Sorting strategy and effect of variation on profitability of a pen of feedlot steers

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INTRODUCTION

Variation and lack of uniformity of feedlot cattle is a major problem for the beef industry. Variability in a pen of feedlot cattle decreases beef product uniformity and consistency (National Cattlemen's Beef Association, 2017). Due to diversity in breeds, genetics, health, and nutritional backgrounds, cattle entering the feedlot are often extremely variable. Typically, feedlots purchase cattle as a lot, process and feed the lot, and harvest as a lot when cattle are ready. Differences in body composition and growth make it challenging for all steers in a lot to reach acceptable market specifications (Smith et al., 1988; Sainz and Oltjen, 1994). It was hypothesized that variation among steers would have a negative effect on lot profitability. A computer simulation was developed using the Davis Growth Model reported by Oltjen et al. (1986a, 1986b). The dynamic, deterministic model predicted growth, body composition, and carcass value for individual steers in a lot for each day in the feeding period. Lot profitability was evaluated using four sorting strategies: 1) steers were purchased, fed, and marketed as a lot without sorting; 2) steers were purchased, sorted by body weight (BW) at initial processing, and fed and marketed as two independent pens; 3) steers were purchased and fed as a lot until midway through the feeding period and, then, sorted by BW into two pens that were marketed independently; and 4) steers were purchased and fed as a lot, and each individual steer was sold at the optimal time. Optimal marketing time was defined as the day profit reached a maximum value.

MATERIALS AND METHODS

Institutional animal care and use approval was not obtained since no live animals were used in this study. Sixty-two angus-based steers (initial BW = 293 kg) were fed a high energy ration during a trial at the University of California Davis feedlot (Dykier and Sainz, 2016). Individual steer measurements for initial BW, frame size, and body fat percent were used as initial values in the model. Model parameters for net energy for maintenance and net energy for gain were reported by Dykier and Sainz (2016). Parameter values for A and K2 in the Davis Growth Model and a feed intake adjustment factor (ADJ) were estimated from the data set of 62 steers. Parameter A was a constant for maintenance energy, K2 was a constant for protein degradation, and ADJ was an individual steer adjustment factor for feed intake (Oltjen et al., 1986a; Hicks et al., 1990). The length of the simulation was 250 d to ensure that the model was run sufficiently long for steers to reach their optimal marketing time. Daily dry matter intake (DMI) was predicted using a modified equation reported by Hicks et al. (1990).

Steer value was carcass value minus steer purchase cost when carcass value was calculated using a grid-based system where value was placed on quality, cutability, and carcass weight. Steer

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purchase price was calculated using the initial BW and a purchase price of $137/45.4 kg (USDA, 2020). All carcass premiums and discounts were assessed from a base price that assumed Choice, Yield Grade 3. Adjustments from the base price were calculated on a dollars per 45.4 kg basis. Yield Grades of 1 and 2 and Quality Grades of Prime and Certified Angus Beef received price premiums, and Yield Grades of 4 and 5 and Quality Grades of Select and no grade received price discounts. Carcass weights (HCW) above 454 kg were discounted, and HCW above 476.3 kg were discounted more severely. Base price, premiums, and discounts were obtained from USDA (2020).

The four marketing scenarios were evaluated using the same data set. Steer profit was calculated by subtracting individual feed cost and steer purchase cost from individual carcass value. Feed costs were calculated using the assumption of $90.00/45.4 kg of gain. Profit for the final analysis was calculated on a mean per steer basis. Total lot profitability was calculated for each day in the feeding period. For the first scenario, the entire lot was marketed on the day of maximum profit. For scenario 2, the 62 steers were sorted into two pens of 31 based on initial BW, and each pen was marketed on the day profit was greatest. Steers in scenario 3 were managed as a single lot until day 100, where they were sorted into two pens based on BW, and each pen was marketed on the day profit was greatest. In scenario 4, each steer was marketed at its optimum time, and mean profitability was the average of each individual steer's profit on the day it was sold.

