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Summary

The seasonal price pattern exhibited in the South Dakota cull cow market is one of low prices in the fall when most culling is done with increasing prices well into the following year. This pattern supports the assertion that cattle producers may improve profitability of their operations by feeding cull cows for several months rather than selling immediately at culling time. A dynamic programming model was used to determine the optimal strategy for marketing cull cows in South Dakota. The model systematically evaluated the sell now versus the hold and maintain or feed for gain strategies of the producer.

Results of the research support the hypothesis that cull cows should be retained and fed under certain circumstances. If cow weight was light and price was low at culling time, the optimal strategy was to feed. If cow weight was heavy and price was low, the optimal strategy was to feed for maintenance and take advantage of expected price increases. The optimal decision concerning length of time in the feedlot was to feed from November (culling time) through April for most price-weight combinations. However, potential added profits above selling in March were near zero and feeding beyond 120 to 150 days was not practical. The optimal rate of gain for most decisions to feed was 1.65 lb per day.

(Key Words: Cow, Cull, Price, Feed, Gain.)

Introduction

A large number of beef cows are culled from South Dakota herds every year. Producers are encouraged to pregnancy check cows after calves are weaned and to market open and low-producing cows. Many of these cows have been grazing ranges that due to typical seasonal variation have reduced quantity and quality of forage. Consequently, cows tend to leave the range in thin condition. Healthy, thin cows tend to gain weight faster than normal due to compensatory gain associated with previous periods of undernutrition.

Even though cows could gain efficiently, it takes time to gain weight. Because of this time element, price levels and potential price changes must be incorporated into the decision to feed or not to feed cull cows. By inspection, it appears that cow prices are at their seasonal lows in the fall of the year when culling and marketing have traditionally taken place. Seasonal high cow prices tend to occur in the spring of the year before cows that didn't winter well and/or lost their calves have been marketed. The index of cull cow prices graphed and shown in figure 1 rises quitely steeply from the fall selling period of October to December into the winter and spring months. The index peaks in May

and then settles downward throughout the summer. This indicates what happens on the average and strongly suggests that producers should evaluate the option of cull cow feeding every fall when culling is done.

Slaughter cow prices not only vary with time but also with quality. Cows sell as canner, cutters, utility and commercial. The best prices are normally attained at the utility grade. Since many cows come off pasture in poor condition, they may sell as canners or cutters at substantial price discounts to utility grade. A cow in thin condition coming off the range gains weight quite rapidly as realimentation takes place carrying a cow from lower grades to higher grades.

The potential to increase the profitability of the entire cow-calf business through cull cow feeding is uncertain. However, it appears to be an attractive alternative to evaluate for all cow-calf producers and especially interesting to the producer who has feeding facilities and access to abundant feed supplies. The major objective of this research was to determine the profitability of feeding cull cows.

Experimental Procedure

The decision evaluation process used in this research is analogous to enterprise budgeting. In the enterprise budget a price and rate of gain are assumed so that income can be calculated. Then, by assuming given prices for feed, a least cost ration can be calculated. Finally, other costs of production are calculated and along with feed costs subtracted from income to derive expected profit. It would take many hours of calculation to do an enterprise budget for every possible combination of price and rate of gain by hand. The model simply is a tool to speed this process to a few minutes once the model is working.

A dynamic programming model was used to determine the optimal decision or strategy for cull cow feeding. This model allows the use of a probability distribution function for price rather than using price as a predetermined variable as in most linear programming models. The dynamic programming model uses stages and states. The stages or times when a decision must be made were months in this model. At the beginning of each month the decision to sell or feed cull cows was made.

States are the current conditions and expected conditions that are present during a decision stage. A state in this model exists when a weight and price of a cow is known and a least cost ration, weather conditions and sunk costs of production are held constant. In this model, price varied according to the proability distribution function and several weight gain rates were allowed. The expected price in the decision stage was a function of the current price and the expected weight was a function of current weight. The model then indicates the optimal (most profitable) decision by comparing the sell now decision with given price and weight with an infinite number of possible outcome combinations for the end of the stage. The large number of combinations evaluated arise because several rates of gain are incorporated within an array of expected or potential price outcomes. The program reduces the number of outcomes evaluated by selecting a most probable price.

In this research, stages were calculated for 1 year assuming that cows culled 1 year would be sold before the next culling season. Least cost rations were derived for cow beginning weights ranging from 770 to 1320 lb. South Dakota feed prices in the fall of 1985 were used in least cost rationing.

