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Relationships of Chute-Side Measurements to Carcass Measurements

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Live body weight is the most valuable indicator of carcass weight at all times in the production system.

Summary

Three data sets were compiled to determine the relationship of weight, performance, hip height and ultrasound-measured fat thickness to hot carcass weight and fat thickness. Weight is generally the best predictor of relative differences in carcass weight at any time in the production system. Hip heights do not predict relative differences in carcass weight. Although the combination of hip height and weight is a more precise indicator of carcass weight than is hip height alone, generally this combination is inferior to weight alone. Only ultrasound-measured fat thickness predicted relative differences in fat thickness. Prediction of relative differences in carcass weight from body weight and fat thickness from ultrasound scans improved as marketing date approached.

Introduction

Previous research conducted at the University of Nebraska suggests relationship of live body weight to final market weight increases from 0.223 at the beginning of the wintering period (weaning) to 0.758 at the beginning of the grazing period, to 0.834 at the beginning of the finishing period (*2002 Nebraska Beef Report,* pp. 37-39). Additional observations are needed to further establish these relationships and to compare the relative value of live body weight to other measurements that may be taken during processing.

The objective of this research was to determine the relationship of weight, performance, hip height, and ultrasound-measured fat thickness at different times in the production system to carcass weight and carcass fat thickness.

Procedure

Three data sets were compiled. Whenever possible, weights were taken following a period of limited intake to equilibrate gut fill differences. If limit-fed weights were not possible, cattle were shrunk 4% and all weights assumed to be on an equal shrunk-weight basis. Hip heights were taken in a restraining chute and every attempt was made to take measurements when the animals were standing with all four legs squarely beneath them. A weight to hip height ratio was calculated for individuals by

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dividing the individual's weight by their hip height at a given point in time. Fat thickness was measured between the 12th and 13th rib with an Aloka 500V model ultrasound machine attached to an eight-inch linear array transducer. Animal hide was curried to remove dirt if necessary and mineral oil was applied to the region to ensure maximal acoustical contact.

Data Set 1

Data set 1 was used to determine the relationships of hip height, fat thickness, weight and average daily gain at times prior to entering the feedlot to carcass weight and carcass measured fat thickness in a long yearling production system. Comparisons also were made to carcass weights adjusted to a constant percentage body fat (28) to illustrate how relationships might change if all cattle were marketed at equal fatness. The data set includes cattle from a long term yearling-calf-fed comparison study. Calves' dams were randomly assigned to calf or yearling treatments. Cows assigned to calf or yearling treatment are managed as two separate herds. Only calves from the yearling system are included in the data set. Thus the data set is unique, because every steer calf (n = 43) from a herd is included. Weaning weights for calves assigned to the yearling treatment were 541 + 66 lb.

Table 1. Correlation coefficients of pre-finishing measurements to carcass characteristics (Data Set 1).

Item	HCW[ab]	HCW[b]	Fat thickness[c]
Weight			
Birth	NS	NS	NS
Winter initial	0.66	0.74	NS
Grass initial	0.68	0.82	0.30
Feedlot intial	0.69	0.81	0.29
Hip height			
Winter initial	0.31	0.32	NS
Grass initial	NS	NS	NS
Feedlot initial	0.49	0.50	NS
Weight/hip height ratio			
Winter initial	0.61	0.69	NS
Grass initial	0.68	0.84	0.37
Feedlot initial	0.62	0.77	0.29
Fat thickness[d]			
Grass initial	NS	0.55	0.51
Feedlot initial	NS	NS	0.53
Fat-Weight Equation[e]			
Grass initial	0.70	0.83	0.52
Feedlot initial	0.75	0.81	0.55
ADG			
Winter	0.28	0.43	0.33
Summer	NS	NS	NS
Feedlot	0.52	0.68	0.35

[a]Adjusted to 28% body fat.
[b]Hot carcass weight.
[c]12th rib fat thickness.
[d]12th rib fat thickness measured via ultrasound.
[e]Multiple regression equation based on weight and fat measurements.
NS = Non-significant relationship (P<0.05).

