MAS353 Experimental Design

Mid-Semester Test

2004-5

SURNAME:

OTHER NAMES:

STUDENT NUMBER:

This test counts for 10% of the assessment of this module.

Section A consists of a series of short questions, in most cases requiring a word or a short sentence in answer. Marks available for each question are shown and total 30. Section B has a single question worth 20 marks.

Write your answers in the spaces provided. You may use the backs of sheets for rough work. You may use your own statistical tables.

Attempt all questions.

NOTES and TEXTBOOKS, other than statistical tables, are not allowed.

1. (a) What is the difference between an observational study and a planned experiment?

(2 marks)

(b) Give an advantage of a planned experiment over an observational study.

(2 marks)

2. (a) What procedure should always be used when allocating treatments to experimental units?

(2 marks)

(b) Give two advantages of using this procedure.

(2 marks)

3. A randomised blocks design is used with 4 treatments and 3 blocks.

(a) How many residual degrees of freedom are there?

(2 marks)

(b) Write down a model for the analysis of data from this design, explaining the terms used.

(3 marks)

Model:

Explanation of notation:

(c) Specify constraints to be placed on the parameters representing treatment and block effects in a randomised blocks design.

(2 marks)

(d) What assumptions are made about the errors, ε, in the model?

(2 marks)

(e) Write down X^T, the transpose of a suitable design matrix X for a randomised blocks experiment with 4 treatments and 3 blocks. Explain which rows of X^T correspond to the treatment effects and which to the block effects. Assume for the purpose of this exercise that the treatments come in the same order in each block.

(6 marks)

4. (a) Write down a model for analysis of data from a 4×4 Latin square design, explaining the terms used.

(3 marks)

Model:

Explanation of notation:

(b) How many degrees of freedom are there for the residual sum of squares in a 4×4 Latin square design?

(2 marks)

(c) Give a possible difficulty in the use of Latin square designs.

(2 marks)

5. A randomised blocks design has 4 treatments and 5 blocks. The total *corrected* sum of squares is 2513.82. The treatment totals are A:197.3, B:147.9, C:240.1, D:240.7. The between-blocks sum of squares is 1113.965.

(a) Complete the ANOVA table.

(6 marks)

Source of variation	Degrees of freedom	Sum of squares	Mean square	Variance ratio
Between treatments				
Between blocks				
Residual				
Total				

(b) State the result of testing the null hypothesis of no differences among treatments.

(2 marks)

(c) Comment on the effectiveness of blocking.

(2 marks)

(d) Calculate the Studentised range yardstick, R, for comparing treatments at the 5% level.

(2 marks)

(e) Identify all pairs of treatments whose means differ by more than the above yardstick.

(2 marks)

(f) Write down a suitable set of coefficients for a contrast which compares treatments A and C with treatments B and D.

(2 marks)

(g) Calculate the sum of squares for this contrast and test its significance.

(4 marks)