Value Indicators in Feeder Cattle:
An Analysis of Multi-State Auction Data

Final Report prepared for the
Agricultural Marketing Service, USDA

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September 2023

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Introduction

Feeder cattle, collectively and at any one point in time, represent a diverse set of animals that vary widely in size, age, gender, quality, genetics, condition, and management. Moreover, regional variation in cattle production systems, cattle types and cattle industry culture add to the national diversity across feeder cattle markets. The Agricultural Marketing Service faces numerous challenges to capturing feeder cattle market price levels and trends across a vast array of public auctions around the country. Increasingly, there is demand for additional information regarding the range of factors that affect the value of feeder cattle. This project was initiated to help address these growing needs.

Project background

Oklahoma Cooperative Extension Service (OCES) has collaborated with the Oklahoma Cattlemen's Association since 2001 to offer and support a value-added preconditioning program called the Oklahoma Quality Beef Network (OQBN) for cattle producers. The program consists of preconditioning calf management protocols that producers adopt which are then certified by OCES personnel for cattle to qualify to sell in special OQBN sales at participating public livestock auctions.

In 2008, OCES personnel began collecting detailed auction data to verify the differences in value for cattle marketed as part of the OQBN program compared to other cattle. This data collection effort was led by Derrell Peel and Kellie Raper and was supported by OCES personnel, OSU graduate students, and other faculty. A programmed spreadsheet was developed by Eric DeVuyst to facilitate the real-time capture of auction data and a broad array of sale lot characteristics beyond what is typically captured in publicly available data. This spreadsheet makes it possible to capture many sale and lot characteristics during auctions that can be analyzed to determine the impact of physical and management factors on

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the value of cattle and to compare OQBN program cattle to non-OQBN cattle. This has resulted in a growing database of over 18,000 lots and over 178,000 head of OQBN program and non-OQBN cattle from 2010-2022.

In the fall of 2021, the Agricultural Marketing Service (USDA-AMS) approached Derrell Peel and Kellie Raper about collecting similar data on a broader set of markets in multiple states with the objective of a more comprehensive analysis to analyze factors that impact feeder cattle value and provide additional evidence to support AMS efforts to expand market information in AMS market reports. Moving rapidly, efforts were initiated to identify collaborators in various states to utilize the OSU data collection tool (with some modifications) to collect feeder cattle auction data in several states and sale locations.

Project Objectives

The project had two primary objectives:

1) To collect feeder cattle auction data in multiple states/sales including as many cattle characteristics as possible to permit analysis that would identify factors affecting the value of different lots of cattle.
2) To quantify the individual impact of various factors that affect the value of feeder cattle using multi-variate econometric analysis.

Data Collection

The basic data collection protocol consisted of capturing the details of the sale for a particular lot of animals. Information on lot characteristics, physical cattle characteristics, and calf management practices were recorded for each lot. Table 1 includes the range of sale characteristics included in the data collection spreadsheet. Lot characteristics include number of head in the lot, average weight, sex, and uniformity. Calf management characteristics include weaning status, days weaned, vaccination status, health status and program certifications. Physical cattle characteristics include hide color/breed, muscling, frame, fill, flesh, Brahman influence, and horns. Additional data collected include sale time, date, age and source verification, seller-announced, and any announced or written management comments. In general, the project attempted to capture the full range of information that buyers have available to them during the sale. This includes visual characteristics of the sale lot, announcements and verbal descriptions provided and, sometimes, written sale information. This set of information,

combined with the details of the sale transaction, represents the data that can be analyzed to assess the impact of various factors on the value of a given lot of cattle.

Data was collected from October 2021-April 2022 across seven states in a total of 92 individual sales at 21 locations (Tables 2 and 3). States included Kansas, Kentucky, Nebraska, Missouri, Oklahoma, South Dakota, and Wyoming. In total, the data includes 275,335 head of feeder cattle in 18,038 sale lots. The value of cattle included in the data was over $291 million. Data was collected by extension personnel and contractors in each of the states. Locations in Oklahoma and South Dakota account for 60% of the lots, but 75% of the cattle.

Data Summary

Lot Size Differences Across States

Average lot size is one indicator of regional differences, both across states and within states. Table 3 indicates that average lot size was highest in South Dakota at 25.6 head, followed by Nebraska (20.6), Wyoming (15.5) and Oklahoma (13.1). Kansas (8.8), Missouri (6.2) and Kentucky (4.3) all have average lots sizes under 10 head, with Kentucky reporting the smallest lot sizes, overall and across individual sales within the state. Lots sizes were relatively consistent across in-state sales for Kentucky, Nebraska, and South Dakota. The Joplin sale in Missouri had the largest lot size (15.4 head) by far for the state while, in Oklahoma, the average lot size for McAlester (2.5) was substantially lower than for the other 3 sale sites.

Physical Characteristics

Nearly 48% of steer lots and 47% of heifer lots were sold at average weights between 500 and 700 pounds (Table 4). Table 4 also indicates that mixed #1-2 muscled lots represented approximately 63% of total lots as did medium/large-framed lots. Interestingly, lot sizes were significantly higher for lots scored as #1 muscling than for those with lower muscling scores. This holds true to a lesser extent for large-framed lots relative to lots with other frame scores.

