SIMULATION OF THE ECONOMIC EFFECT OF VARIABILITY WITHIN A PEN OF FEEDLOT STEERS

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Story in Brief

A computer simulation model was developed to quantify the economic effect of variation in initial weight and body condition among cattle fed and marketed uniformly. In general, as variation in initial body weight increased, average net return decreased. Respective mean profits for steers having standard deviations of 40, 80, 120 and 160 lb around an initial weight of 700 lb were $45.96 ± .14, $40.26 ± .59, $24.51 ± .69 and $9.98 ± .77. Similarly, increased variation in body condition decreased average net return, although not at the same rate as initial weight. Respective mean profits for steers having standard deviations of .6, 1.2, 1.8 and 2.4 around an initial body condition score of 5 (1, extremely thin, to 9, extremely fat) were $46.43 ± .13, $45.97 ± .26, $43.85 ± .38 and $37.76 ± .90. These results suggest that variation, particularly in initial weight among cattle fed and marketed as a group, should be minimized in order to realize maximum profit potential. This should be of particular interest to those utilizing retained ownership as a marketing option.

(Key Words: Computer Simulation, Feedlot Cattle, Economic Analysis)

Introduction

Predictability and product uniformity are becoming increasingly important in the beef cattle industry. However, due to the diversity in age, weight, condition and breed type, today's feeder cattle differ in feedlot performance and composition of growth. Within a pen of cattle, these variables make it extremely difficult for all carcasses to meet desired market specifications for weight, quality grade and cutability. Yet, despite this variability among feeder steers, it is still common to find rather diverse cattle being fed, managed and marketed uniformly.

It is logical to assume that variability will have a detrimental effect on the profitability of a feedlot enterprise. Yet little, if any, research has been conducted to quantify the interaction between animal variation and economic outcome. At the biological level studies such as this may be cost prohibitive; however, computer simulation lacks these cost constraints. Therefore, it is a useful tool for evaluating these types of problems. To be successful, a precise computer model for estimation of feedlot performance and carcass quality is required. The objective of this research was to develop a computer program to simulate the economic effects of variation in initial weight and body condition within a pen of feedlot steers.

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Materials and Methods

A computer program was developed to evaluate the effect of within pen variability on the economic outcome of feeding yearling steers. A dynamic beef cattle growth model (Oltjen et al., 1986) was used to simulate body weight gain and composition of growth, the two variables of major interest in this study. Variables predicted in the growth model include body weight, empty body fat and feed intake. Intake is derived from a prediction equation (Fox and Black, 1977) included in the program, and is adjusted for weight, frame-size, initial weight when started on feed, body fat, and dietary energy content (NRC, 1987). Carcass weight and composition was calculated using equations of Garrett and Hinman (1969); carcass grades were estimated using equations of Fox and Black (1984).

For this analysis steers were of moderate frame size and anabolic implants were used. One ration, having NEm and NEg values of .94 and .62 Mcal/lb, respectively, was fed for the entire 130 day feeding period. All cattle were slaughtered on the same day, regardless of variation in body weight or composition. To enable economic analysis, income was calculated for each steer on a carcass grade and yield basis. The price structure used in calculating carcass value is shown in Table 1. Offal value was added and kill costs subtracted for a more realistic evaluation of the animals true worth. The following expense costs were also used: purchase price of $78/cwt, feed cost of $4.50/cwt (as fed), processing cost of $8.00/hd and yardage costs of $.05/day. Interest rate for the purchase of cattle and feed was assumed to be 11 percent. Net return was calculated for each animal and pen averages determined. The input values used in the program are industry averages and reflect High Plains market conditions as of January 1, 1988.

Mean initial body weight was set at 700 lb and mean initial condition score at 5 (1, extremely thin to 9, extremely fat). Standard deviations of body weight and condition score were set at various increments and a random number generator was used to provide normally distributed initial animal variation. Each individual steer in pens of 100 animals was simulated and pen performance evaluated.

Results and Discussion

The effect of variation in initial body weight on profit is shown in Figure 1. Profit is calculated as the mean of all pen average net

Table 1. Price structure for determining carcass value

Adjustments[1], $/cwt					
Weight		Quality Grade		Yield Grade	
<500 lb	-5	Standard	-24	1	+1
500-550 lb	-4	Select	-6.5	2	+1
550-900 lb	0	Choice	0	3	0
>900 lb	-5	Prime	+3	4	-10
				5	-14

[1]Base value = $95/cwt, offal value = $8.47/cwt, kill cost = $25/hd.

