Design of Experiments: Chapter 2

1 KEY CONCEPTS

- Construction of a statistical linear model for a simple comparative experiment;

- Invariance to reparameterisation of the fitted values of the model;

- Use of ANOVA and F-test to investigate if all model parameters are zero;

- Perform multiple comparisions using T, Bonferroni and Tukey tests;

- Construction and estimation of a linear model including a blocking term;

- Use of ANOVA for linear models with a blocking term;

- Multiple comparisons in the presence of a blocking term;

- Theory of balanced incomplete block designs.

2 EXERCISES

- The bioactivity of four different drugs A, B, C, D for treating a particular illness was compared in a study and the following ANOVA table was given for the data:

Source	DF	Sum of Squares	Mean Square
Treatment	3	64.42	21.47
Residual	26	62.12	2.39
Total	29	126.54	

  1. Use an F test to test at the 0.05 level the null hypothesis that the four treatments have the same bioactivity.

2. The treatment averages are as follows: $\bar{y}_A = 66.10$ (7 samples), $\bar{y}_B = 65.75$ (8 samples), $\bar{y}_C = 62.63$ (9 samples), $\bar{y}_D = 63.85$ (6 samples). Use the Tukey and the Bonferroni method to perform multiple comparisons of the four treatments at the 0.05 level.

- The entries of the following ANOVA table were determined from some data collected according to a block design with three blocks:

Source	DF	Sum of Squares	Mean Square
Block		520	
Treatment		498	
Residual		40	
Total	14		

The treatment averages were 45, 58, 46, 44, 45 for five different treatments.

1. Complete the above ANOVA table (Are any entries impossible to determine with the information given? Explain if so)

2. Use the Tukey method to compare the five treatment means at level 0.01. Report only those pairs that are found to be significantly different.

- Five different perfume brands are judged in a competition by ten judges, where each judge can only evaluate three perfumes. Assume the judge is a block factor of the design.

  – What are the values of p (number of treatments), b (number of blocks) and k (block size)?

  – Can a balanced incomplete block design be used in this situation? If so deduce the values of λ and r.

  – Allocate treatments to blocks so that the resulting scheme is a balanced incomplete block design.