The distribution of hide color and/or breed designation is reported in Table 5. Not surprisingly, black hided cattle dominate the data, with 60% of cattle recorded as black hided and another 15% recorded as predominantly black. This is followed by nearly 9% designated at mixed high quality lots. These are typically lots with no predominant hide color, but cattle of good quality. Red or predominantly red lots

make up 7.8% of lots, followed by white/gray-hided lots of cattle at 6.3%. Herefords were represented in less than 1% of lots. Approximately 9% of lots showed Brahman influence with another 1% of lots showing minimal Brahman influence.

Management Characteristics

Management characteristics are those attributes of the cattle directly influenced by producers through how cattle are managed between birth and sale. Nearly 64% of cattle were marketed as weaned cattle, implying they had been separated from the dams for a minimum of 30 days before marketing (Table 6). Vaccination information was collected in two forms: (1) vaccinated cattle were reported as having more than one dose of respiratory complex vaccinations and (2) limited vaccination cattle were reported as having had one dose of respiratory complex vaccinations. Cattle considered fully vaccinated comprise 54.1% of the lots collected and limited vaccination cattle comprise another 8.4%, for a total of 62.5% of lots having received at least one round of respiratory vaccinations prior to sale. Approximately 46% of lots were both weaned and vaccinated prior to marketing. Nearly 6% of lots were marketed as Natural (5.4%) or Non-Hormone Treated Cattle (NHTC) (0.5%). Interestingly, the lot size for NHTC cattle was nearly double that of other characteristics. Two certification programs with sizable data were the Oklahoma Quality Beef Network (OQBN) with 1.1 percent of the lots and the Integrity Beef program with 0.5 percent of total lots. A very small number of sale specific certification programs were noted in the data as well. Finally, horns or minimal horns were documented in 3.3% of lots.

Value Characteristics of Feeder Cattle Auction Data

Modeling

The economic concept of the "law of one price" holds that price differences for a particular product are explained by adjusting for time, place, and form. In the case of feeder cattle, observed price differences for a particular lot of cattle are therefore due to time differences impacting the supply and demand that determine overall market values, location differences, and individual characteristics of the animals. A hedonic pricing model was used to analyze the contribution of lot attributes, physical attributes, and management attributes to overall lot price. The basic assumption of hedonic models is that buyers choose among goods with varying attributes and place values on the individual characteristics of a good based on the perceived utility or benefit that they gain from each (Lancaster, 1966; Rosen, 1974). The overall price of a good then is the sum of values that the buyer places on each of the good's individual characteristics.

Hedonic models are commonly used to model pricing differences in markets where the product can be viewed as differentiated in that buyers have choices related to specific characteristics. Examples include real estate, rental housing, and cars. Hedonic modeling has been used often to analyze the marginal price impact of varying lot characteristics, physical characteristics, and calf management practices on lot prices for feeder cattle. Selected examples include Bulut and Lawrence (2007), Coatney, Menkhaus, and Schmitz (1996), Schroeder et al. (1988), Williams et al. (2014), Williams et al. (2012), and Zimmerman et al. (2012).

Conceptually, the hedonic model used for this analysis is:

1) $P_{it} = f(M_t,\ C_{ji}),$

where P_{it} is the price of the lot i of cattle in time t; M_t is the cattle market level in time t; and C_{ji} is the set of j characteristics that differentiate each lot of cattle, i, including sale locations.

Because the data for this project was collected over several months, adjusting prices for changes in general market conditions is necessary. The CME Feeder Cattle Index was used as a reference market for underlying market values each week. Thus, the price of a lot of cattle in a given week (equation 1) would reflect the underlying market level M_t (as indicated by the CME Feeder Cattle Index) along with the set of sale characteristics and the sale location.

However, cattle price and the CME Index value will be highly correlated, resulting in a regression model with a high degree of multicollinearity when the CME Index is included as a separate independent variable. The usual solution for this is to use a first-difference specification, where the dependent variable is the difference between the lot price and the CME Index value. The resulting value is called a basis, as it is the difference between two prices, and is specified as:

2) $Basis_{it} = P_{it} - CME\ Index_t.$

By subtracting out the underlying market value, the regression model focuses on the remaining differences in value due to the lot characteristics. Using this basis specification, changes in cattle market conditions at different times are removed from the model, while retaining the focus on the impact of individual sale characteristics and location differences.

