. So CRBD loses b−1 denominator df.

If the block dot plots vary, then the one way Anova model assumptions do not hold and the one way Anova F design is not as good as the CRBD design at detecting significantly different means.