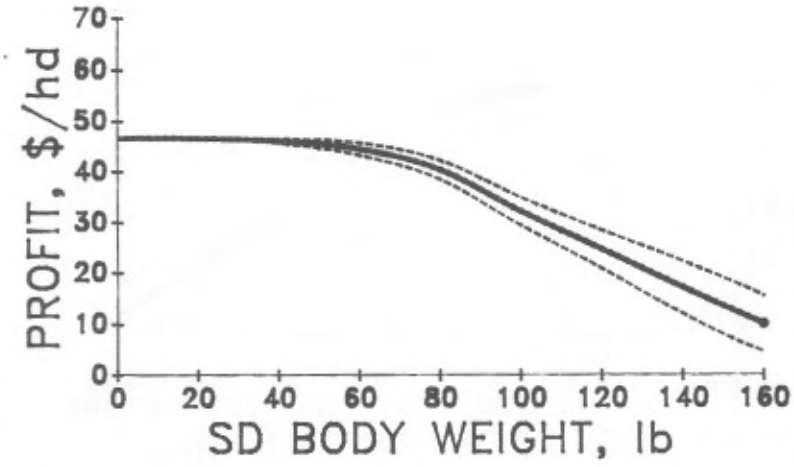

Figure 1. Relationship between profit and standard deviation (SD) of initial body weight for steers fed 130 days. Dotted lines represent one standard deviation from the mean.

returns and was maximized when the standard deviation of body weight (SDBW) was zero. As variation in initial body weight increased, profit decreased in a curvilinear manner. Respective mean profits for steers having standard deviations of 40, 80, 120 and 160 lb around an initial weight of 700 lb were \$45.96 ± .14, \$40.26 ± .59, \$24.51 ± .69 and \$9.98 ± .77.

Decreased profit is primarily due to a reduction in carcass value (Figure 2), as it is affected by undesirable carcass weights, quality and cutability. Average carcass value was relatively constant at \$95/cwt until SDBW exceeds 40 lb, and decreased linearly with standard deviations of body weight greater than 80 lb. Respective average carcass values for steers with standard deviations of 40, 80, 120 and 160 lb were \$94.99, \$94.41, \$92.55 and \$90.88/cwt. The price structure for determining carcass value was changed in the program to evaluate the relative sensitivity of net return to change in the price break between Select and Choice grade carcasses. Holding all other factors constant, net profit was assessed at a discount for Select carcasses of -\$9.00. Relatively little difference was found in net profit at SDBW of 40 lb or less. There was a \$1.50 decrease in profit per head at SDBW of 80 lb and a \$.68 decrease at SDBW of 120 lb. These results suggest that net returns are relatively insensitive to a change in the carcass quality grade price differential between choice and select.

The effect of variation in initial body weight on profit over various feeding periods is shown in Figure 3. Net returns increase almost linearly with increased time on feed when SDBW equals zero. This is due primarily to increased weight of carcasses with desirable characteristics. This trend should not be continuous as points will be reached where carcass weights will become excessive and carcass cutability reduced. Profit is not only reduced with increased variation

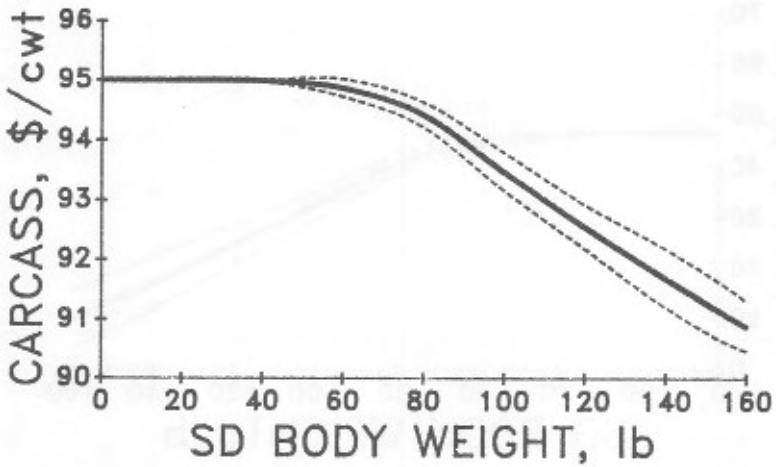

Figure 2. Relationship between carcass value and standard deviation (SD) of initial body weight for steers fed 130 days. Dotted lines represent one standard deviation from the mean.