The hedonic model to be estimated is:

$$3)\ Basis_i = \beta_0 + \beta_1 \mathrm{Ln}(\mathrm{head}_i) + \beta_2 (\frac{\mathrm{avgwt}}{100})_i + \beta_3 \left(\frac{avgwt}{100}\right)_i^2 + \sum_{j=1}^{3} \beta_{3+j}\, Gender_{ij} + \beta_7 \mathrm{Wean}_i$$
$$+ \beta_8 \mathrm{Vaxx}_i + \beta_9 \mathrm{Health}_i + \sum_{j=1}^{10} \beta_{9+j} Hidecolor_{ij} + \sum_{j=1}^{2} \beta_{19+j}\, \mathrm{Horn}_i$$
$$+ \sum_{j=1}^{3} \beta_{21+j}\, Condition_{ij} + \sum_{j=1}^{5} \beta_{24+j}\, Muscling_{ij} + \sum_{j=1}^{4} \beta_{29+j}\, Frame_{ij}$$
$$+ \sum_{j=1}^{3} \beta_{33+j}\, Fill_{ij} + \beta_{37} Uniform_i + \sum_{j=1}^{7} \beta_{37+j}\, Certification_{ij}$$
$$+ \sum_{j=1}^{2} \beta_{44+j}\, Brahman_i + \beta_{47} \mathrm{Natural}_i + \beta_{48} \mathrm{Cripple}_i + \beta_{49} \mathrm{Badeye}_i$$
$$+ \sum_{j=1}^{21} \beta_{49+j}\, Location_{ij} + \sum_{j=1}^{5} \beta_{70+j}\, Month_{ij} + \mu_i + e_i$$

where $i = 1,\ldots,18038$ denotes each sale lot; *head* is the number of animals in lot *i; avgwt* is the average weight of the animals in lot *i*; $gender_{i1}$ equals 1 if heifers; $gender_{i2}$ equals 1 if the lot is bulls or mixed gender; $gender_{i3}$ equals 1 if the lot is replacement heifers; *wean* equals 1 if the lot is weaned; *vac* equals 1 if the lot is vaccinated; *health* equals 1 if there are unhealthy animals in the lot; $hidecolor_{ij}$ are dummy variables for hide colors (black is base color); *horn* equals 1 if horns are present in the lot; $conditon_{ij}$ are condition (fleshiness) scores (average flesh is base); $muscling_{ij}$ are dummy variables for muscle score (1&2 is base); $frame_{ij}$ are dummy variables for frame size (medium framed is base); $fill_{ij}$ are dummy variables for amount of fill (average fill is base); *uniform* equals 1 if the lot is not uniform; *certification* equals 1 if third-party verification of vaccination and weaning; *Brahman* equals 1 if Brahman influence is visible in the lot; $location_{ij}$ is composed of dummy variables for sale location (OKC is Base); $month_{ij}$ is comprised of dummy variables for the month the sale occurred (October is Base); and e_i are error terms for each observation.

Note that the *vaxx* variable combines vaccinated cattle and limited vaccinated cattle into one category for estimation. The *gender* variable splits heifers designated as replacement heifers into a separate

gender variable. The *horns* variable splits lots with horns present into horned lots (20% or more have horns) and minimal horns (some horns but less than 20% of animals).

Lot size was modeled as a natural logarithm, and average weight was divided by 100. Basis was calculated using the weekly CME Feeder Cattle Index retrieved from the LMIC. The regression was estimated using the Mixed procedure in STATA 15 with the variance for each sale and each lot being held as a random effect.

Results

Results from the hedonic model analysis are presented in Tables 7, 8, 9, 10, 11, and 12. Table 7 reports estimates for general sale characteristics, including lot size and average weight. Figure 1 illustrates market premiums for lot size as depicted in the data set, based on a logarithmic function. Lot size premiums for feeder cattle are routinely observed to be nonlinear with larger marginal premiums as lots move from 1 up to 10 head and decreasing marginal premiums thereafter[3].

Figure 1. Lot Size Premium

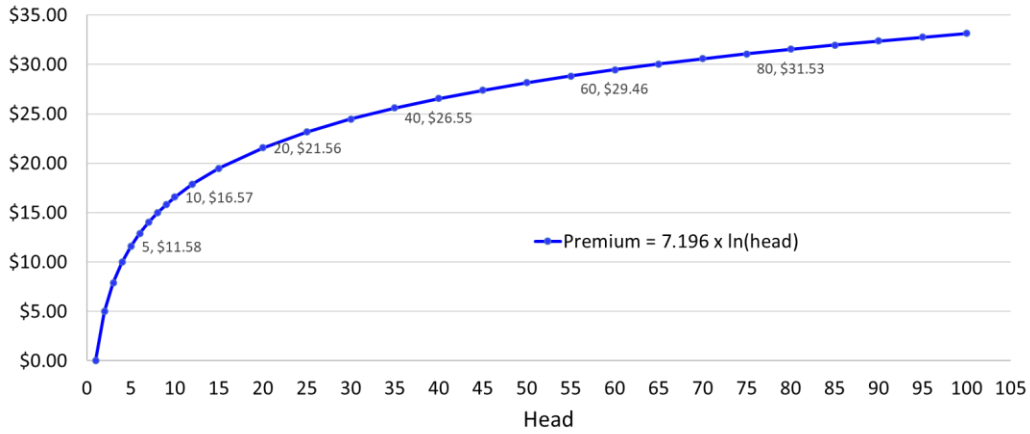

Table 8 shows the impact of lot size on price premiums. Price premiums are quite pronounced for lots less than 10 head. For example, a lot of 5 head has a premium of $11.58/cwt compared to a single animal lot. For larger lots the marginal increase in price for larger lots decreases significantly. For example, a 40 head lot receives an average premium of $4.99/cwt. compared to a 20 head lot and a lot of 60 animals receives a premium of $2.91/cwt. over a 40 head lot.