Data Set 2

Data set 2 was developed to determine if the relationship of measurements to carcass traits improved with time on feed. Cattle in this data set were yearling steers on a 112 day feeding trial to test differences in corn hybrids. Cattle assigned to this trial were received in the fall and were part of a group of approximately 1500 calves. The 600 heaviest steers were sorted off in the fall and placed on calf-fed trials. The remaining 900 steers were wintered together on corn stalks and placed in a dry lot where they received ammoniated wheat straw. They were sorted again in mid-April and the lightest 250 steers were placed on grass, where they consumed a combination of cool season, warm season or legume grasses. In September, when the trial started, the lightest 25 steers and the heaviest 25 steers were removed, leaving 200 steers for the study. Steers on this trial weighed 444 + 55 lb at the beginning of the wintering period, 620+ 31 lb at the beginning of the grazing period, and 805+ 42 lb upon entering the feedlot. No treatment differences were expected or found for performance or carcass characteristics. The trial protocol required the steers be weighed every 28 days. Ultrasound fat thickness and hip height measurements were taken at the same time. As with Data set 1, carcass weights were adjusted to a constant percentage body fat (28) to illustrate how the relationship might change if each individual animal were marketed at equal fatness.

Data Set 3

Data set 3 was compiled to determine the relationship of initial weight and reimplant weight to final weight in calf-fed steers. The data set includes steers from three calf-fed trials conducted in 1997. Steers were included in the data set if their treatment final weight was not different from the control in their trial. Cattle were sorted into each trial from a large group to meet specific weight range specifications and to reduce the standard deviation of weight as much as possible. When trials were pooled, cattle included in this data set had initial weights averaging 628 + 48 lb. Simple correlation coefficients were used to determine the relationship of initial weight and reimplant weight to final weight. There were 352 head in this data set.

Results

Data Set 1

Table 1 shows results from analysis of Data set 1. Ultrasound measured fat thickness was the best indicator of relative differences in carcass fat thickness prior to entering the feedlot. It was thought that the ratio of a steers' weight and hip height would give indication of its fattening potential. This is clearly not the case since the correlation coefficient between ratio of hip height to weight and carcass measured fat thickness are not significant or poor (r = 0.29 to 0.37).

With the exception of birth weight, weights collected at different times in the production system provide insight into relative differences in carcass weight. The relationships improved as cattle

Table 2. Correlation coefficients of finishing measurements to carcass characteristics (Data Set 2).

Item	HCW[ab]	HCW[b]	Fat thickness[c]
Weight			
Day 0	0.38	0.51	NS
Day 28	0.55	0.72	NS
Day 56	0.64	0.80	NS
Day 84	0.62	0.81	NS
Day 112[d]	0.64	0.90	0.15
Hip height			
Day 28	0.34	0.43	NS
Day 56	0.36	0.48	NS
Day 84	0.42	0.50	NS
Day 112[d]	0.42	0.47	NS
Weight/hip height ratio			
Day 28	0.33	0.46	NS
Day 56	0.49	0.61	NS
Day 84	0.42	0.61	0.17
Day 112[d]	0.49	0.77	0.27
Fat thickness[e]			
Day 56	-0.29	NS	0.48
Day 84	-0.17	0.15	0.47
Day 112[d]	-0.19	0.15	0.50
Fat-weight equation[f]			
Day 56	0.71	0.80	0.40
Day 84	0.66	0.82	0.36
Day 112[d]	0.71	0.90	0.41

[a]Adjusted to 28% body fat.
[b]Hot carcass weight.
[c]12[th] rib fat thickness.
[d]Slaughter date.
[e]12th rib fat thickness measured via ultrasound.
[f]Multiple regression equation based on weight and fat measurements.
NS = Non-significant relationship (P<0.05).

