AS 656 ASL R2505

2010

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A.S. Leaflet R2505

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Summary and Implications

This analysis of nearly 15,000 head of fall placed calf-feds found similar results to 2002 ISU work in spite of 22% higher corn prices and 38 % higher cattle prices. The data does show strong correlations between economically important carcass and production variables, some of which are antagonistic. Carcass weight has a strong positive correlation with REA and ADG; that is faster growing cattle have larger carcasses with larger ribeyes. As MS increases so does FC and FG; thus higher marbling cattle put on more external fat and require more feed per pound of gain. Also, as ADG increases FG decreases, a favorable outcome. Marbling is less correlated than some variables, but has a positive relationship with ADG, but negative with REA, PW and HT.

In general, the relative importance of each variable in the model on net return in the feedlot was less pronounced in this analysis than in previous work. The difference may be explained by the inclusion of placement weight and individual health treatments that were not in the earlier study. There are also almost thirteen times more observations in this analysis that may have moderated the impact of any one variable. In both studies marbling was identified as having the largest relative impact on net returns for feedlot cattle when the Choice-Select spread is $8/cwt or higher. The Choice-Select spread where the relative importance of marbling score is equal to other factors is approximately $6/cwt in the current analysis. The relative importance ranking of carcass and management variable was similar in this analysis to previous work. Hot carcass weight and feed to gain were next behind marbling followed by ribeye area. Placement weight is strongly correlated to carcass weight and statistically may be capturing part of the variation that was explained by carcass weigh in the earlier model.

Introduction

Beef producers manage their resources and cattle characteristics in the context of market incentives to maximize their economic returns. This task becomes more difficult as market signals often change faster than cattle producers can adjust genetics and production systems. In the commodity era of beef production when there was little differentiation on quality grade economic incentives were to focus on pounds. During the late 1990s consumer demand for an improved eating experience and higher quality grade beef brought about value-based marketing programs that paid larger premiums for Choice relative to Select grade (Figure 1) and increased bids for premium Choice and Prime carcasses. Previous work reported in 2002 found that marbling score had a greater economic payoff than carcass weight at Choice-Select spreads of $8/cwt or higher. Producers shifted their focus from pounds to marbling in pursuit of premiums.

The economics of beef production has changed since data from 1996-1999 were analyzed and reported in 2002. Value-based marketing is commonplace, the national beef cowherd has shifted toward more Angus influence, and carcass weights have increased. Most notably, however, is that cattle and grain prices have increased. Iowa-fed cattle and corn prices for 1996-99 averaged $64.13 and $2.49, respectively, compared to $88.87 and $3.04 for 2005-2008. Because of increased demand from biofuel production, the expectation is that grain prices will remain higher than historic levels. How do the economic signals change with higher grain and beef prices?

This paper revisits the 2002 project/analysis and evaluates the relative importance of selected cattle performance and carcass characteristics on feedlot profitability given the new price levels. The original paper contains a review of relevant literature regarding the emergence of grid marketing as marketing method and the cattle and carcass characteristics that impact profitability. This analysis expands the initial study and represents significantly more cattle from the Tri-County Steer Carcass Futurity with individual gain and carcass measurements and estimated feed intake and efficiency. The results indicate that even with higher feed costs, marbling score remains a major driver of feedlot profitability at Choice – Select boxed beef spreads of approximately $6/cwt or more, similar to the previous results.

Materials and Methods

The Tri-County Steer Carcass Futurity Cooperative (TCSCF) in southwest Iowa has specialized in feeding retained ownership cattle for twenty-seven years and has fed for cowherd owners in twenty-one states. Iowa State University Extension advises the Tri-County Steer Carcass Futurity Board, which is responsible for collection and analysis of animal, feeding, and carcass data. Within three days of arrival at the feedlot, individual animal weight and condition score are recorded. Individual weights, disposition score, and health treatments are recorded throughout the feeding period; at slaughter, full carcass data is collected. TCSCF has collected data on over 35,000 head in recent years. For this analysis the data were limited to cattle placed at six to eighteen months of age, which is 74% of the cattle (22,717 head). The data were further restricted to fourth quarter placements to remove much of the seasonal effects and still represents 64.7% of the six-to-eighteen-month-old placements. These data on nearly 15,000 steers and heifers are summarized in Table 1. Compared to the 2005 National Beef Quality Audit, the data have less variability. For example, the coefficient of variation for carcass weight and yield grade are 11% and 20% for the TCSCF carcasses compared to 13% and 31% for the NBQA. The greater consistency is largely due to cooperating feedlots following similar management and marketing protocol and pens of cattle are sorted and sold at two or more harvest dates.