[3] The pattern of lot size premiums will depend on the nonlinear functional form utilized in the analysis. Lot size is sometimes estimated as a quadratic function, which implies a peak lot size premium with declining premiums beyond the peak. The logarithmic function is chosen here because it captures the initial increases in premiums faster and is asymptotic, with no maximum value.

Feeder cattle price per hundredweight ($/cwt.) decreases as animal weight increases. This price decrease is not linear but decreases at a decreasing rate as weight increases. In fact, heavy weight feeder cattle may show little price decrease as weight increases. This price decrease, frequently referred to as the price slide or price rollback, varies seasonally and with different market conditions, including feed costs (Peel and Riley, 2018). The model estimates show that price decreases in a nearly linear fashion by $14.62/cwt for each one hundred pounds of weight. The quadratic term is small but will slow the decrease in price by weight by 0.416 times weight squared. This quadratic term would offset the linear decrease at a weight well above the feeder cattle weight range.

Value of Animal Characteristics

Table 9 includes model estimates for the value of various animal characteristics. Compared to steers, heifer price is lower by an average of 18.70/cwt. Bulls/mixed lots are lower in price by 7.39/cwt. Although producers cannot generally control the production of steers versus heifers (sexed semen being an exception), marketing bulls rather than steers is a management choice. At the average weight of 596 pounds, this analysis indicates that bulls bring an average of $44.06/head less than steers. Some heifers are specifically identified as replacement heifers in sales. The price of replacement heifers is $20.09/cwt. less than steers and is a bigger discount than the heifer average. However, a check of the data confirmed that replacement heifers are all among the heaviest heifers by weight and the price reflects the heavier weight. All of the gender variables are highly significant statistically.

All lots were identified by hide color or breed characteristics if possible. The majority of lots were black-hided (60%) with another 15 percent predominantly black-hided. All of the estimated differences due to hide-color/breed were statistically significant. Compared to black-hided lots, the predominantly black-hided lots had the smallest discount of $1.93/cwt. (Table 9). Red-hided, white/gray hided, and mixed high quality lots all had discounts between $5-$6/cwt relative to black-hided lots. Animals with distinctive Hereford breeding received a discount of $9.93/cwt. compared to black-hided animals. Lots identified as dairy or longhorn breeding, mixed low quality or beef-dairy crossbred animals received discounts ranging from $28.62 - $32.52/cwt. Regardless of hide color, animals exhibiting brahman breeding were identified and received an additional discount of $8.94/cwt. While lots with a few animals showing Brahman breeding (Minimal Brahman) received an additional discount of $6.17/cwt.

compared to cattle exhibiting no Brahman influence. These discounts are in addition to any discount related to the lot's specific hide color or breed notation.

Using lots with mixed #1-#2 muscling as a base, lots that were all #1 muscling received a premium of $2.91/cwt. In comparison. Lots of #2 muscling received a slight discount of $0.63/cwt. While lots of #2-#3 muscling were discounted $6.06/cwt. However, the estimates for #2 and #2-#3 muscling were not statistically different from #1-#2 muscled lots. Lots with #3 muscling received a statistically significant discount of $24.31/cwt.

Compared to medium-framed animals, lots of large-framed animals received a statistically significant discount of $2.67/cwt. Mixed medium/large frame and small framed animals received similar discounts of $1.41-$1.51/cwt. However, these discounts were not statistically different from the medium-framed animals.

Value of Management Characteristics

Management decisions have a significant impact on the value of feeder cattle. The decision to market feeder cattle as bulls rather than steers was discussed in the previous section (see Table 9). Table 10 presents the value of a variety of other management decisions affecting feeder cattle. Weaned calves (30 days or more) bring a premium of $4.48/cwt compared to unweaned calves. Vaccinated calves receive a premium of $1.97/cwt. over unvaccinated calves. Removing horns or using polled genetics increases feeder cattle value over horned cattle. Cattle with horns receive a discount of $8.47/cwt. compared to no horns. Lots that included only a few horned animals (less than 20 %) received a slightly smaller discount of $6.20/cwt.

Animals marketed with excessive flesh were discounted $4.02/cwt. compared to animals of average flesh. Animals described as thin flesh received a slight but statistically insignificant premium compared to average fleshed animals. Animals described as full (tanked) received a discount of $15.15/cwt. compared to animals with average fill. Likewise, animals described as gaunt received a similar discount of $16.30/cwt. Animal fill is sometimes under control of the producer but may also be the result of auction facility management.

