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The use of body measurements in cattle to predict future live weight

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ABSTRACT

Farmers need to select cattle into final slaughter groups in advance. Traditionally combinations of live weight and eye appraisal are used to make these selections. To improve this process, live weight, length from withers to top of tail, width across hook bones and depth from brisket level behind shoulder to top of withers were measured at 3-monthly intervals on Angus steers from 8 to 30 months of age. Of all the individual measurements, previous live weight predicted end weight better than any single body measurement. This was improved by including other body measurements selected using stepwise regressions. Although no particular combination of measurements was best for all time periods the results showed that length, width and body depth added value to current live weight as selection criteria for drafting steers into final slaughter time herds.

Keywords: live weight, body measurements, Angus, Friesian, stepwise regressions.

INTRODUCTION

Farmers are increasingly entering into supply contracts which require them to deliver on time for processing, a predetermined number and weight of cattle. Being able to match animals for final live weight 12 months in advance so that all animals within the group achieve the target weight on time enables the whole group to be slaughtered at once. This is especially important to the bull finisher because of the behavioural and within-herd instability (Jago *et al.*, 1997) that can occur when new herds of bulls are created. The need to establish herd rankings up to 12 months in advance is desirable. Some farmers believe that they can achieve this by using body frame size and characteristics (judged by eye). However, there is no data to substantiate this claim.

The use of body measurements as an alternative to weighing is widely accepted.

Good correlations have been reported between live weight and heart girth measurements (McRae, 1986), body length and heart girth measurements (Ross, 1958) and size index (Misner, 1944). The proprietary 'Dalton Weighband' converts heart girth measurement to live weight and has been widely used for 35 years (www.daltonsupplies.co.au). These findings all indicate it may be possible to use these relationships in predicting liveweight ranking within a herd over time.

Webby *et al.* (1993) showed that herd ranking based on live weight changed over time and that the chance of predicting which animals were going to be the heaviest in the herd 12 months out was low. This earlier study, however, did not take into account the frame size aspects of an animal. The study reported in this paper investigated the use of body measurements to further improve the ability of farmers to identify, up to 19 months in advance, individual animals in a herd that will meet a specific contract.

MATERIALS AND METHODS

Data were collected within a series of cattle nutritional trials at the Whatawhata Research Centre from 1993 to 1995. Body measurements were monitored on 60 Angus steers from age 12 to 30 months (August 1993 to February

1995), generation 1, and 30 Angus steers from age 8 to 27 months (April 1994 to November 1995), generation 2. Boom and Sheath (1997, 2000) described the experiments and management of the animals involved.

Body measurements

Measurements of the body frame size of the cattle were made at approximately 3-monthly intervals during the course of the experiments. These measurements coincided with a scheduled yarding to weigh the cattle involved.

Along with live weight, the body measurements carried out included:

1. Height withers (ht).
2. Body depth from brisket (behind shoulder) to withers (d).
3. Length from the front of the withers to the root of the tail bone (lg).
4. Hook width, measured over the extreme width of the pelvis above the tuber coxae (wd).

Method of measurement

The cattle were measured while they stood in the weighing crate. For measurement 1 and 2 above, a tape was set up attached to the outside of the weighing crate to measure from the weighing platform to the top of the crate. It was positioned along the crate so that it lined up vertically just behind the shoulder of the animal standing on the platform. Measurements were then taken by sighting from the tape on a horizontal line across, or into the animal. For measurements 3 and 4 above, a second tape was used. Facing the side of the animal, the tape was positioned over the wither and run over the animal to the point just over the root of the tail. The width over the hook bones was measured in a similar way.

Analyses

Generation 1 data was analysed using stepwise regressions as implemented by Genstat (1993) to choose a good subset of body variables as well as current live weight to predict final live weight. Polynomial terms in these variables were used in the search. From this equation, further equations were derived and tested using subsets of

the terms in the best-fit equation. These regressions were cross-validated on data from generation 2.

RESULTS

In table 1, the body measurements and live weights from 8 to 27 months are shown for generation 2 steers as an illustration of the typical values and variability of the measurements.