Sensitivity analyses were conducted, evaluating total feed costs, grid prices, and calf purchase price. Other variables were held constant, and prices were changed ±10% from their observed value. Average profit per steer was calculated for the four scenarios, and percent change was calculated for each analysis using previous profit from that scenario as a baseline.

RESULTS AND DISCUSSION

Scenario 4 was most profitable ($161.78, standard deviation = $144.79), representing the greatest possible profit, where each steer was marketed on its optimal day (Table 1). Scenario 4 was 32% more profitable than scenario 1, the management practice commonly used by commercial feedlots. However, it is important to realize that it would not be practical to implement scenario 4 commercially because pen space is often limited, and feedlot management generally requires shipping and harvesting lots as a whole. Scenario 3 ranked second. However, scenario 2 only differed slightly, mean steer profit was $125.10 and $127.85 for scenarios 2 and 3, respectively (Table 1). With this set of cattle and model parameterization, additional profit gained from sorting midway through the finishing period (i.e., day 100) was only slightly better than sorting cattle at the time of initial processing. This is an important consideration for feedlot producers because sorting cattle midway through the feeding period requires processing cattle through the chute another time, increasing labor costs, and stressing the animals. However, many feedlots utilizing hormonal implants to improve growth and efficiency process cattle a second time midway through the feeding period to reimplant cattle and, thus, may be able to easily implement sorting. These results were similar to those reported by Smith et al. (1988); a reduction in variation in a pen of feedlot cattle improved overall profitability. Results of this simulation represent the greatest potential returns to feedlot producers and do not account for increased labor costs of sorting in scenarios 2 and 3.

Profits in scenarios 2 and 3 were similar because pen groupings based on BW sorting were similar, optimal time of harvest was days 189 and 187 for the "light-weight pens" and days 211 and 219 for the "heavy-weight pens" in scenarios 2 and 3, respectively. (Table 1). Steers tended to grow at a relatively constant rate so that, when sorted on day 100, groupings were nearly identical to sorting on initial BW at the time of processing. However, depending on the variability upon entering in the feedlot and variation in growth rate, these two scenarios may rank differently. Interestingly, in both scenarios 2 and 3, most animals that were lighter at the time of sorting were harvested earlier than their heavier contemporaries. Steers in pen 1 (i.e., the light-weight pen) in both scenarios 2 and 3 had decreased quality grade and HCW compared to pen 2 in scenarios 2 and 3 and scenarios 3 and 4 (Table 1). These results disagree with those reported by Sainz and Oltjen (1994) that found heavier initial BW associated with decreased days on feed. Even when harvested at their optimal time, some lighter cattle struggled to meet market specifications. These results may be caused by the DMI equation, demonstrating the need for data from a long-term feeding trial with more complete DMI data, as steers in the current data set were not fed to an endpoint of harvest.

Differences in scenario profit were explained by the distribution of weights, grades, and DMI in

Table 1. Mean (±standard deviation) steer profitability and performance predicted by the feedlot steer model for four sorting scenarios: 1) steers purchased, fed, and marketed as a lot without sorting; 2) steers purchased, sorted by BW at receiving, and fed and marketed as two lots independently; 3) steers purchased and fed as a lot until midway through the feeding period and then sorted by BW into two lots marketed independently; and 4) steers purchased and fed as a lot and each individual steer marketed at its optimal time