Producers may participate in a wide variety of certification programs. In this analysis, enough data for three programs permitted evaluation of program certification value, including the Oklahoma Quality Beef Network (OQBN), the Integrity Beef program, and Non-Hormone Treated Cattle (NHTC). A small number of other program cattle were included in the data, but numbers were insufficient to analyze individually. The value of OQBN certification was $4.52/cwt. while the Integrity Beef certification had a premium of $10.39/cwt. NHTC had a positive value of $1.20/cwt., but the estimated parameter is not statistically significant. Note that numbers of NHTC cattle were minimal in the data but the estimated parameter is included here because of the national scope of the program. Programs such as OQBN and Integrity Beef encompass preconditioning protocols such as weaning and vaccination, along with castration and dehorning. Integrity Beef includes additional requirements for genetics, likely influencing the magnitude of the premium. The total value of these programs is the sum of these management practices and the certification. For example, the value of OQBN would be a total of certification, weaning and vaccination implying that the total value-added for a 550-pound steer would be $10.97/cwt. ($4.52+$1.97+$4.48). This is consistent with observed premiums for OQBN cattle in Oklahoma, where the 5-year average OQBN premium over nonpreconditioned cattle for 5 weight steers was $12.59/cwt for 2018-2022 (Raper and Peel, 2023). A significant number of cattle were marketed as natural (977 lots with 24,233 head). Natural definitions vary widely and are not consistent. The estimated parameter on natural cattle is slightly negative at -$0.88/cwt. but is not statistically different from zero.

Cattle identified visually as obviously unhealthy received discount of $38.25/cwt. Cattle specifically identified as crippled received a discount of $49.90/cwt. while cattle with bad eyes were discounted $20.46/cwt.

Location

Feeder cattle prices at any point time vary considerably in different regions of the country (Highfill and Peel, 2015). The hedonic model used in this analysis included binary variables to account for different sale locations. Table 11 presents the estimated parameters for each sale location compared to the base market at OKC National. The signs and significance of the location variables generally confirm previously identified regional differences in feeder cattle prices. Variables that are statistically insignificant cannot be said to have prices different from OKC National.

Consistent with previous research, the highest average prices and largest premiums to the base market are noted in Nebraska/Wyoming with statistically significant premiums of $11.07/cwt. for Valentine, a premium of $9.47/cwt. for Ogallala and $10.24/cwt. in Torrington. By contrast, Kentucky auctions showed statistically significant discounts to the base market of OKC National. Estimates for the four Kentucky markets are -$19.09/cwt. for Springfield; -$12.75/cwt. in Campbellsville; -$9.22/cwt. in Stanford; and -$7.56/cwt. for Richmond.

South Dakota auctions showed a mixed set of discounts and premiums, generally not significantly different from the base market. This includes premiums of $4.01/cwt. in Faith; $3.62/cwt. in Philip and discounts of -$1.80 for Mitchell and -$0.57 for Pierre. The discount of $5.16/cwt for Hub City was statistically different from the base market at OKC National.

Within Oklahoma, OKC West (El Reno) has a premium of $2.05/cwt while Woodward posts a slight premium of $0.58/cwt. However, neither of these estimates are statistically significant. Prices at McAlester, OK are significantly less than OKC National by $5.58/cwt. The auction at Salina, KS posted a $4.02/cwt. premium to the base market that was marginally significant.

Regional Observations and Comments

Significant regional differences became apparent in this project that impacts both market reporting and data collection. In some cases, these differences reflect regional culture relative to how cattle are marketed as well as regionally unique terminology and practices including the amount of information provided and the manner in which information is provided to buyers. Individual sale barns vary widely in sale management and information availability/communication, which affect the feasibility and amount of market information that can be reported/collected[4]. Individual auction and regional differences will impact the feasibility of collecting additional value data on a broader scale.

Summary

This project analyzes factors affecting the value of feeder cattle with what is likely the most comprehensive feeder cattle auction data set available. The data includes information on numerous

[4] An example is the attempt to collect data at the auction in Okeechobee, FL. While this auction is currently reported with the current market information, the management and pace of the auction made it infeasible to collect the augmented data needed for this project. No usable data was obtained to include in this analysis. This highlights the challenges of expanding market information for some markets.

additional factors beyond current market reporting. The analysis provides estimates of the contributions of a variety of sale, animal and management characteristics that contribute to the value of a lot of feeder cattle. Additionally, the analysis confirms regional differences in feeder cattle value based on geographic location.

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Table 1. Data Collection Details and Protocol.

Characteristic	Description/Details	Protocol
Lot Size	Number of Head in sale group	
Sale price	$/cwt.	Cattle sold by the head not included.
Average Weight	Average weight per head (lbs.) General weight range for data is animals from 300-1000 pounds.	
Gender	Steers, Heifers, Bulls/Mixed lots	
Vaccinations	Vaccinated, limited vaccinations, unknown/not vaccinated	Animals with a single round of respiratory vaccination are designated limited vaccination
Weaned	Weaned, not weaned/unknown weaning	Must be 30 days or more to be designated as weaned.
Days Weaned	Days weaned are noted if announced or documented.	Comments may include “long weaned” or “yearling”, etc.
Certified	Animals certified in a specific program are designated. Common programs are indicated (OQBN, Noble Beef, NHTC, NeverEver, MacVac and Breed)	Other program names are noted in comments if not part of program list.
Hide Color	Lots are identified by color description including black, black mixed, red, red mixed, Hereford, white/grey, dairy/longhorn, mixed color, and other	Predominantly black-hided lots with minority other colors noted as black mixed. Same for red.
Brahman	Brahman influenced breeding is noted.	If roughly 20% or more of the lot shows Brahman influence. Less than 20% but obvious Brahman influence is designated minimal Brahman.
Flesh	Thin, average, and fleshy cattle noted.	
Muscling	#1, 1-2, 2, 2-3, light	
Frame	Large, medium-large, medium, and small	
Horns	Horned cattle noted	If roughly 20% or more of the lot have horns
Uniformity	Non-uniform lots are noted	
Health	Unhealthy cattle are noted	
Additional characteristics either stated or observed	Includes age/source; owner identified; BQA certified; natural; genetic information; crippled; rugged; wormy; bad eye; cough; lice; ringworm; muddy/tags; dewormed	Additional characteristics or information can be noted in comments
Sale location	Sale and state	
Sale Date		
Time	Each sale lot is time stamped when entered	

