REAL TIME SELECTION

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SUMMARY
Selecting animals on measured traits in real time has a number of potential applications in commercial sheep flocks, particularly with the rapid adoption of on-farm measurement. The process of real time selection is shown to be accurate even without prior information. Some example software is described to show how the process can be applied.
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INTRODUCTION
On-farm measurement of phenotypic performance in commercial sheep flocks has rapidly expanded. Body weighing and ultra-sonic scanning of pregnancy and litter size have been available measurements for many years. More recently, on-farm measurement of fibre diameter, as well as coefficient of variation (CV) of diameter, fibre curvature and staple profile, have become possible with the rapid adoption of OFDA and Fleecescan technology. Single trait measurements have been mainly used for only one purpose, such as:

- Body weight to determine optimal sale time of lambs
- Pregnancy scanning to separate non-pregnant ewes from those rearing singles and twins for differential management
- Fibre diameter to allocate fleeces to sale lots

In most cases, the measurements generated have not been used to their maximum extent because it has not been possible or feasible to

- make selection decisions at measurement time, where animals do not have permanent tags
- recall the animal's measurements at a later time, where animals have permanent tags
- use records from multiple traits on farm

In this paper, we identify the simple procedures that can be used to overcome these limitations and the applications for which the data can be used in sheep production systems. Finally, we describe some simple software that allows real-time selection to be used effectively in many situations.

REAL-TIME SELECTION ON A SINGLE TRAIT
Real time selection means making a decision on an animal's destination at the time of measurement. Normally, we allow ourselves the luxury of measuring all animals, making decisions on paper and then going back through the animals to identify those we wish to select/cull or separate into groups for subsequent management. But, provided the selection process is accurate, real time selection avoids a second handling of animals and can be used in situations where animals do not have ear tags. The basic process of real time selection involves converting each animal's measurement into a standardized deviation from the mean of all animals for which records are available (James 2002).

That author looked at a number of real time selection strategies based on prior information or assumptions on the likely mean and distribution of the measured data. He showed that prior knowledge of these parameters was not necessary for effective real time selection. The rate at which the information builds during the measurement process is demonstrated in Table 1. Here we simulated a population measured for fibre diameter, with known mean and standard deviation (sd), and estimated the proportion of replicate populations that reached nominated ranges for the estimated sd and mean at various stages of measurement.

Table 1. Probability that estimated mean and standard deviation (sd) lie within nominated ranges of the true population values of 20?m and 1.3?m respectively.

No. of animals measured	Estimated mean (deviation from true): ±0.4? m	Estimated mean (deviation from true): ±0.1? m	Estimated sd (deviation from true): ±0.2? m	Estimated sd (deviation from true): ±0.05? m
25	**91%**	**34%**	**71%**	**21%**
50	**97%**	**47%**	**89%**	**32%**
100	**100%**	**55%**	**95%**	**45%**
200	**100%**	**71%**	**100%**	**58%**
500	**100%**	**94%**	**100%**	**80%**

The population mean was estimated precisely in relatively small samples while the population sd was less precisely estimated. These estimated parameters are only required to establish the cut-offs for a continuously distributed trait, an absolute cut-off (such as 45kg body weight or twin-bearing ewes) requires no estimate of mean and sd. The impact of variation in estimated sd is likely to result in variation in the number of animals selected (James 2002), either too few or too many.

The accuracy of the selection process was examined in the same simulation study by assessing the error rates based on selecting a variable proportion of animals on measured fibre diameter. The error rate was defined as the proportion of animals that were selected in real time that would not have been chosen if we had collected all the data before doing any selection (Table 2). The results fully confirm the conclusions of James (2002). In medium and large populations where a substantial proportion of the population is required, real time selection introduces very little error (1-3%) into the process. Most of the errors occur early in the measurement process when the cumulative information on mean and sd is less precise.

Selecting ewes in commercial or stud situations or selecting commercial wethers are obvious situations where real time selection on fibre diameter can operate. This selection might be used to cull animals from the flock or to group animals to identify a shearing order that will allow optimized clip preparation. Equally, segmenting the flock into 2 or 3 groups for differential management would be easily accommodated in real time. Selecting animals on measured body weight in meat-producing flocks would be another obvious application of real time selection. The labour and time savings from not re-handling the animals or manipulating the data make the process very attractive. Where no permanent identification exists, real time selection is the only option for making effective use of the measured data. But it should be noted that as selection intensity increases (small proportion selected – see Table 2), the error rates start climbing to much higher levels. Clearly, real time selection is not an appropriate method when intense selection is being applied such as choosing a small number of stud rams as elite sires.

