Statistics 5301 — Final Exam Sketched Solutions
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1a) We have two treatments (gender mixes). We need to block on grade and teacher. We can use 12 classes. If we use all 6 teachers (with each teacher doing one class of each grade), we can do a replicated Latin square. Let grades be rows and teachers be columns. Assign treatments to units at random subject to each treatment occurs one in each column and three times in each row.

An alternative might be to use three teachers, with each teacher doing four classes, two from each grade. Then randomly assign treatments to the two classes in each teacher/grade combination. This would be a randomized complete block with the teacher/grade combinations as blocks.

1b) Alcohol consumption is the treatment. We need to block by body weight. I would measure the body weights as they come in, order them by body weight, and group them into 25 groups of 4 (4 smallest, next for smallest, etc). Then I would randomly assign the four treatments to the subjects in each block. This is a randomized complete block design.

If I could not get the body weights till later (seems unlikely), I would do a completely randomized design and use body weight as a covariate.

1c) You have $2^7 = 128$ possible combinations, but only $8 = 48/6$ possible runs. A fractional factorial seems best. We can do a 2^{7-4}_{III} design. This will allow us to compute main effects. Label the factors A-G. Set D=AB, E=AC, F=BC, and G=ABC.

	Base factors			Additional factors				levls used
	A	B	C	D=AB	E=AC	F=BC	G=ABC	
(1)	-1	-1	-1	1	1	1	-1	def
a	1	-1	-1	-1	-1	1	1	afg
b	-1	1	-1	-1	1	-1	1	beg
ab	1	1	-1	1	-1	-1	-1	abd
c	-1	-1	1	1	-1	-1	1	cdg
ac	1	-1	1	-1	1	-1	-1	ace
bc	-1	1	1	-1	-1	1	-1	bcf
abc	1	1	1	1	1	1	1	abcdefg

2a) This is an analysis of covariance. There are 12 units. Granule size is the treatment. Initial moisture content is the covariate.

source	df
moisture	1
size	1
error	9

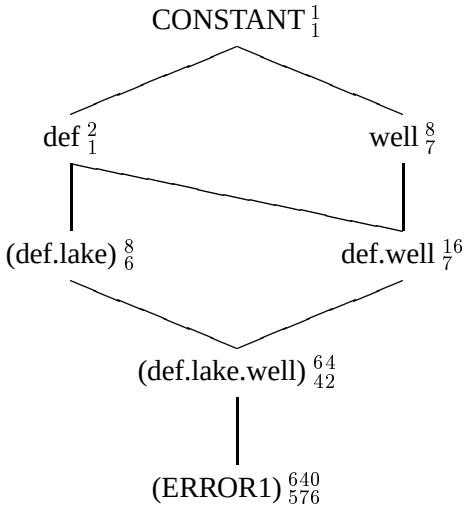
2b) This is a cross over design (replicated Latin square). The blocking factors are subject (the 20 women) and time (the first and second two-month time periods). The experimenters carefully balanced so that an equal number of each treatment occurred at each time, so they were probably worried about systematic differences between the first two months and the second two months. Treatments are the two types of perspiration. Response is the average menstrual cycle length for the 40 two-month time periods.

source	df
subject	19
time	1
treatment	1
error	18

2c) This is a split plot design. The 8 "shooting/developing" cycles are the whole plots. The individual frames are the split plots. The brand/speed combinations are the whole plot treatments. The lenses are the split plot treatments. There is no blocking at the whole plot level.

source	df
brand	1
speed	1
brand.speed	1
Whole plot error	4
lens	2
brand.lens	2
speed.lens	2
brand.speed.lens	2
Split plot error	8

3) The error term (denominator) for well is lake by well (nested in deformity status).



4) The blocks are

+,+	+,-	-,+	-,-
ab	(1)	b	a
c	abc	ac	bc
d	abd	ad	bd
abcd	cd	bcd	acd

	A	B	C	D	AB	BCD
(1)	-1	-1	-1	-1	1	-1
a	1	-1	-1	-1	-1	-1
b	-1	1	-1	-1	-1	1
ab	1	1	-1	-1	1	1
c	-1	-1	1	-1	1	1
ac	1	-1	1	-1	-1	1
bc	-1	1	1	-1	-1	-1
abc	1	1	1	-1	1	-1
d	-1	-1	-1	1	1	1
ad	1	-1	-1	1	-1	1
bd	-1	1	-1	1	-1	-1
abd	1	1	-1	1	1	-1
cd	-1	-1	1	1	1	-1
acd	1	-1	1	1	-1	-1
bcd	-1	1	1	1	-1	1
abcd	1	1	1	1	1	1