Table 2. General Data Summary

	Total	**Average**	**Range (Min-Max)**
Sales	92		
Head	275,335		
Sale Lots	18,038	15.3 head	1 – 453
Weight (lbs.)		596	149 – 1422
Price ($/cwt.)		$156.82	$5.00 - $308.18
Value of Sales	$291,710,731.01	Lot: $16,172 Head: $919	

Table 3. State and Sale Locations

State	Sale Location (Number of Sales)	Total Lots	Total Head	Ave. Lot Size (Head)
Kansas	Salina (1)	**230**	**2,019**	**8.8**
Kentucky		**1891**	**8,090**	**4.3**
	Campbellsville (1)	206	477	2.3
	Richmond (1)	145	409	2.8
	Springfield (1)	178	439	2.5
	Stanford (4)	1362	6765	5.0
Nebraska		**997**	**20,529**	**20.6**
	Ogallala (5)	828	17,867	21.6
	Valentine (1)	169	2,662	15.8
Missouri		**2,751**	**16,948**	**6.2**
	EMCC (Bowling Green) (4)	1,151	5,301	4.6
	F&T (Palmyra) (4)	938	3,506	3.7
	Joplin (2)	415	6,390	15.4
	Kingsville (1)	247	1,751	7.1
Oklahoma		**5,411**	**70,957**	**13.1**
	OKC West (El Reno) (12)	2,110	30,661	14.5
	McAlester (3)	917	19,418	2.5
	OKC Natl (Oklahoma City) (7)	894	18,552	21.7
	Woodward (9)	1490	2,326	12.5
South Dakota		**5,426**	**136,150**	**25.6**
	Faith (4)	988	16,407	16.6
	Ft. Pierre (7)	1,106	40,545	36.7
	Hub City (Aberdeen) (4)	896	20,869	23.3
	Mitchell (4)	1,063	21,562	20.3
	Philip (9)	1,373	36,767	26.8
Wyoming	Torrington (8)	**1,332**	**20,642**	**15.5**

Table 4. Feeder Cattle Weight, Muscling and Frame Characteristics

Weight (lbs.)	Steers			Heifers		
	Lots	Head	Avg Lot Size	Lots	Head	Avg Lot Size
<300	95	224	2.4	121	305	2.5
300-400	572	3215	5.6	718	3774	5.3
400-500	1428	15972	11.2	1744	16988	9.7
500-600	2207	37681	17.1	2157	31851	14.8
600-700	1949	35533	18.2	1672	27712	16.6
700-800	1321	29757	22.5	1059	24179	22.8
800-900	706	19548	27.7	487	10164	20.9
900-1000	284	7793	27.4	141	2231	15.8
>1000	135	2567	19.0	65	407	6.3
Total	8697	152290	17.5	8164	117611	14.4
Muscling	**All Animals**					
#1	2,207	62,594	28.4			
#1-2	11,347	151,815	13.4			
#2	3,334	39,144	11.7			
#2-3/light	399	2,221	5.6			
Frame	**All Animals**					
Large	2,338	43,586	18.6			
Medium/Large	11,693	172,933	14.8			
Medium	3.091	38,705	12.5			
Small	164	508	3.1			

Table 5. Hide Color/Breed

Color/Breed	Head	% of Total
Black	165,845	60.0
Predominantly Black	41,310	15.0
Red	10,499	3.8
Predominantly Red	11,030	4.0
Hereford	2,658	0.1
White/Gray	17,429	6.3
Dairy/Longhorn	546	0.2
Mixed High Quality	24,131	8.8
Brahman Influence	2,559	9.3
Minimal Brahman Influence	2,765	1.0

Table 6. Management Characteristics

	Lots	Total Head	Avg Lot Size	% of Lots
Weaned	11,451	177,942	15.5	63.5
Vaccinated	9,763	192,799	19.7	45.1
Limited Vaccination	1,514	20,355	13.4	8.4
Vacc/Limited Vacc	11,277	213,154	18.9	62.5
Weaned/Vacc	8,349	141,311	16.9	46.3
Natural	977	24,233	24.8	5.4
OQBN	192	1524	7.9	1.1
Integrity	91	1179	13.0	0.5
NHTC	97	4,270	44.0	0.5
Horns	384	3,204	8.3	2.1
Minimal Horns	221	6,089	27.6	1.2

Table 7. Model Estimates: General Sale Characteristics

Variable	Estimate	Std. Error	t-value
Log lot size (head)	7.196***	.312	23.03
Ave.weight (cwt.)	-14.62***	1.086	-13.46
Ave. weight^2 (cwt.)	.416***	.086	4.86