The majority of the cattle in this analysis are calf feds with 89% placed by twelve months of age (Figure 2) and 75.4% of the cattle are steers. The cattle in this dataset are heavily influenced by Angus genetics with less than 15% not having at least one Angus grandparent (Figure 3). Table 2 shows the correlation of selected performance and carcass variables for steers and heifers. Hot carcass weight is highly and positively correlated with REA, ADG and PW. There is a strong negative correlation between ADG and estimated FG. Keep in mind that FG is estimated using the Cornell Net Carbohydrate and Protein System model (CNCPS), which prorates total pen level feed intake to individual animals based on the amount and composition of gain and reflected in the YG factors. There were moderate (approximately 0.3) and positive correlations between FC and MS and FC and FG and a similar negative relationship with FC and REA. Ribeye area is positively correlated with PW and ADG and negatively correlated with FG. There were weaker correlations (near 0.15) between ADG and MS (positive) and ADG and HT (negative).

Input and output prices were standardized across years and marketing periods to identify profit differences due to performance, efficiency and carcass traits. Feed prices were standardized for the cost per pound of feed delivered to the cattle. Corn, alfalfa hay, mixed hay, soybean meal, limestone, supplement and mineral block prices were obtained from USDA Agricultural Marketing Service. Deccox, Zinpro and Aureomycin prices were obtained from commercially available prices reported on the internet. Corn gluten meal price was estimated as 2.73 time corn price, the price ratio was obtained from the *Feedstuffs* magazine price reported for Chicago between September 2002 and August 2007. Dry Distillers Grain with Solubles price was estimated as 0.91 times corn price, the price ratio was obtained from USDA reported prices compiled by the Livestock Market Information Center. Corn silage price in $/ton was estimated as 9 times the corn price ($/bu). Feed ingredients without regularly reported prices were valued relative to a reference ingredient using the % TDN as the adjusting factor. Vitamin and mineral supplements and protein supplements were priced relative to comparable products.

Cattle prices were based on USDA-AMS reported prices. The Nebraska weighted average price Choice-Select 35-65% average price from August 2004 to July 2009 was used as the fed cattle base price. This price is adjusted by a monthly index to estimate the marketing grid base price. The Nebraska weighted average price from 1992-2008 was used for estimating the fed cattle price monthly seasonal index. Feeder cattle prices and price seasonality for each weight range was estimated using the USDA-AMS reported prices for combined auctions of Missouri, Nebraska and Kansas. The ten-year time series between September 1999 and August 2009 was used to estimate the seasonality index of feeder cattle prices and the last five years (September 2004 to August 2009) average price for each range was used as the base price for feeder cattle price.

Net return (NR) per head is defined as the difference between total revenue (TR) and total costs (TC). Equation 1 is the net revenue for the ith animal.

Eq. 1 $NR_i = TR_i - TC_i$

Total revenue was calculated for each animal using actual carcass weight and grade, a standardized base price for cattle and the representative marketing grid commercially available in the mid-2000s. The grid in Table 3 pays premiums and discounts based on quality grade and yield grade, and pays discounts on out-of- range carcasses. Later the grid premiums and discounts will be changed to determine the sensitivity of the results to grid parameters. Hot carcass weight is measured at the plant on each animal. Quality grade is determined in the plant by an USDA grader based on the carcass being in the acceptable range for youthfulness and lean color and on the degree of marbling. Dark cutters were a very small percentage of the total and were not included in the dataset. Marbling score is the measure of marbling and was called by the USDA Grader. These scores are on a scale with 1000 equal to low Choice and 1300 equal to low Prime.

In most commercial applications the USDA grader will determine the yield grade based on visual appraisal.

However, these yield grade data were calculated from measured data collected by trained employees of the TCSCF which measure FC and REA in inches and square inches, respectively in the plant ahead of the grading station. Kidney, pelvic and heart is a percentage estimated by the TCSCF staff. Yield grade reflects the lean meat yield of the carcass and is calculated from carcass measurement collected by TCSCF staff.

