Brief Communication

A STATISTICAL APPRAISAL OF A SACRED COW

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INTRODUCTION

Some experiments concerned with the effect of a treatment on animals have all the animals on the same treatment run together in one mob. This is done for convenience and to conserve resources. The practice has been encouraged by Conniffe (1976) for a particular type of experiment and is widely adopted in New Zealand. In the situation, experimenters endeavour to ensure that no differences other than treatment differences exist between the mobs, and, on assuming this to be the case, regard the individual animals within the mobs as replicates. That is to say, the effect of treatments is tested for significance by the same method that would be used if the animals had all been run together in one mob. If treatments are applied to replicate mobs, the assumption concerning the differences between mobs can be checked, and if it is found to be doubtful, an analysis treating the mobs as the individual experimental units instead of the animals can be undertaken. It is, however, not possible to test the assumption without resorting to replication. Lack of replication would not matter so much if the assumption was reasonable, but it is easy to find examples where the assumption is inappropriate. The onus is therefore on the experimenter to establish that the assumption is appropriate in his case.

EXAMPLE

The data which are used come from a small part of a trial (N. Cullen, unpublished) which was designed to investigate lamb fattening and stock thrift on swards of three different compositions. Two of the swards were from a high and a low seeding rate of a mixture containing ryegrass. The third sward was from a mixture containing no ryegrass. The trial was laid out in two adjacent and apparently similar blocks, the three swards being present once on each block. Each sward was grazed by 14 ewes with 1 lamb each at foot. The average weight gains of the lambs from the six mobs during 2 months in spring are given in Table 1.

An analysis of variance of the weight gains is given in Table 2. If the *variation between animals within the mobs* is used as the

TABLE 1: AVERAGE WEIGHT GAIN (kg) IN SIX MOBS OF 14 LAMBS WHOSE DAMS WERE GRAZING THREE GRASS TREATMENTS

	Block 1	*Block 2*	*Treatment Mean*
No ryegrass	19.0	18.1	18.6
Low seeding rate with ryegrass	18.1	18.0	18.1
High seeding rate with ryegrass	16.4	18.3	17.3
Block and overall mean	17.8	18.2	18.0

TABLE 2: ANALYSIS OF VARIANCE OF WEIGHT GAIN DATA FROM TABLE 1

Source	*df*	*Sums of Squares*	*Mean Squares*
Blocks	1	1.920	1.920
Treatments	2	21.013	10.507
Residual variation between mobs	2	29.475	14.738
Between animals within mobs	78	231.414	2.967

estimate of error variance, the weight gain of the lambs appears significantly affected by the treatments ($F = 10.507/2.967$). However, when the residual *variation between mobs* is used as the estimate of the error variance, this becomes non-significant ($F = 10.507/14.738$).

The apparent significance when using the within-mob estimate of variance probably arises because no allowance has been made for an important component of experimental error, namely, random differences between mobs and/or treatments. Even if this had not been significant ($F = 14.738/2.967 = 4.97^*$), it could not be concluded that the component is absent.

In this example individual animals were not satisfactory as replicates, and taking them as such leads to very different conclusions than from not doing so. Because the mobs have been replicated, it has been possible to demonstrate how misleading it can be to regard individual animals as replicates.

CONCLUSION

This example, which is by no means an unusual case, demonstrates that it cannot be automatically assumed that animals within a mob provide adequate replication of an experiment when the mobs are the experimental units. Significant differences may well be obtained which appear to be due to treatments or to treatment interactions, but which are actually random differences between mobs, treatments or the effect of the environment. Unless *a priori*

such effects are known to be not operating, the only satisfactory solution to the problem is to run experiments of this type with treatments replicated on distinct mobs of animals, or with sufficient between-mob factorial structure for some high order interactions to be used as conservative estimates of error. If the available resources are such that neither of these two courses of action is possible, then the limitations of the experiment should be explicitly recognized. The problem is not one that can be solved by statistical analysis, but only by the conduct of the experiment.

REFERENCE

Conniffe, D., 1976. *Ir. J. agric. Res., 15*: 39.