Table 8. Lot Size Premium

Lot Size (Head)	Premium ($/cwt) (Relative to 1 head)	Marginal Premium ($/cwt)
2	$4.99	
3	$7.91	$2.92
4	$9.98	$2.07
5	$11.58	$1.60
10	$16.57	$4.99
20	$21.56	$4.99
30	$24.48	$2.92
40	$26.55	$2.07
50	$28.15	$1.60
60	$29.46	$1.31
70	$30.57	$1.11
80	$31.53	$0.96
90	$32.38	$0.85
100	$33.14	$0.76

Table 9. Model Estimates: Animal Characteristics

Comparison Base	Variable	Estimate	Std. Error	t-value
Steers				
	Heifers	-18.698***	.487	-38.43
	Bulls	-7.392***	.862	-8.58
	Rep. Heifers	-20.094***	2.096	-9.59
Black-hided				
	Black mixed	-1.93***	.502	-3.84
	Red	-5.252***	.817	-6.43
	Hereford	-9.932***	1.304	-7.62
	White/Gray	-5.152***	.789	-6.53
	Dairy/Longhorn	-32.521***	4.628	-7.03
	Mixed Low Quality	-28.057***	4.468	-6.28
	Mixed High Quality	-5.597***	.722	-7.75
	Beef-Dairy Cross	-29.618***	6.688	-4.43
	Brahman Influence	-8.935***	2.315	-3.86
	Minimal Brahman	-6.165***	.966	-6.38
#1-2 Muscling				
	# 1	2.91**	1.48	1.97
	#2	-.631	1.039	-0.61
	#2-3	-6.061	3.719	0.103
	#3	-24.31***	2.555	-9.51
Medium Frame				
	Large	-2.669***	1.033	-2.58
	Medium/Large	-1.406	.946	-1.49
	Small	-1.514	6.006	-0.25

Table 10. Model Results: Management Characteristics

Comparison Base	Variable	Estimate	Std. Error	t-value
Unweaned				
	Weaned	4.475***	.649	6.89
Unvaccinated				
	Vaccinated	1.966***	.578	3.40
No Horns				
	Horns	-8.465***	1.563	-5.42
	Minimal Horns	-6.198***	1.324	-4.68
Average Flesh				
	Thin	.466	1.566	0.30
	Fleshy	-4.024***	1.37	-2.94
Average Fill				
	Full	-15.153***	3.035	-4.99
	Gaunt	-16.295**	7.173	-2.27
Not Certified				
	OQBN	4.524***	1.539	2.94
	Integrity Beef	10.39***	1.61	6.45
	NHTC	1.204	1.418	0.85
Conventional				
	Natural	-.884	.97	-0.91

Table 11. Model Results: Animal Health

Comparison Base	Variable	Estimate	Std. Error	t-value
Healthy				
	Unhealthy	-38.248***	6.182	-6.19
	Crippled	-43.903***	7.381	-5.95
	Bad Eye	-20.458***	3.228	-6.34

Table 12. Model Results: Location Impacts

Comparison Base	State	Sale	Estimate	Std. Error	t-value
OKC National					
	Oklahoma	OKC West	2.045	2.495	0.82
		McAlester	-5.581**	2.23	-2.47
		Woodward	.581	1.884	0.31
	Kansas	Salina	4.016*	2.355	1.71
	Kentucky	Springfield	-19.088***	.973	-19.62
		Campbellsville	-12.745***	2.263	-5.63
		Stanford	-9.218***	3.253	-2.83
		Richmond	-7.562**	3.282	-2.30
	Missouri	F&T Livestock	-1.583	2.845	-0.56
		Joplin	0.66	2.824	0.23
		EMCC	1.371	2.169	0.63
		Kingsville	4.546**	2.234	2.03
	Nebraska	Ogallala	9.474***	2.285	4.15
		Valentine	11.071***	2.378	4.66
	South Dakota	Faith	4.012	2.639	1.52
		Ft. Pierre	-0.569	2.362	-0.24
		Hub City	-5.157**	2.149	-2.40
		Mitchell	-1.799	1.922	-0.94
		Philip	3.616	3.039	1.19
	Wyoming	Torrington	10.236***	2.024	5.06