Total cost per head is the sum of each animal's feed cost, yardage charge, animal health, feeder animal cost, and interest on the feeder and half the feed cost. Feed cost is based on standardized feed prices, total gain, and FG. As discussed earlier, FG in this analysis is calculated for each animal using pen level feed disappearance and individual animal gain (collected at the beginning and end of feeding period) and carcass yield grade. The yield grade measurements quantify the percent bone, lean, and fat in the carcass. Using this information, the Cornell Net Carbohydrate and Protein System was used to prorate total pen feed consumption across the individual animals based on the amount and composition of gain (lean or fat). As a result the FG variable explicitly incorporates average daily gain.

The goal of the regression analysis is to explain as much of the variation in profitability across cattle as possible. The results are evaluated over a range of cattle prices, discounts and premiums and feed prices. The NR is calculated for a given set of input and out prices and then regressed on independent variables hypothesized to impact revenue and costs (Equation 2). The analysis is repeated under different price scenarios to evaluate how the importance of each characteristic changes under varying economic signals.

Eq.2 NRi = f(FGi, HCWi, FCi, REAi, KPHi, MARi, PWi, HCi)

It is expected that FG, FC, KPH, HC, and PW will be inversely related to profits. The remaining variables are expected to have a positive effect on net returns. Ordinary Least Squares regression is used and the resulting beta coefficients reflect the change in NR for a one unit change in the independent variable. However, the independent variables have different standard deviations, a measure of variability, meaning that a one unit change for variable X may be more likely than a one unit change in variable Y. Standardized beta coefficients are calculated by scaling ordinary least squares coefficient estimates by the ratio of the standard deviation of the relevant independent variable to the standard deviation of the dependent variable. This calculation converts ordinary least squares estimates to unit-free coefficients whose absolute magnitudes are directly comparable, revealing the relative importance of the variable, or it is the % change of the independent variables on the dependent variable. Simply put, this technique reveals how many standard deviations the dependent variable is expected to change in response to a standard deviation change in each respective independent variable.

Results and Discussion

Models were estimated for steers and heifers placed in the fourth quarter (Table 4). The R^2 were 0.78 for nearly 10,400 steers and 0.73 for 3,255 heifers indicating that 78% to 73% on the variation in net returns is explained by the variables indicated in the model. The Regression Beta is the output of the ordinary least square regression model. All variables are highly significant ($P< .01$) and have the expected sign.

The Standardize Beta number is the percent of variation in NR explained by that variable. The larger the Standardize Beta in absolute value the more important the variable is to NR. The most important variable explaining NR in the baseline scenario is MS with a Standardized Beta of 0.42 for steers and heifers. For heifers HCW, PW and FG had Standardize Beta coefficients that explained approximately 30% of variation in NR. Placement Weight is the second most important explanatory variable for steers NR.

The Regression Beta coefficients are the dollar impact on NR for a one unit change in the independent variable, but may be difficult to interpret. Table 5 scales the regression beta into units that are more commonly used by producers. For example, multiplying the MS beta by ten degrees of marbling points is equivalent from $Modest^0$ to $Modest^{10}$, and is associated with increasing NR by $5.17/head in steers and $4.17/head in heifers. Similarly, a 10 lb increase in HCW is associated with increasing NR by $3.50/head in steers and $4.60/head in heifers. An increase in one-tenth pound increase in ADG increases NR by $3.58/head head in steers and $2.15/head in heifers. The steer NR decreased $1.29/head for every dollar spent in health treatments, therefore there is an effect beyond the treatment cost itself. Other variables associated with lower NR were FC, FG and PW. The other variables are interpreted similarly.
The Standardized Beta from Table 4 and the Economic Values from Table 5 should be used together. For example, the Economic Value of increasing placement weight 10 pounds is a decrease in NR of $3.40 per head which seems small, but the Standardized Beta is 0.34 for steers, making it the second most important variable impacting NR. The reason is that it relatively easy to change placement weight 10 lbs, but more difficult to change it one standard deviation which is 95 lbs.

A sensitivity analysis was applied to the steer model to analyze how the results change when the Choice-Select spread, base carcass price and feed prices change (Table 6). Choice-Select spread initial baseline was set at $8 and is examined at $4, $12, or $16 per cwt carcass. Feed prices were adjusted up and down by 20% and the base carcass price is evaluated at $10/cwt higher and lower.

The importance of MS on NR is directly related to the Choice-Select spread. At $4/cwt it is the second most important variable, slightly lower than PW. However, at $8 (baseline) and higher Choice-Select spread values MS is increasingly important and increases in importance with the spread. As marbling becomes more important the other variables become relatively less important in explaining NR. The Regression Beta for MS is the dollar value from increasing the MS one degree. One-third of a quality grade (33.3 degrees) is worth $12.65 per head at a $4 Choice-Select spread and $31.30 per head at a $16 spread. At a Choice-Select spread of approximately $6/cwt MS and PW have Standardized Betas that are nearly equal and larger than the other variables.

