QUEEN MARY, UNIVERSITY OF LONDON

MAS 314 Design of Experiments

Key Objectives Spring 2007

General Given a proposal for an experiment, be able to ask pertinent questions about the aims of the experiment, the treatments and their structure, the plots and any blocks, replication, data recording, costs, resources. Understand the most appropriate designs for experiments on people and animals. Be able to present an experimental plan in a form suitable for the experimenter. Understand why factorial experiments are better than one-factor-at-a-time experiments.

Factorial treatments Understand what is meant by the *interaction* between two or more treatment factors, and be able to interpret it to a non-statistician. Be able to decompose the treatment degrees of freedom (both by hand and in Genstat) for complete factorial structures with equal replication and for the structure with two crossed factors plus a control.

Orthogonal designs For a wide range of orthogonal designs, be able to:

- draw the Hasse diagram for the block factors;
- hence calculate degrees of freedom and the null anova table;
- draw the Hasse diagram for the treatment factors;
- hence calculate treatment degrees of freedom;
- construct a suitable design, either systematically or by using one of the methods below;
- randomize the design;
- allocate treatment subspaces to strata and hence calculate the skeleton anova table;
- analyse data from the designed experiment, both by hand and in Genstat.

Latin squares Be able to construct Latin squares of any size, and a pair of orthogonal Latin squares of side n, where n is a prime number or $n = 4$ or $n = 9$. Be able to use these to construct fractional factorial designs and lattice designs.

Factorial designs Be able to construct factorial designs for experiments in blocks or split plots or fractions, using Latin squares or the method of characters.

Incomplete block designs Understand the meaning and importance of *balance*, *resolvability* and *efficiency*. Be able to construct balanced incomplete block designs by using all subsets, by using perfect difference sets, by taking enough replicates of a lattice design, and by adding an extra block to a balanced lattice design. Be able to construct lattice designs in which every concurrence is equal to 0 or 1. Know the formula for efficiency factors for balanced incomplete block designs and for lattice designs.

The examination will contain TWO questions in Part A and FOUR questions in Part B. The rubric will be as follows.

> *The paper has two Sections and you should attempt both Sections. Please read carefully the instructions given at the beginning of each Section.*
>
> *Calculators ARE permitted in this examination. The unauthorized use of material stored in pre-programmable memory constitutes an examination offence. Please state on your answer book the name and type of machine used.*
>
> *The New Cambridge Elementary Statistical Tables to be provided.*

The rubric to Section A will be as follows.

> **Section A: Each question carries 25 marks. You should attempt BOTH questions.**

The rubric to Section B will be as follows.

> **Section B: Each question carries 25 marks. You may attempt all questions. Except for the award of a bare pass, only marks for the best TWO questions will be counted.**

R. A. Bailey
7 March 2007