Appendix: Complete Model Regression Results

Mixed-effects regression

Basis	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Lnhead	7.196	.312	23.03	0	6.584	7.809	***
avgwthun	-14.62	1.086	-13.46	0	-16.749	-12.491	***
avgwt2hun	.416	.086	4.86	0	.248	.583	***
Heifer	-18.698	.487	-38.43	0	-19.652	-17.744	***
bullsmixed	-7.392	.862	-8.58	0	-9.081	-5.704	***
repheifer	-20.094	2.096	-9.59	0	-24.202	-15.985	***
weaned	4.475	.649	6.89	0	3.203	5.747	***
Vaxx	1.966	.578	3.40	.001	.834	3.098	***
nothealthy	-38.248	6.182	-6.19	0	-50.364	-26.132	***
blckmix	-1.93	.502	-3.84	0	-2.913	-.946	***
red	-5.252	.817	-6.43	0	-6.854	-3.65	***
redmix	-2.945	.678	-4.34	0	-4.273	-1.616	***
heref	-9.932	1.304	-7.62	0	-12.487	-7.377	***
whgr	-5.152	.789	-6.53	0	-6.698	-3.606	***
daiLong	-32.521	4.628	-7.03	0	-41.592	-23.45	***
mixlowqual	-28.057	4.468	-6.28	0	-36.815	-19.299	***
other	-19.237	2.666	-7.22	0	-24.462	-14.012	***
mixhighqual	-5.597	.722	-7.75	0	-7.013	-4.182	***
BDB	-29.618	6.688	-4.43	0	-42.726	-16.511	***
horned	-8.465	1.563	-5.42	0	-11.529	-5.402	***
minhorn	-6.198	1.324	-4.68	0	-8.794	-3.602	***
thin	.466	1.566	0.30	.766	-2.603	3.534	
fleshy	-4.024	1.37	-2.94	.003	-6.709	-1.338	***
thick1	2.91	1.48	1.97	.049	.009	5.81	**
med2	-.631	1.039	-0.61	.544	-2.667	1.405	
twoand3	-6.061	3.719	-1.63	.103	-13.349	1.227	
light3	-24.31	2.555	-9.51	0	-29.318	-19.301	***
large	-2.669	1.033	-2.58	.01	-4.693	-.644	***
medlarg	-1.406	.946	-1.49	.137	-3.26	.447	
small	-1.514	6.006	-0.25	.801	-13.285	10.257	
Full	-15.153	3.035	-4.99	0	-21.101	-9.205	***
gaunt	-16.295	7.173	-2.27	.023	-30.354	-2.236	**
OQBN	4.524	1.539	2.94	.003	1.509	7.54	***
othercert	1.793	1.163	1.54	.123	-.487	4.073	
NobleBeef	10.39	1.61	6.45	0	7.235	13.545	***
NHTC	1.204	1.418	0.85	.396	-1.575	3.984	
MacVac	.373	2.34	0.16	.873	-4.213	4.958	
Breed	.693	3.23	0.21	.83	-5.638	7.025	
BQACert	-1.348	1.274	-1.06	.29	-3.845	1.148	
brahman	-8.935	2.315	-3.86	0	-13.473	-4.398	***
minbrahman	-6.165	.966	-6.38	0	-8.058	-4.273	***
Natural	-.884	.97	-0.91	.362	-2.785	1.016	
Cripple	-43.903	7.381	-5.95	0	-58.369	-29.437	***
BadEye	-20.458	3.228	-6.34	0	-26.785	-14.13	***
Elreno	2.045	2.495	0.82	.412	-2.845	6.934	
McAlister	-5.581	2.263	-2.47	.014	-10.017	-1.146	**
Woodward	.581	1.884	0.31	.758	-3.112	4.274	
Salinakansas	4.016	2.355	1.71	.088	-.6	8.632	*
Torrington	10.236	2.024	5.06	0	6.268	14.204	***
Ogallala	9.474	2.285	4.15	0	4.995	13.953	***
Valentine	11.071	2.378	4.66	0	6.41	15.731	***

springfield	-19.088	.973	-19.62	0	-20.994	-17.181	***
Campbellsville	-12.745	2.263	-5.63	0	-17.181	-8.31	***
Stanford	-9.218	3.253	-2.83	.005	-15.594	-2.843	***
Richmond	-7.562	3.282	-2.30	.021	-13.995	-1.13	**
FTL	-1.583	2.845	-0.56	.578	-7.159	3.993	
Joplin	.66	2.824	0.23	.815	-4.875	6.195	
EMCC	1.371	2.169	0.63	.527	-2.88	5.623	
Kingsville	4.546	2.234	2.03	.042	.167	8.924	**
Faith	4.012	2.639	1.52	.128	-1.161	9.186	
FTpierre	-.569	2.362	-0.24	.81	-5.199	4.061	
Hubcity	-5.157	2.149	-2.40	.016	-9.369	-.945	**
Mitchell	-1.799	1.922	-0.94	.349	-5.566	1.967	
Philip	3.616	3.039	1.19	.234	-2.34	9.571	
Nov	1.225	2.858	0.43	.668	-4.376	6.827	
Dec	-.803	2.654	-0.30	.762	-6.004	4.398	
Jan	2.467	2.668	0.92	.355	-2.763	7.696	
Feb	11.13	2.149	5.18	0	6.917	15.342	***
Mar	14.029	2.217	6.33	0	9.683	18.375	***
April	22.031	3.472	6.34	0	15.225	28.837	***
Constant	59.442	3.907	15.21	0	51.784	67.099	***
Constant	1.196	.153	.b	.b	.932	1.536	
Constant	2.836	.021	.b	.b	2.796	2.877	
Constant	1.861	.122	.b	.b	1.637	2.116	

Mean dependent var	-0.397	SD dependent var	28.056
Number of obs	18038	Chi-square	.
Prob > chi2	.	Akaike crit. (AIC)	156225.527

**** p<.01, ** p<.05, * p<.1*