Marbling Score remains the most important variable over the range of feed and carcass prices considered. Feed to Gain, PW and HCW are the most sensitive variables to changes in feed costs (also compare to Table 4). Placement Weight and HCW are more important with lower feed costs and FG is more important with higher feed costs. Hot Carcass Weight is the only variable to show much change due to a change in base price. It is more important at higher prices and less important a lower prices.

Table 1. Summary of Tri-County Steer Carcass Futurity Cooperative cattle and carcass data included in regression analysis, fourth quarter placements 180-540 days of age at placement.

	obs	mean	st dev	min	max
Hot Carcass Weight (HCW)	14,707	721	70	458	983
Fat Cover (FC)	14,707	0.44	0.14	0.02	1.20
Ribeye Area (REA)	14,707	12.41	1.19	8.50	18.40
KPH	14,707	2.27	0.46	0.25	4.50
Marbling Score (MS)	14,707	1024	79	800	1490
Yield Grade (YG)	14,707	2.83	0.57	0.11	5.19
Feed to Gain* (FG)	14,706	6.89	0.87	4.40	14.53
Average Daily Gain (ADG)	14,707	3.13	0.51	0.77	5.49
Placement Weight (PW)	14,707	630	95	294	1022
Individual Health Treatments (HT)	14,707	5.62	15.85	0.00	245.30
Weight Gained (WG)	14,540	542	72	319	762

* Feed to gain estimated using the Cornell Net Carbohydrate and Protein System model (CNCPS) http://www.cncps.cornell.edu/downloads.htm

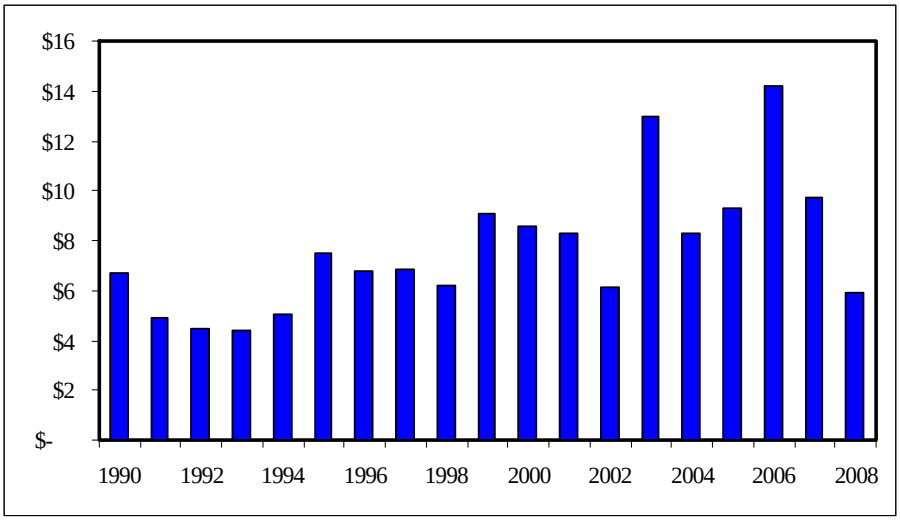

Figure 1. Annual Choice - Select boxed beef price spread, $/cwt.

Table 2. Correlation matrix of selected carcass and management variables for Tri-County Steer Carcass Futurity steers and heifers placed in the fourth quarter, n=13,639.

BOTH SEXES	HCW	FC	REA	MS	FG	ADG	PW	HT
Hot Carcass Wt	1							
Fat Cover	0.04	1						
Ribeye Area	0.53	-0.29	1					
Marbling Score	0.04	0.27	-0.15	1				
Feed To Gain	-0.08	0.27	-0.31	0.02	1			
Average Daily Gain	0.57	0.10	0.28	0.16	-0.54	1		
Placement Weight	0.55	0.03	0.26	-0.10	0.40	0.01	1	
Health Treatments	-0.10	-0.09	0.00	-0.11	-0.06	-0.14	-0.07	1