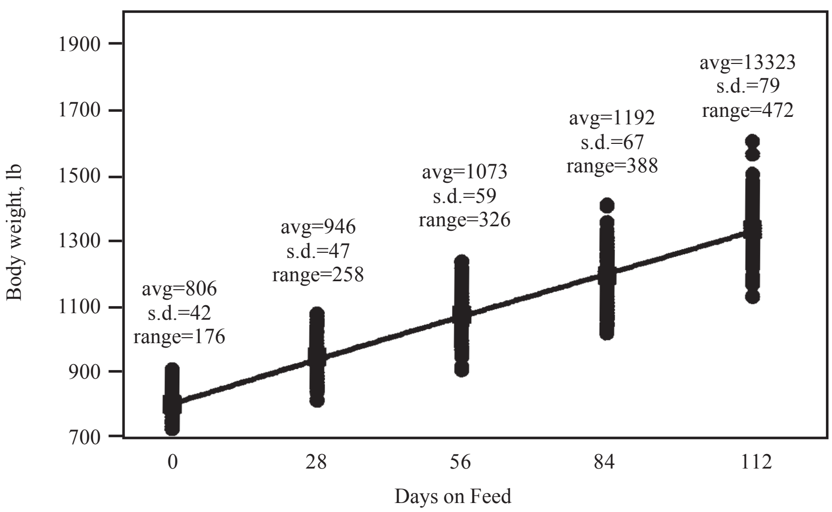

Figure 1. Distribution of interim weights for cattle on a 112day feeding trial (Data Set 2). s.d.=one standard deviation from the mean (lb), range=actual difference between maximum and minimum weights (lb). Correlation coefficients among weights ranged from 0.51 to 0.86.

grew. The relationship of weights taken at the beginning of the winter phase, beginning of the summer phase and beginning of the finishing phase were 0.74, 0.82 and 0.81, respectively. Previous data suggests these relationships are 0.22, 0.75 and 0.83, respectively (*2002 Nebraska Beef Report,* pp. 37-39). Perhaps the difference in the relationships at the beginning of the winter period is related to the fact that every calf from the herd was included in this data set. Inclusion of every calf may increase variation thereby increasing correlation coefficients in relation to data sets where the heaviest or lightest steers are removed. These data confirm that weight entering the feedlot should give good insight into relative differences in carcass weight.

When carcass weights were adjusted to a constant percentage body fat, correlation coefficients generally decreased indicating that if cattle were sold at equal fatness, it is more difficult to predict relative differences in carcass weight. When weight and fat were combined in a multiple regression equation, the relationships to fat-adjusted carcass weights improved when steers entered the feedlot, (r = 0.75 vs. r = 0.69).

Hip heights taken at the beginning of the wintering period and the beginning of the finishing period were significantly related to carcass weight but were always inferior to the live body weight taken at the same time point. The weight/hip height ratio was generally intermediate to live body weight or hip height alone.

Hip heights are difficult and time consuming to accurately measure. When hip heights were taken on the same group of cattle for two consecutive days, the correlation coefficient between days was 0.81. This repeatability is less than that of either ultrasound (r = 0.93) or live body weight (r = 0.99).

Although ADG for the winter period was significantly related to carcass weight and fat thickness, the relationships were poor and would not predict relative differences in these carcass characteristics. ADG for the feeding period also was significantly related to carcass weight and fat thickness. This is not useful, since gain is calculated at the end of the feeding period.

Data Set 2

Relationships from Data set two are shown in Table 2. Similar to Data set 1, only ultrasound-measured fat thickness was consistently related to carcass fat thickness. This relationship improved as the marketing date approached. The same trend could be seen with live body weight measurements. Also, live body weight was always superior to hip heights taken at the same time point while weight/hip height ratios were intermediate. As before, adjusting carcass weights to a consistent percentage body fat decreased

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correlation coefficients. Combining weight and fat in a multiple regression equation improved these correlation coefficients.

Figure 1 shows the distributions of weight with days on feed for Data set 2. As a group, cattle tend to gain weight at a linear rate and variation in weight increases as cattle get heavier. Correlation coefficients among weights taken at different times through the finishing period ranged from 0.51 to 0.86 suggesting heavier cattle generally remain heavier through the feeding period if marketed as one group. The variability in weight also increased with time on feed causing a larger range in weights at the end of feeding period compared to that found at beginning of the feeding period. Therefore, delaying sorting to late in the finishing period should increase the accuracy in identifying marketing groups based on carcass weight.

