Name: _____
ID: _____

Stat 421, Test 2, Fall, Nov. 15, 2017; Marzban

7.5+16

ONLY a half-size "cheat sheet" is allowed

Multiple choice: Circle all the correct answers; there is wrong-answer penalty

For rest, SHOW answer & work; NO CREDIT for correct answer without explanation

Points

1 **1.** Suppose the **true model** for a certain problem is known to be $y_{ij} = \mu + \tau_i + \beta_j + \epsilon_{ij}\, i = 1 \cdots a, j = 1 \cdots b$, where τ_i is the treatment effect, and β_j is the block effect. Then $E[\sum_j (\overline{y_{.j}} - \overline{y_{..}})^2]$ is proportional to

a) 0 b) σ_ϵ^2 c) none of the above.

1 **2.** In an RCBD involving one treatment and one block factor, the predicted response (or the fitted value) depends on (or varies with)

a) The level of the treatment factor
b) The level of the block factor
c) Both a and b
d) none of the above

1 **3.** Suppose we are interested in performing a 1-sided test of whether a specific contrast is greater than zero. The most appropriate test(s) is/are

a) t-test b) chi-squared test c) F test

1 **4.** In a replicated factorial design involving 3 treatments A, B, C, which of the following is true?

a) An F-test of A effect cannot be performed, if there exists an AB interaction term in the model.
b) An F-test of A effect cannot be performed, if there exists an ABC interaction term in the model.
c) An F-test of ABC effect cannot be performed.
d) None of the above.

1.5 **5.** We have two treatment factors A, B, and two block factors C, D, respectively with 3, 3, 9, and 9 levels. Possible models/designs are

a) lm(y ~ A + B + C + D) on $3 \times 3 \times 9 \times 9$ runs from a factorial design.
b) lm(y ~ A * B * C * D) on $3 \times 3 \times 9 \times 9 \times n$ runs from a replicated factorial design.
c) lm(y ~ A + B + C + D) on 9×9 runs from an LSD, with A and B combined into a 9-level factor.
d) lm(y ~ E + C + D) on 9×9 runs from an LSD, with E defined as a 9-level factor combining A and B.

1 **6.** In a 2^3 design, involving factors A, B, and C. Which statement is FALSE?

a) In a model without an ABC interaction, the numerical estimate of the A effect will not depend on abc sum of $y's$.
b) In a model without an ABC interaction, the numerical estimate of the A effect will be equal to that from a model with ABC interaction.
c) In a model without a BC interaction, the numerical estimate of the A effect will be equal to that from a model with BC interaction.
d) None of the above.

1 **7.** In 2^k, if there are only two blocks, then it's natural to confound _____ with the block effect

a) a main effect b) a 2-way interaction c) the highest-order interaction d) None of the above.

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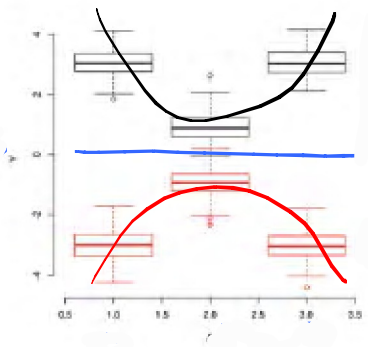
8. Consider a problem involving a response Y observed at each of 3 levels of factor A. The data are shown in the adjacent figure. The black (red) boxplot denotes the data collected on day 1 (2).



1 **a)** Without doing any tests (i.e., based on the figure only), is factor A useful? Explain in 1 sentence.

1 **b)** If you run a test of $\alpha_i = 0$ in the model $y_{ij} = \mu + \alpha_i + \epsilon_{ij}$ what kind of p-value would you expect? Circle: Small Large

1.5 **c)** If you run a test of $\alpha_i = 0$ in the model $y_{ijk} = \mu + \alpha_i + \beta_j + \epsilon_{ijk}$ with β corresponding to the Day factor, what kind of p-value would you expect? Circle: Small Large

1 **d)** If you run a test of $(\alpha\beta)_{ij} = 0$ in the model $y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \epsilon_{ijk}$, what kind of p-value would you expect? Circle: Small Large

2013/11 & lect-hw12_4

~2 **9.** The following values of the response have been observed in a Standard LSD. Compute $SS_{treatment}$. Hint: recall there is a "quick" way and a "long" way.

1.5

	B_1	B_2	B_3
A_1	+1	−1	−1
A_2	0	−1	0
A_3	−1	+2	+1

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10. Consider the model $y_{ijk} = (\alpha\beta)_{ij} + \epsilon_{ijk}$, $i = 1-a, j = 1-b, k = 1-n$.

~2 a) **Starting from the expression for SSE**, find the least-squares equations, and estimate the interaction term.

1

~1 b) How many independent parameters does this model have, and which are they?

~1 2 c) How many independent least-squares equations are there for this problem?

~1 d) How may constraints are necessary?

hw-section-1

~2 **11.** For the model $y_{ij} = \mu + \alpha_i + \beta_j + \epsilon_{ij}$, the estimated SSE is $\sum_{ij}(y_{ij} - \overline{y_{i.}} - \overline{y_{.j}} + \overline{y_{..}})^2$. Similarly, for the model $y_{ij} = \mu + \alpha_i + \epsilon_{ij}$, the estimated SSE is $\sum_{ij}(y_{ij} - \overline{y_{i.}})^2$. Show that the difference between these two SSE's is related to the SS of another effect; what is that effect?

~2 lect15/magic

12. In a 2^4 design involving factros A, B, C, D, what is the contrast vector for the AB effect, in the Yates order (i.e., A changes fastest).

~2 lect16/p4 1.5

13. In 2^k design with n replications, every individual effect can be tested with a t-test. If there are p terms in the model (including μ, but excluding ϵ), what is the df of that test (i.e., the df of SSE)? Show work.

~2 lect17/p.8

14. A scientist who does not know much about experimental design performed the 8 runs in a 2^3 design in the following 4 blocks: $[(1), a], [b, ab], [c, ac], [bc, abc]$. Which effects are going to be confounded with block? Show work.

~2 1.5

15. Consider a 2^4 design performed in 8 blocks. What is the **total** number of effects that will be confounded with blocks? Show work.