Table 2 gives a range of results of the analyses with varying time spans showing how well the different components of live weight, body measurements and combinations, predicted final body weight. The left-hand column describes the measurement or combination formula (see description below) used to predict the final weight. Six subset equations were chosen from the best fitting equation in generation 1 data. Starting live weight (lwt) is part of each of the 6 equations.

The key to the combinations is:

$$\text{Combo 1} = [\text{wt} + (\text{lg} \times \text{wd} \times \text{d}) + \text{d} + (\text{lg} \times \text{d}) + (\text{lg} \times \text{ht}) + (\text{wd} \times \text{ht}) + (\text{dx} \times \text{wt}^2)]$$

$$\text{Combo 2} = [\text{wt} + (\text{lg} \times \text{wd} \times \text{d}) + \text{d}]$$

$$\text{Combo 3} = [\text{wt} + (\text{lg} \times \text{wd} \times \text{d})]$$

$$\text{Combo 4} = [\text{wt} + \text{d}]$$

$$\text{Combo 5} = [\text{lg} \times \text{wt}^3]$$

$$\text{Combo 6} = [\text{wt} + (\text{lg} \times \text{wd} \times \text{d}) + \text{d} + (\text{lg} \times \text{d}) + (\text{lg} \times \text{ht}) + (\text{wd} \times \text{ht})]$$

TABLE 1: Average body measurements (mm) and live weight (kg) for 30 Angus steers from 8 to 27 months of age (standard deviation is shown in brackets).

Age (months)	Height at withers	Depth	Length	Width	Live weight
8	992 (23)	484 (28)	984 (33)	360 (20)	185 (16)
12	1033 (19)	507 (20)	1017 (33)	378 (18)	221 (23)
15	1088 (37)	579 (31)	1134 (34)	440 (18)	330 (24)
18	1140 (40)	603 (39)	1160 (42)	455 (24)	356 (24)
22	1187 (31)	657 (24)	1257 (32)	458 (24)	389 (26)
24	1201 (31)	677 (26)	1348 (30)	481 (21)	415 (35)
27	1229 (29)	696 (21)	1362 (38)	509 (11)	490 (42)

On their own, depth, width and length did not predict final live weight as well as current live weight. However the derived equations were able to improve these predictions. The worst predictions occurred in the data with the 1993 born steers in which predictions from 8 to 27 months (19 months) were calculated. The predictions improved the closer they were made to the end point. The best predictions occurred within 6 months, as shown by 1992 born steer data from 24 to 30 months of age.

Figure 1 looks closer at the relationship of current live weight to final live weight and shows that from age 16 months, final live weight can be reasonably well predicted ($r^2 = 0.73$ and 0.49 for Generation 1 and Generation 2 respectively). At 12 months of age the relationship is falling away ($r^2 = 0.42$ and 0.25 for Generation 1 and Generation 2 respectively). Figure 2 uses the equation Combo 1 and prediction of final live weight from age 12 months is improved ($r^2 = 0.51$ and 0.42).

FIGURE 1: The r^2 values using current live weight for predicting final live weight for generation 1 (Gen 1) and generation 2 (Gen 2) steers.

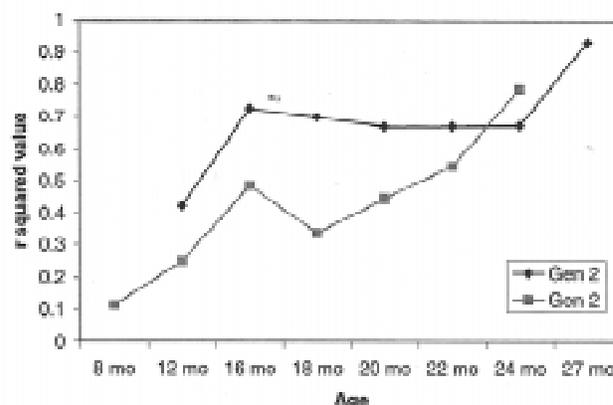


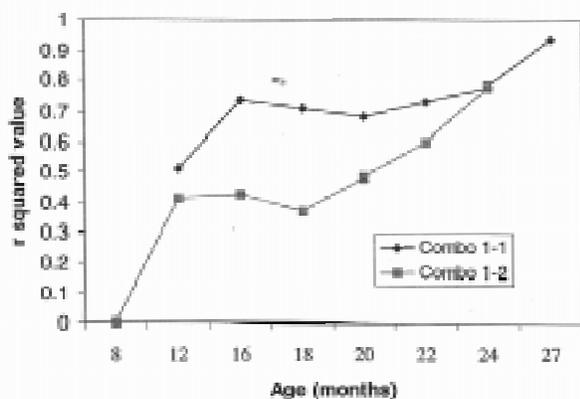
TABLE 2: The r^2 values and residual standard deviations for predicting end body weight using a range of measurements, current live weight and combination equations.