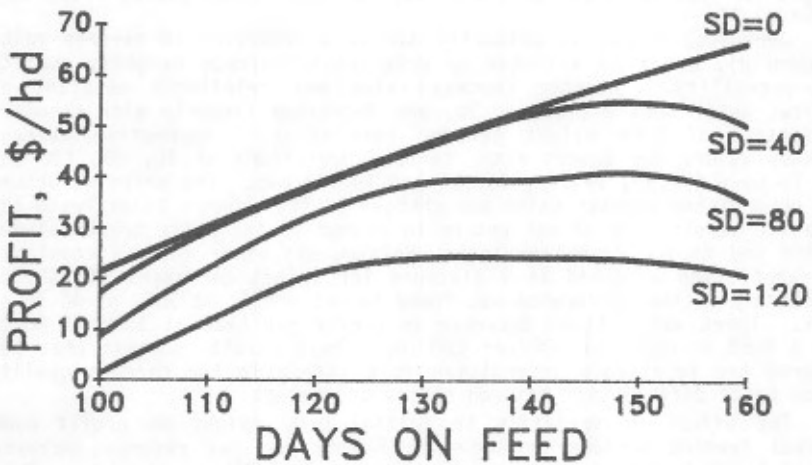

Figure 3. Relationship between profit and days on feed for steers with different initial weight standard deviation (SD).

in initial body weight, but is also maximized with fewer days on feed. These results suggest that to maximize the profit potential of a group of cattle managed and marketed uniformly, variation in initial body weight should be minimized; however, if cattle of diverse initial weight are to be fed, it is economically beneficial to market them earlier than one would market a group of cattle with similar initial weights. Cattle of lighter mean initial weights, (425 lb) showed a similar trend toward decreased profit as SDBW increased. However, there was greater variability about the calculated mean profit with lighter weight cattle.

Figure 4 shows the effect that variation in body condition has on net profit. Increased variation in body condition decreased average net return, although not at the same magnitude of initial body weight variation. Respective mean profits for steers having standard deviations of .6, 1.2, 1.8 and 2.4 around an initial body condition score of 5 were \$46.43 ± .13, \$45.97 ± .26, \$43.85 ± .38 and \$37.76 ± .90. As with variation in initial weight, decreased profit is due primarily to undesirable carcass characteristics; however, carcass weight is affected little by variation in body condition. Initial weight and body composition have an effect on feed intake and therefore subsequent feedlot performance (Hyer et al., 1986); however, the feed intake equation used herein may not be sensitive enough to these factors. This is noted in Figure 3 where profits appear to increase linearly for SDBW = 0.

Simulations in this report present minimal, or conservative, estimates of the effect of variation. In actual practice, these values serve as the smallest expected decrease in profit for a given standard deviation. The results support the practice of sorting incoming feedlot cattle for uniformity in expected days on feed. However, in cases when this is not done or is impractical, such as a cow-calf producer retaining ownership of a limited number of cattle, variation may be costly.

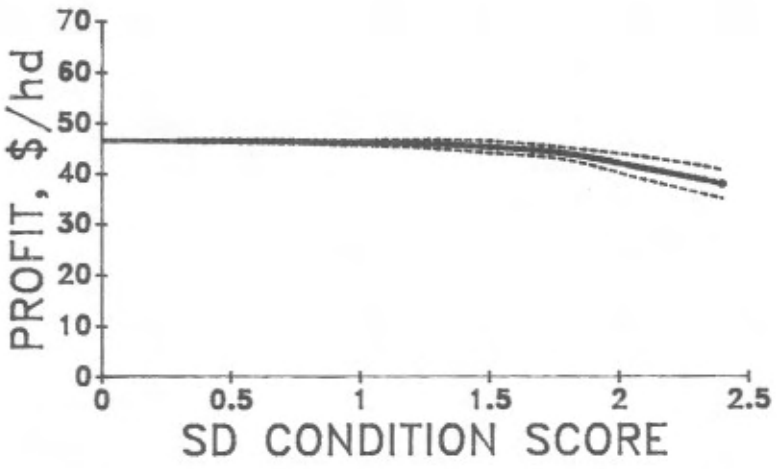

Figure 4. Relationship between profit and standard deviation (SD) of condition score for steers fed 130 days. Dotted lines represent one standard deviation from the mean.

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