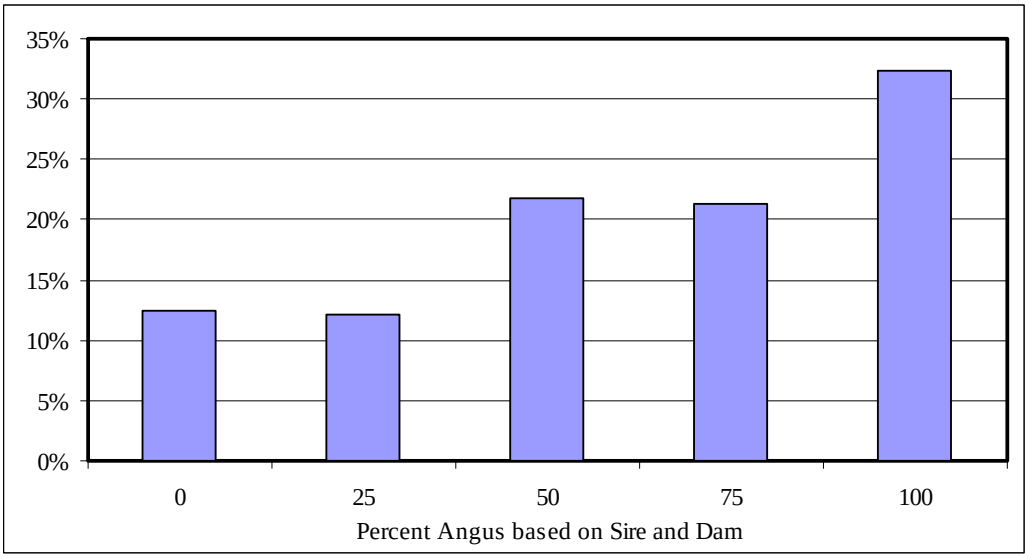

Figure 2. Percent Angus genetics reported by owner.

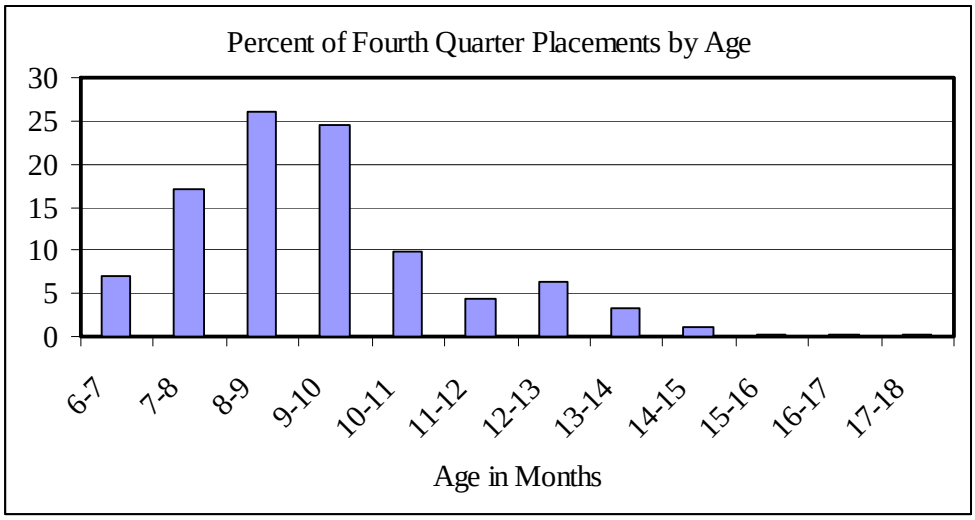

Figure 3. Fourth quarter placements by age.

Table 3. Marketing grid used for calculating final carcass value.

Base Carcass Price	$140.12		
Quality Grade	Adjustment	Carcass Weight	Adjustment
Prime	$15.00	Under 500 lbs	-$30.00
CAB (Ch+ and Cho)	$5.00	500-549 lbs	-$20.00
NonBlack (Ch+ and Cho)	$5.00	951 - 999 lbs	-$10.00
Select ($ off of Choice)	-$8.00	1000 lbs and up	-$20.00
Standard ($ off of Choice)	-$25.00		
Off Grades ($ off of Choice)	-$35.00		
Yield Grade	Adjustment		
Yield Grade 1	$5.00		
Yield Grade 2	$3.50		
Yield Grade 4	-$20.00		
Yield Grade 5	-$25.00		

Table 4. Regression results for Tri-County Steer Carcass Futurity cattle placed on feed in fourth quarter. Dependent variable is net return per head.