(rsd values appear in brackets)

Stock class (n)	Steers (60)	Steers (60)	Steers (30)	Steers (30)	Steers (30)	Steers (30)
Year born	1992	1992	1993	1993	1993	1993
Age at start and end (months)	12 - 30	24 - 30	8 - 18	8 - 27	12 - 27	22 - 27
Prediction span (months)	18	6	10	19	15	5
Live weight (wt)	.424 (27.1)	.672 (20.4)	.457 (16.9)	.114 (34.9)	.250 (32.1)	.547 (25.0)
Depth (d)	.133 (33.2)	.165 (32.6)	.078 (22.0)	<0 (37.7)	.037 (36.4)	.280 (31.5)
Length (lg)	.175 (32.4)	.230 (31.3)	.146 (21.1)	.002 (37.1)	.075 (35.7)	.186 (33.5)
Width (wd)	.231 (31.3)	.202 (31.9)	<0 (22.9)	<0 (37.8)	.230 (32.6)	.378 (29.2)
Comb 1	.514* (24.9)	.783 (16.6)	.346 (18.5)	<0 (37.3)	.415* (28.4)	.600 (23.5)
Comb 2	.447 (26.5)	.740 (18.4)	.427 (17.3)	.103 (35.1)	.262 (31.9)	.636 (22.4)
Comb 3	.454 (26.4)	.706 (19.4)	.441 (17.1)	.131* (34.6)	.271 (31.7)	.650* (21.9)
Comb 4	.421 (27.2)	.745 (18.0)	.448 (17.0)	.119 (34.8)	.223 (32.7)	.578 (24.1)
Comb 5	.444 (26.6)	.641 (21.4)	.466* (16.7)	.129 (34.6)	.297 (31.1)	.556 (24.7)
Comb 6	.509 (25.0)	.787* (16.5)	.355 (18.4)	<0 (37.4)	.221 (32.7)	.611 (23.1)

* largest r^2 equation

FIGURE 2: The r^2 values using current combination equation 1 for predicting final live weight for generation 1 (Combo 1-1) and generation 2 (Combo 1-2) steers.



DISCUSSION

The varying components that were measured changed at different rates. For example, average live weight at 8 months of age was 38% of what it was at 27 months of age, withers height was 81%, body depth at shoulder 70%, length 72% and width 71% (refer table 1). Taylor (1963) graphically illustrated this differential growth and showed similar relationships with height, length, depth and width. In studies with Ayrshire cattle, Russell (1975) noted that at birth, withers height was 52% and width and length were 25% of mature size. Typically, live weight would be about 5% of mature weight at birth.

In this study, we considered only the most practical and easy to measure dimensions for farmer application. Given the size and nature of the cattle involved this excluded other measurements such as girth. In making the selection of cattle into final slaughter contract mobs, a farmer may only have to measure body dimensions once, making this an attractive technique for bringing more precision into drafting cattle.

In judging cattle by eye, farmers must make some assessment of live weight. As our data show, size alone is inadequate as a criteria for making drafting decision. With the data we have analysed at this stage we are encouraged in the fact that we were able to derive equations that improved on current live weight as a means of predicting future live weight. Even the relative simple Combo 3 [$wt + (lg \times wd \times d)$] gave some improvement over current live weight. A more substantial data set of body and live weight measurements may make it possible to improve on these equations. Webby *et al.* (1993) reported, with Friesian bulls from age 3 to 18 months that only from 12 months of age was it possible to predict herd ranking at 18 months. Although that data did not extend beyond 18 months of age, we do agree in saying that only from age 12 to 16 months can we use current live weight to predict live weight at a greater age (27 to 30 months) reasonably well.

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