Results and Discussion

The decision outcomes of the model were limited in the printout process. However, interpolation between outcomes presented is appropriate. The model output presented in tables 1 and 2 has the following code:

1. Sell cows
2. Maintain cow weight
3. Feed, .55 lb per day
4. Feed, 1.10 lb per day
5. Feed, 1.65 lb per day
6. Feed, 2.20 lb per day
7. Feed, 2.75 lb per day

In table 1, potential discounted profit in dollars per head is presented along with the optimal feeding decisions to be made at the beginning of stage one (November). The optimal decision is to feed when you begin the month with a 770-lb cow and a price of $300 per hundredweight. The five (5) code for this state indicates that the best rate of gain under these conditions is 1.65 lb per day and the 42.15 is the potential profit (above selling immediately) to be made if this animal is fed through all following stages until the sell decision is made.

At the heavier weights, the optimal decision is to feed at a low rate of gain (code 3) or to maintain (code 2) to take advantage of expected price increases. At a current price of $40 per hundredweight and weight of 1322 lb, the optimal decision is to sell (code 1).

As the cow moves through the stages of the model (month to month), the expected profit from feeding decreases because part of the expected profit from feeding was attained in the previous stage (month). When a state (price-weight combination) is identified by a code of 1 at a stage several months from the beginning of feeding, all profits were worked into the cow through price and gain increases from previous months and no further profit can be made. Table 2 contains optimal decisions for the stage beginning of April. All of the weight price combinations with a 1 code show no further profit potential and thus indicate sell as the best decision. For example, if current price is $37.50 and the cow weighs 1102 lb, the best decision is sell. For a current price (April 1) of $30 and a weight of 882 lb, the best decision is to feed for gain according to code 5 (1.65 lb per day). The expected proifit is low at $4.07 per head because most price increase benefits were taken up in previous months.

The next printout for stage May to June shows results of all codes of 1 except for very low prices and light weights. The expected profits were all under $2 per head for feeding the month of May. The June printout resulted in all codes of 1, indicating that no cows should be held past the beginning of June. From a practical standpoint, few cows would be fed past the beginning of March given the low expected profits from continued feeding.

Given the conditions of the cow market in late 1985, feeding of cull cows appeared to have a good profit potential. This was especially true for thin cows because they demanded a price only in the mid-thirties. A better condition cow, on the other hand, demanded a higher price and potential profit from feeding was not large. Feeding heavy cows a maintenance diet for several months to take advantage of potential price increases did not provide for large profits.

TABLE 1. EXPECTED PROFIT FROM FEEDING CULL COWS FROM NOVEMBER TO DECEMBER WITH VARIOUS BEGINNING COW PRICES AND WEIGHTS

Cow price	Cow weights, lb					
$/cwt.	770	880	990	1100	1210	1320
30.00[a]	5	5	5	5	3	2
	42.15	42.89	44.31	45.38	37.70	22.12
32.50	5	5	5	5	3	2
	43.46	43.75	44.40	44.84	34.49	16.45
35.00	5	5	5	5	3	2
	43.61	43.40	43.38	42.92	30.37	10.37
37.50	5	5	5	5	3	2
	39.91	39.05	38.46	36.88	23.65	1.74
40.00	5	5	5	5	4	1
	30.07	28.15	26.70	23.71	10.41	.00

[a] The first row is the code and the second line is the potential profit from feeding at the rate of gain indicated by the code.

TABLE 2. EXPECTED PROFIT FROM FEEDING CULL COWS FROM APRIL TO MAY WITH VARIOUS BEGINNING COW WEIGHTS

Cow price	Cow weights, lb					
$/cwt.	770	880	990	1100	1210	1320
30.00[a]	5	5	5	5	4	1
	4.49	4.07	3.82	3.52	2.81	.00
32.50	5	5	5	5	5	1
	3.28	2.88	2.54	2.28	1.24	.00
35.00	5	5	5	5	1	1
	2.65	2.13	1.59	1.09	.00	.00
37.50	5	5	5	1	1	1
	2.16	1.39	.65	.00	.00	.00
40.00	5	5	5	1	1	1
	1.68	.67	.00	.00	.00	.00

[a] The first row is the code and the second line is the potential profit from feeding at the rate of gain indicated by the code.