	Steers placed in 4th quarter			Heifers placed in 4th quarter		
R2 & obs are:	0.78		10,384	0.73		3,255
Variable	Regression Beta*	Std Error	Standardize Beta	Regression Beta*	Std Error	Standardize Beta
Intercept	-649.04	10.20	0.00	-496.39	17.86	0.00
Hot Carcass Wt	0.35	0.01	0.25	0.46	0.02	0.31
Fat Cover	-53.67	3.77	-0.08	-106.46	6.04	-0.19
Ribeye Area	12.10	0.46	0.15	12.12	0.91	0.16
Marbling Score	0.52	0.01	0.42	0.42	0.01	0.42
Feed To Gain	-26.05	0.82	-0.23	-28.71	1.24	-0.33
Daily Gain	35.82	1.41	0.20	21.54	2.44	0.12
Placement Weight	-0.34	0.01	-0.34	-0.29	0.01	-0.32
Health treatments	-1.29	0.03	-0.23	-1.24	0.05	-0.24

* All variable are significant at P<.01

Table 5. Economic value of a one unit change in the independent variable on the net returns for steers and heifers placed in the fourth quarter

Variable	One Unit	Steers	Heifers
Intercept		-649.04	-496.39
Hot Carcass Wt	10 pound	3.50	4.60
Fat Cover	1/10 inch	-5.37	-10.65
Ribeye Area	1 sq. inch	12.10	12.12
Marbling Score	10 degrees	5.17	4.17
Feed To Gain	1/10 pound	-2.61	-2.87
Daily Gain	1/10 pound	3.58	2.15
Placement Weight	10 pound	-3.40	-2.90
Health treatments	1 dollar	-1.29	-1.24

Table 6. Sensitivity analysis of Choice-Select spread, base price and feed price changes on the net return to Tri-County Steer Carcass Futurity steers placed in the fourth quarter.

Sensitivity	Ch-Sel $4		Baseline		Ch-Sel $12		Ch-Sel $16	
R-square is:	0.77		0.78		0.78		0.77	
Variable	Regrsn Beta	Strd Beta	Regrsn Beta	Strd Beta	Regrsn Beta	Strd Beta	Regrsn Beta	Strd Beta
Intercept	-504	0	-649	0	-939	0	-1084	0
Hot Carcass Wt	0.37	0.28	0.35	0.25	0.32	0.20	0.30	0.17
Fat Cover	-54.78	-0.08	-53.67	-0.08	-51.44	-0.06	-50.32	-0.06
Ribeye Area	12.42	0.17	12.10	0.15	11.47	0.13	11.15	0.11
Marbling Score	0.38	0.32	0.52	0.42	0.80	0.56	0.94	0.60
Feed To Gain	-26.58	-0.25	-26.05	-0.23	-25.00	-0.19	-24.48	-0.17
Daily Gain	34.66	0.20	35.82	0.20	38.14	0.18	39.30	0.17
Placement Weight	-0.34	-0.36	-0.34	-0.34	-0.34	-0.30	-0.34	-0.27
Health treatments	-1.28	-0.24	-1.29	-0.23	-1.31	-0.20	-1.31	-0.18

Sensitivity	Feed +20%		Feed -20%		Base Price +$10		Base Price -$10	
R-square is:	0.75		0.81		0.79		0.77	
Variable	Regrsn Beta	Strd Beta	Regrsn Beta	Strd Beta	Regrsn Beta	Strd Beta	Regrsn Beta	Strd Beta
Intercept	-632	0	-666	0	-649	0	-649	0
Hot Carcass Wt	0.23	0.17	0.48	0.34	0.45	0.32	0.25	0.19
Fat Cover	-52.95	-0.08	-54.38	-0.07	-53.67	-0.07	-53.67	-0.08
Ribeye Area	12.85	0.17	11.35	0.14	12.10	0.15	12.10	0.16
Marbling Score	0.52	0.43	0.51	0.41	0.52	0.41	0.52	0.43
Feed To Gain	-30.83	-0.28	-21.28	-0.19	-26.05	-0.23	-26.05	-0.24
Daily Gain	34.64	0.19	37.00	0.20	35.82	0.19	35.82	0.20
Placement Weight	-0.27	-0.27	-0.41	-0.41	-0.34	-0.33	-0.34	-0.35
Health treatments	-1.32	-0.23	-1.27	-0.22	-1.29	-0.22	-1.29	-0.23

Acknowledgements

Special thanks to the Tri-County Steer Carcass Futurity Cooperative for the use of their data and to Certified Angus Beef for financial support of the analysis.