

Homework set 10

Problems to be discussed at next week's tutorial: Quiz 10; 181, 182, 193.

1. Which one of the following experimental layouts is most likely to have arisen from a randomised block design, with rows corresponding to blocks?

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2. The following ANOVA table was obtained in a study of five treatments in which seven researchers used each treatment exactly once.

Source	df	SS	MS	F
Treatments T	4	30.0	7.5	6.25
Researchers R	6	23.4	3.9	3.25
Error	24	28.8	1.2	

If $^{ns} = (p > 0.05)$; $* = (0.01 < p \leq 0.05)$; $** = (p \leq 0.01)$, the results of testing for the significance of the treatment (T) and researcher (R) effects, respectively, are best described as

[A.] T** R*; [B.] T* R*; [C.] T* R^{ns}; [D.] T* R**; [E.] T** R**

3. In an experiment to study two factors, factor A with 4 levels and factor B with 3 levels, two observations were taken at each of the 12 combinations of the two factors. If the test for interaction is significant at the 5% level, which one of the following statements may not be true if the interaction is significant?

- [A.] The value of F for testing the interaction is greater than 2.5.
 [B.] Factors A and B both have an effect.
 [C.] Changes between the levels of factor A differ for different levels of factor B.
 [D.] The lines in the 'interaction diagram' are not parallel.
 [E.] The F-tests for A and B are both statistically significant.

4. Which one of the following statements, which relate to a randomised block design, is true?

- [A.] The appropriate analysis for a randomised block design is one-way ANOVA.
 [B.] The degrees of freedom for treatments is reduced if blocking is used.
 [C.] The aim of blocking is to decrease the error variance.
 [D.] The error mean square is necessarily smaller with blocking than without blocking.
 [E.] The plots within the blocks should be as heterogeneous (dissimilar) as possible.

5. A 4×4 Latin square experiment is carried out, with two observations in each cell. The number of degrees of freedom for the error MS is

[A.] 12; [B.] 18; [C.] 20; [D.] 22; [E.] 25; [F.] 31.

6. An engineer is interested in the effect of cutting speed and tool geometry on the life in hours of a machine tool. Two cutting speeds and two different geometries are used. Three experimental tests are done at each of the four combinations:

	low speed	high speed
geometry #1	34.0, 32.7, 29.4	38.5, 40.3, 41.4
geometry #2	26.4, 23.9, 24.2	40.3, 39.8, 37.8

- (a) Using MATLAB, or otherwise, obtain an analysis of variance table to test main effects and interaction.
 (b) Show that interaction is significant and produce a plot that displays the interaction.
 (c) Estimate the effect of cutting speed for tool geometry #2; and give a 95% confidence interval for this effect.

Quiz 10

Questions 10.1 and 10.2 refer to the following information:

The ANOVA below was obtained for a randomized block design experiment:

Source	DF	SS	MS	F	P
block	5	31.6	6.32	7.26	0.001
treatment	3	35.6	11.87	13.64	0.000
error	15	13.0	0.87		
Total	23	80.2			

Q10.1 A 95% confidence interval for the difference between two of the treatment means could be:

- A. (2.35, 3.50)
- B. (3.12, 5.01)
- C. (1.48, 3.62)
- D. (2.87, 5.17)
- E. (3.06, 5.87)

Q10.2 If the same data had been analysed assuming a completely randomized design, then the error mean square would have been:

- A. 0.87
- B. 0.93
- C. 2.23
- D. 2.70
- E. 7.19

Q10.3 Each of the 2×2 tables below shows the means from an experiment involving two factors, P and Q, each with two levels (0 and 1). Which one of the tables indicates the greatest interaction between the two factors?

A.

	Q0	Q1
P0	14	12
P1	20	16

B.

	Q0	Q1
P0	10	14
P1	16	20

C.

	Q0	Q1
P0	14	14
P1	14	10

D.

	Q0	Q1
P0	10	14
P1	20	18

E.

	Q0	Q1
P0	10	12
P1	12	24

Questions 10.4 and 10.5 refer to the following information:

An experiment was conducted which involved two treatment factors C and D in a two-factor factorial experiment. The following ANOVA table arose from analysing the response variable (a few entries are missing):

Source	DF	SS	MS	F	P
C			307.18	93.53	0.000
D		157.60	78.80	23.99	0.000
Intn	8	15.23	1.90	0.58	0.789
Error	45	147.79	3.28		
Total	59				

Q10.4 Which one of the following statements is correct?

- A. The interaction is not significant, so an additive model is appropriate.
- B. The interaction is not significant, so a non-additive model is appropriate.
- C. The interaction is significant, so an additive model is appropriate.
- D. The interaction is significant, so a non-additive model is appropriate.
- E. The interaction is not significant, so the main effects are not significant either.

Q10.5 The number of levels of factors C and D used in the experiment, and the number of replicates of each factor combination, were:

- A. 4 levels of factor C, 2 levels of factor D, 8 replicates.
- B. 5 levels of factor C, 2 levels of factor D, 6 replicates.
- C. 9 levels of factor C, 2 levels of factor D, 3 replicates.
- D. 5 levels of factor C, 3 levels of factor D, 4 replicates.
- E. 5 levels of factor C, 4 levels of factor D, 3 replicates.