Table 2. Selection error rates at various selection intensities in a range of population sizes.

Proportion selected	Error rate in population of:			
	100 animals	200 animals	500 animals	1000 animals
70%	**3.7%**	**2.5%**	**1.7%**	**1.1%**
50%	**5.9%**	**4.2%**	**2.7%**	**1.7%**
30%	**7.2%**	**5.5%**	**3.4%**	**2.1%**
10%	**13.9%**	**10.3%**	**6.8%**	**4.3%**

REAL-TIME SELECTION ON MULTIPLE TRAITS

The process of real time selection on a single trait can be extended to more complex selection processes. A number of traits measured at different times might contribute to a final selection decision, but it is not necessary to wait until all the data is collected and processed before selection can proceed. We can build up the information using both the principles of index selection and real-time selection in an interactive way.

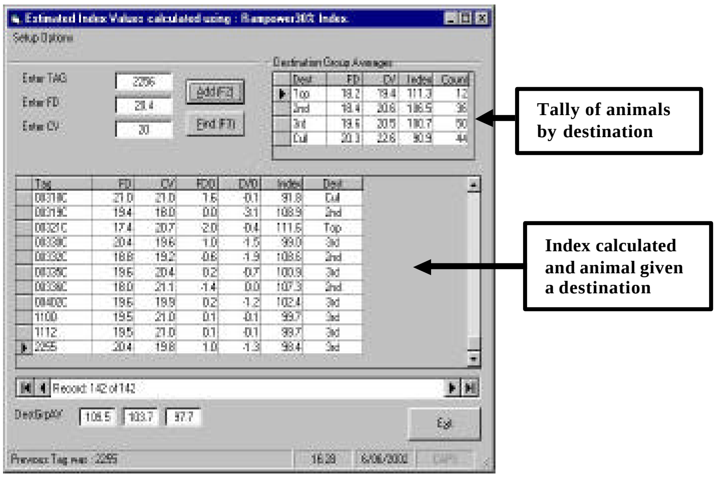
For example, we may collect fibre diameter and CV of diameter prior to shearing. At shearing, fleece weights may be recorded and then, after shearing, a body weight is added at which point final selection decisions are required. At each stage, pre-, at and post-shearing, the data is added and an interim index is calculated. At the final weighing, the body weight is added and the final selection index calculated in real time so that the animal can be allocated (and drafted) according to its final index. Apart from the final index being calculated in real time, some preliminary selection is possible on the basis of earlier information alone. For example, only a selected proportion of animals might be fleece weighed or body weighed depending on their ranking on a preliminary index involving fibre diameter and CV of diameter. Even without a final measurement phase, having the information available on screen at the time of allocating a destination would still be more useful than having the information in printed list form only.

REAL-TIME SELECTION SOFTWARE

We have developed some example real-time decision making aids based on current measurements of fibre diameter (and variability) that constantly updates these calculations during the measurement process. The computer software, Virtual Raceside Classer, captures measures of fibre diameter and CV directly from the testing machine. The program then

- calculates the expected index and ranking of the animal in the whole group, (based on the average & variance of the group and a pre-selected breeding index)
- determines destination code according to pre-specified proportions of animals to be classed into various destinations based on the index

Figure 1 Virtual Raceside Classer data entry and destination screen



The program keeps a tally of the animals classed into each destination group and the performance level of these groups. The likely mean diameter and mean CV at start-up are used to form a small number of standard animals to start the selection process, since at least 2 records are required for an estimate of sd. As more animals are added the average and variance of the group is updated.

The list of traits can be expanded to include a fleece weight and body weight. At the end of the measurement and selection process some graphical displays summarise the merit of the selected animals for the measured traits.

This approach is currently being incorporated into the OFDA software through the Interactive Wool Group. Adoption of similar procedures by other agencies supporting on-farm measurement will do much to improve profitability in commercial wool production by making better use of measured data.

REFERENCES

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