Figure 2 shows the distribution of ADG for each of the four 28-day periods. ADG tends to remain constant through the feeding period for a group of cattle. Any variation from the constant ADG is probably due to differences in gut fill, error associated with measuring weight, or environmental factors. Comparing the small variability of gain calculated from hot carcass weight for the entire trial to the large variability for any one of the measured periods, demonstrates that ADG calculated from non-shrunk weights gives way to false variability due to differences in gut fill.

When sorting cattle into marketing groups, it would be useful to know what an individual can be expected to gain during a future period of time. It was thought that relative differences in rates of gain could be predicted from previous rates of gain. However, correlation coefficients for ADG among periods ranged from -0.11 to 0.18 and suggest while a group of cattle gain at a constant rate, an individual does not. Therefore, it is difficult to predict gain for a period of time for an individual animal based on that animal's previous performance. Also, the variation in and poor correlations of ADG through the feeding period is likely the reason that the correlation coefficient of weight to final weight improves as marketing draws nearer, but never reaches 1.0. Finally, while sorting on weight may improve uniformity of a group of cattle with large differences in weight, the advantage of sorting decreases as variation in weight decreases.

Figure 3 shows the distribution of 12th rib fat measurements taken over the last 56 days on feed. Similar to weight, cattle appear to fatten at a linear rate and variation in fat thickness increases with time on feed. Since only three ultrasound measurements were taken, average fattening rate (AFR) can be calculated for only two periods. Cattle fattened at a rate of 0.0037 inch/day between the first and second measurements and 0.0038 inch/day between the second and third ultrasound measurements. The correlation coefficient relating the AFR of individuals from the first period to the AFR from the second period was -0.35. Like ADG, on average, cattle fatten at a constant

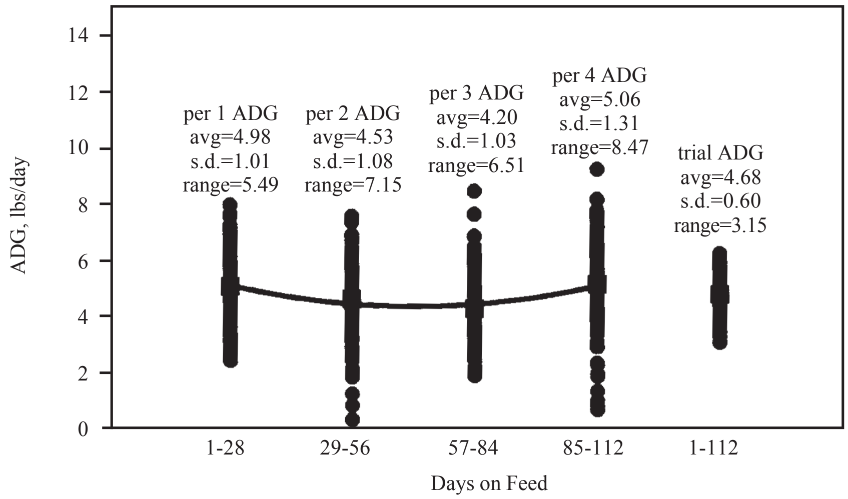

Figure 2. Interim ADG for cattle on a 112 day feeding trial (Data Set 2). s.d.=one standard deviation from the mean (lb/day), range=actual difference between minimum and maximum ADG (lb/day). Correlation coefficients among periods ranged from -0.11 to 0.18.

