

Week 12 Tuesday
 Please note: Due date change for HW on Latin Square and Graeco-Latin Square.
 Due Nov. 17 (not Nov. 12 as was on webpage).

Nov 8-2:51 PM

For Blocking, experimental units/conditions vary more between blocks than within blocks. $\sigma^2_{\text{Between block}} \gg \sigma^2_{\text{Within block}}$
 Better to cross a factor with Block to control variation.

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For whole plots + split plots
 $\sigma^2_{\text{whole plot}} \gg \sigma^2_{\text{split plot}}$.
 Crossing is better than nesting factors with plots.
 Experimental constraints limit possibilities.

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Box example: Layout

	Temp					
Run	1	2	3	4	5	6
1	x	x	x	x	x	x
2	x	x	x	x	x	x
3	x	x	x	x	x	x
4	x	x	x	x	x	x

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T_i = temperature
 P_{ij} = whole plot or run within temperature
 C_k = Coatings
 $Y_{ijk} = \mu + T_i + P_{ij} + C_k + TC_{ik} + CP_{ij} + C_k + TC_{ik} + CP_{ij} + \epsilon_{ijk}$
 whole plot terms
 split plot terms

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Source	df	EMS
T_i	2	$4\sigma_p^2 + 8\phi_T$
P_{ij}	3	$4\sigma_p^2$
C_k	3	$\sigma_{cp}^2 + 6\phi_c$
TC_{ik}	6	$\sigma_{cp}^2 + 2\phi_{TC}$
$CP_{ij} + C_k + TC_{ik} + CP_{ij}$	9	σ_{cp}^2
		24-1=23

whole plot terms
 split plot terms

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Number 1 mistake made is to run the analysis like a CRD, they do this by ignoring plot. Incorrect layout is

		Temp		
		360	370	380
C o n d i t i o n	1	x x	x x	x x
	2	x x	x x	x x
	3	x x	x x	x x
	4	x x	x x	x x

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Analysis:

Source	df	EMS
T_i	2	$\sigma_e^2 + 8\phi_T$
C_j	3	$\sigma_e^2 + 6\phi_C$
TC_{ij}	6	$\sigma_e^2 + 2\phi_{TC}$
error	12	σ_e^2

$P_{iij} + CP_{iijc}$
in right model.

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Since our "incorrect" MSE is weighted average of the $MS_p + MS_{cp}$, this error term is too small or too large for our F-tests.

F-tests	Correct model	incorrect model
T:	MS_T / MS_p	MS_T / MSE $F \uparrow P \downarrow$
C:	MS_C / MS_{cp}	MS_C / MSE $F \downarrow P \uparrow$
TC:	MS_{TC} / MS_{cp}	MS_{TC} / MSE $F \downarrow P \uparrow$

$MS_p > MSE > MS_{cp}$
 \uparrow

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Incorrect analysis obscures our results. Suppose ran 2 bars at each temperature without reheating the oven. Joe Blow does this.

Joe's layout

		Temp						
		360		370		380		
Bar	Cost	1	x	x	x	x	x	x
		2	x	x	x	x	x	x
		3	x	x	x	x	x	x
		4	x	x	x	x	x	x

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Layout looks ok, same model

T_i
 $B_{(i)j}$
 C_k
 TC_{ik}
 $CB_{(ij)k}$

What is the embedded problem in design?
 Hint:
 Confounding

Nov 8-3:48 PM

Dr. Tom Knows there is an effect due to "run". Even if Temp is set at 360° for each run, there is "run-to-run" variation.



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Original expt.

① Select Temp, select bar, heat, then measure

② Select Temp, select bar etc.

Each Temp was run twice.
 2 runs / Temp

Nov 8-3:55 PM

Joe's experiment:

Select Temp, 2 bars, heat a measure

⇒ Run + Temp are confounded.

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Is another design better?
 Try a CRD, run correctly.

Select temp x coating combination + run all 24 samples.

Source	df	Problems
T:	2	4x as long
C _j :	3	too big,
TC _{ij} :	6	does not control
E _{(ij)k} :	12	p-p variation

Nov 8-3:59 PM

If double # bars,

		360				370				380			
		1	2	3	4	5	6	7	8	9	10	11	12
Plot	1	x											
	2	x											
	3	x											
	4	x											

Nov 8-4:05 PM

Source	df
$\sum T_i$	2
$P_{(i,j)}$	9
$\sum K$	3
$\sum TC_{ik}$	6 ←
$CP_{(i,j)k}$	27
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	$48 - 1 = 47$

Nov 8-4:07 PM