	Scenario 1	Scenario 2		Scenario 3		Scenario 4
Parameter		Pen 1	Pen 2	Pen 1	Pen 2	
Mean lot profitability, $	122.45 (139.65)	125.10 (139.65)		127.85 (137.42)		161.78 (144.79)
Day of sale	201	189	211	187	219	190[a]
Pen profitability	n/a	121.35 (151.21)	128.85 (124.51)	89.87 (151.49)	165.82 (112.43)	n/a
DMI[b], kg	9.38 (0.86)	8.95 (0.64)	9.87 (0.71)	8.91 (0.63)	9.83 (0.71)	9.41 (0.89)
BW[c], kg	609.4 (53.06)	576.14 (45.96)	642.62 (36.81)	566.96 (36.43)	651.80 (26.53)	596.26 (72.53)
HCW, kg	387.46 (38.82)	363.03 (33.12)	411.89 (27.42)	356.26 (25.93)	418.66 (19.95	378.68 (53.05)
Quality grade[d]	11.11 (0.95)	10.90 (1.01)	11.33 (0.84)	10.65 (0.96)	11.58 (0.67)	10.99 (1.03)
Yield grade	3.90 (0.62)	3.76 (0.66)	4.04 (0.55)	3.60 (0.63)	4.20 (0.44)	3.82 (0.67)

[a]Individual steers were each harvested on their optimal day ranging from 130 to 250 d on feed.

[b]DMI for the feeding period.

[c]Shrunk BW at harvest.

[d]Quality grade: (No grade: <9.5, Select: 9.5 to <10.5, Choice: 10.5 to <11.5, Certified Angus Beef: 11.5 to <13.5, Prime: ≥13.5).

Table 1. Similar to Sainz et al. (1995), with an increased feeding period, BW, HCW, DMI, quality grade, and yield grade all increased. In scenario 4, when each steer was sold at its optimum time, feed was not consumed in excess, only contributing toward a more valuable carcass. Contrary to results reported by Pyatt et al. (2005), steers in scenario 4 had decreased HCW and quality grade, but overall profitability still remained greatest due to decreased feed costs and carcass discounts. However, despite harvesting all animals at their optimal time, mean quality grade was greater in scenario 1 than in scenario 2 (Table 1). This occurred because some of the steers lacked the genetic potential to achieve a marbling level greater than Select, regardless of the length of the feeding period. Scenario 3–pen 2 was the only combination that resulted in more than half of the pen grading Certified Angus Beef. Furthermore, consistent with the result reported by Sainz and Oltjen (1994), quality grade was relatively similar across all sorting strategies.

Results of sensitivity analyses showed that the model was most sensitive to grid base price. When grid base price was increased by 10%, mean profit per steer increased 172% (i.e., $332.56 per steer) and 145% (i.e., $300.56 per steer) for scenarios 4 and 1, respectively. When grid base price was decreased by 10%, mean profit per steer decreased by 101% (i.e., $2.33 per steer) and 136% (i.e., $43.78 per steer) for scenarios 4 and 1, respectively. Calf purchase price had the second largest effect on mean profit per steer. When grid base prices are unusually low or calf prices are particularly high, a producer may want to utilize sorting strategies to help improve profit margins. Feed prices did not have the effect anticipated. Averaged across all four scenarios, a 10% increase in feed costs caused a 39% decrease in mean profit per steer and a 10% decrease in feed costs caused a 66% increase in mean profit per steer. Increasing grid premiums increased profitability, and increasing discounts decreased profitability. However, depending on the Choice–Select spread, profitability estimates could vary greatly. Changing the discounts on overweight carcasses did not proportionately effect scenarios and pens because, in some scenarios, there were no overweight carcasses. All scenarios ranked the same during sensitivity analyses, but the variation between group profitability increased. Simulations in this report present conservative estimates of the effects of variation because the data set used for model evaluation was from a contemporary group of calves from a single herd that was relatively uniform at the start of the feeding period.

IMPLICATIONS

As volatility and uncertainty in cattle markets continue to increase, the value of uniform, predictable cattle will increase. Some feedlots are starting to implement camera systems that predict carcass measurements based on BW and body dimensions. Thus, these feedlots know much of the information predicted by the model and could use this methodology to determine the optimal marketing method. With consumer demand for high-quality beef, we see further divergence of the Choice–Select spread, emphasizing the need for predictability in beef finishing systems. Opportunities exist to combine new technologies and existing sorting strategies to improve feedlot profitability.

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