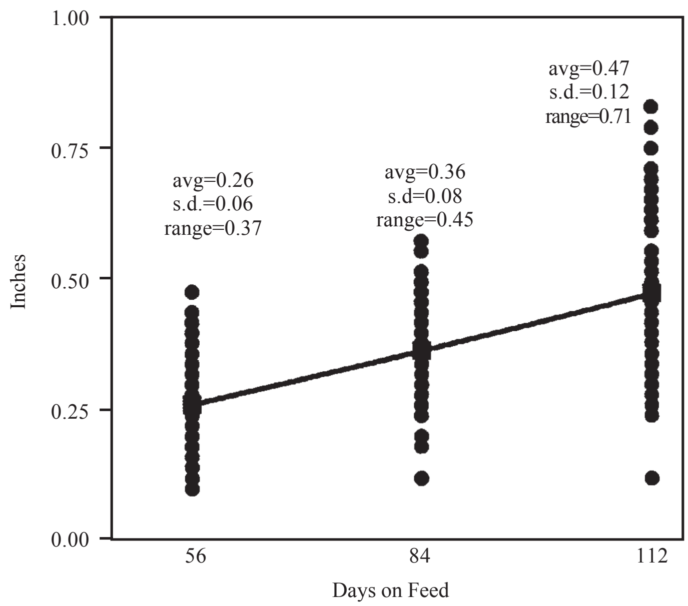

Figure 3. Distribution of 12th rib fat measurements taken via ultrasound (Data Set 2). s.d.=one standard deviation from the mean (in), range=actual difference between maximum and minimum fat thicness (in).

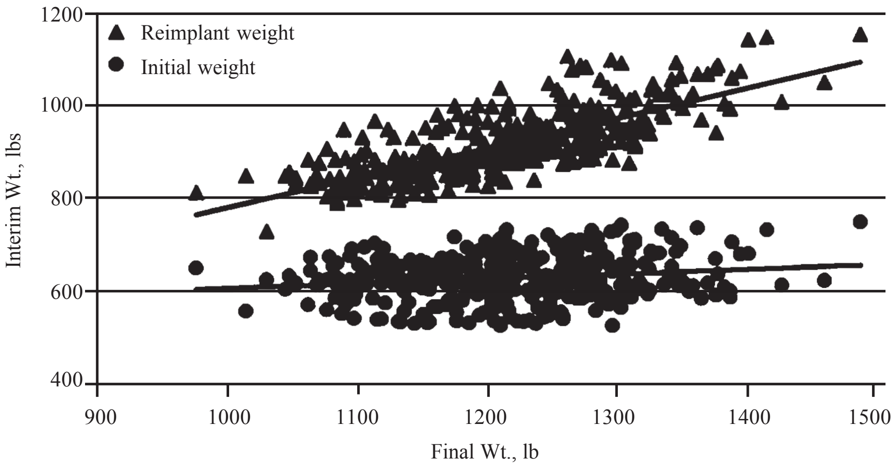

Figure 4. Relationship of initial weight and reimplant weight to final weight for calf-fed research trials (~350 head).

rate, but individuals do not. This may be due to actual variation in individual fattening rate, or because the ultrasound scans did not precisely detect small differences in fatness. Also, the variation in AFR is large. Therefore, using a constant fattening rate for a group of cattle may be appropriate, assigning a constant rate of fattening for individuals is probably not. The poor relationship of fattening rate from one period to another suggests that future fattening rates for an individual cannot be predicted by taking two ultrasound measurements and calculating a fattening rate for an individual. Thus sorting systems that predict fattening rate or relative differences in fatness at a future time likely will realize poor success in identifying animals for different marketing groups based on fatness. Rates of weight gain and fat accretion respond similarly over the feeding period, although unrelated to one another (r = -0.08 to 0.08). We suggest that both may be related to dry matter intake.

Data Set 3

The results of the analysis of Data set 3 are presented in Figure 4. For calf-fed steers, the relationship of weight to final weight greatly improves at reimplant time (r = 0.76) compared to the relationship to final weight at the time they enter the feedlot (r = 0.18) Calf-fed steers are normally reimplanted 90 to 120 days prior to slaughter. The preceeding relationships suggest while sorting calf-feds by weight upon entry into the feedlot will probably realize limited success in identifying relative differences in carcass weight, sorting at reimplant time shows promise. Cooper et al. (*1999 Nebraska Beef Report,* pp. 57-59) reported correlation coefficients for weights at reimplant time vs. carcass weight ranging from 0.46 to 0.86. These data agree with those findings and suggest that sorting by weight at reimplant time may be a viable option for producers feeding calves.

These data reaffirm that measuring live body weight is a powerful tool for producers to predict relative differences in carcass weight. While accuracy in predicting these differences is generally increased by delaying sorting until late in the feeding period, producers should realize success by sorting yearlings upon entry into the feedlot and sorting calf-feds at reimplant time.

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