

QUEEN MARY, UNIVERSITY OF LONDON

MAS 314

Design of Experiments

Assignment 9

For discussion on 13 March 2007

1 The following extract is taken from *Manual of Crop Experimentation* by Pearce, Clarke, Dyke and Kempson. Calculate the analysis of variance table, the means for the two main effects, the standard error of a difference between two varieties, and the standard error of the difference between two cutting schemes.

An example from *Statistical Methods* by G. W. Snedecor and W. G. Cochran (1967, p. 370) used three varieties of alfalfa (lucerne) on the main-plots in six randomized blocks. Each of the main plots was divided into four sub-plots, the sub-plots treatments being four cutting schemes. All sub-plots were cut twice: the second cut took place on 27th July. (The data of the first are not given.) Some of the plots received a further cut as follows: B, 1st September; C, 20th September; D, 7th October, but A was not cut further. The yields in tons per acre for the following year are set out below.

Variety	Cutting	Block					
		I	II	III	IV	V	VI
Ladak	A	2.17	1.88	1.62	2.34	1.58	1.66
	B	1.58	1.26	1.22	1.59	1.25	0.94
	C	2.29	1.60	1.67	1.91	1.39	1.12
	D	2.23	2.01	1.82	2.10	1.66	1.10
Cossack	A	2.33	2.01	1.70	1.78	1.42	1.35
	B	1.38	1.30	1.85	1.09	1.13	1.06
	C	1.86	1.70	1.81	1.54	1.67	0.88
	D	2.27	1.81	2.01	1.40	1.31	1.06
Ranger	A	1.75	1.95	2.13	1.78	1.31	1.30
	B	1.52	1.47	1.80	1.37	1.01	1.31
	C	1.55	1.61	1.82	1.56	1.23	1.13
	D	1.56	1.72	1.99	1.55	1.51	1.33

2 A cattle breeder wants to find a way of protecting his cattle against a particular stomach disease. He wants to compare the effects of:

S : spraying the grass in the paddock with a special chemical
 N : no spray

He also wants to compare the effect of

$+$: injecting each animal with a special vaccine
 $-$: no injection

He has several paddocks. Each paddock contains 20 animals, labelled $1, \dots, 20$ with ear-tags. He wants to apply the treatments once. A month later he will assess the amount of stomach disease in each animal by counting the number of a certain type of bacterium in a sample from the stomach contents. The logarithm of this number will be analysed.

He wants to use two paddocks to find out the effect of the spray, using S on one paddock and N on the other. He wants to use another two paddocks to find out the effect of the injection, using $+$ on one paddock and $-$ on the other. He asks you:

Since N and $-$ are both ‘no treatment’, can I just use three paddocks, one for S , one for $+$ and one for ‘no treatment’?

How do you answer?

3 Prove Theorem 5.1.