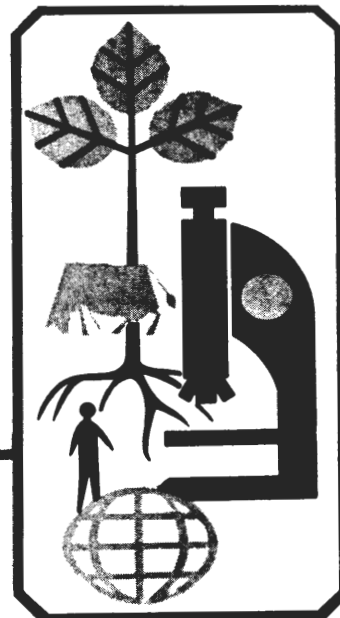


# Major Determinates of Feeder Cattle Prices at Arizona Livestock Auctions

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Agricultural Experiment Station  
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Tucson



**MAJOR DETERMINANTS  
OF  
FEEDER CATTLE PRICES  
AT ARIZONA LIVESTOCK AUCTIONS\***

by

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in cooperation with

**Farm Production Economics Division**

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# MAJOR DETERMINANTS OF FEEDER CATTLE PRICES AT ARIZONA LIVESTOCK AUCTIONS

## Introduction

The livestock industry in Arizona is an important source of income. The January 1, 1971, inventory of all cattle and calves in Arizona was estimated at 1,289,000 head, valued at \$212,685,000. Cash receipts from cattle and calves in 1970 were estimated to be \$314,327,000, or approximately 48.5 percent of the receipts from all agricultural products in the state.

An important facet of the livestock industry in Arizona is the production of feeder cattle. There were 341,000 calves born and raised in the state in 1970. Estimates are that the calf crop returned between \$35 and \$40 million to the ranching industry, in addition to providing breeding herd replacements.

While the feeding industry is relatively large in Arizona, most of the native calves are sold for shipment to other states for feeding. Ranchers may market their calves through terminal markets in other states, sell direct to order buyers, feeders or other ranchers for cash or on contract, or they may choose to market through one of

the several auctions in the state. While most calves are sold direct there is a growing number being marketed through the auctions. In 1949, there were only three auctions in Arizona which marketed a total of 32,600 head of cattle.<sup>1</sup> The number grew to eight with 348,100 head in 1965, or approximately 10 times the 1949 volume.

Since 1964, the types of auctions and volume of sales have made further significant changes. In 1969, there were seven regular weekly auctions: four in Phoenix, two in Tucson, and one in Willcox. They handled a total of 213,792 cattle and calves. In addition to the weekly auctions, local producers' associations have their own organized feeder auctions, held either in the spring or the fall or both periods. In 1969, there were eight county Cattlemen's Association auctions, selling a total of 8,691 head, and 19 Indian Reservation sales, handling 12,472 head. The Willcox auction held four special feeder cattle sales with a total of 4,943 animals sold.

The objective of this study is to analyze some of the important determinants of feeder cattle prices at Arizona livestock auctions. These determinants are important factors for

ranchers to consider in production and marketing decisions.

Prices received by producers at the various auctions were analyzed to determine what characteristics of the cattle and of the auctions significantly affected those prices. Specifically the objectives were:

a) to test the hypothesis that feeder cattle prices at the various markets observed were significantly affected by (1) animal weight, (2) grade, (3) sex, (4) breed, (5) size of lots, and (6) current fat cattle price;

b) to estimate the magnitude of the difference in those instances where the effect of the above variables was found to be significant with respect to selling price.

The study results reflect only the conditions in the markets from which data were collected and should not be interpreted as representative for the state. While the producer auctions primarily handled only local feeders, this was not true of the weekly central auctions. In the latter case some of the cattle included in the sales originated outside the state. Additionally, the observations were made in only one year.

<sup>1</sup>Thomas M. Stubblefield, et al, *Evaluation of Marketing Practices Used by Cattle Feeders and Producers in the Western States*, Technical Bulletin 181, The University of Arizona, December 1968, p. 30.

# Procedures for Data Collection

Data for this study were obtained at 47 sales in 1969, including: six Navajo Indian sales; one Hopi Indian sale; six Fort Apache Indian sales; two Hualapai Indian sales; three San Carlos Indian sales; four Willcox special feeder cattle sales; six sales sponsored by Cattlemen's Associations, three in

the spring of 1969 and three in the fall; and nine sales at Phoenix and ten at Tucson.

Sales information was recorded on all steers and heifers, including calves, between the weights of 200 and 875 pounds. Cattle sold were graded on the basis of official United States Standards as published by the Consumer and Marketing Service, Livestock Division, USDA. "The grade of a feeder is determined from a composite evalu-

ation of two general value-determining characteristics — its logical slaughter potential (as beef) and its thriftiness."<sup>2</sup> The actual grading was conducted by individuals familiar with feeder cattle and feeder cattle auctions in Arizona. All of these individuals also attended a two day refresher course on feeder cattle grading immediately prior to the data collection period.

A total of nine categories was considered, including: low standard, average standard, high standard; low good, average good, high good; low choice, average choice, and high choice. Breeds were analyzed as Hereford, Angus, Hereford-Angus crosses, Brahman and Brahman crosses and other crosses. "Other crosses" were included to cover the nondescriptive breeds or so called "okie cattle".

## Sample Description

The sample consisted of 2941 lots of feeder cattle observed at the 47 different sales. A total of 28,501 head were included in the sample providing an average lot size of less than 10 head.

Sixty-four percent of the lots were steers and 36 percent were heifers. By breed classifications, 54 percent of the lots were Herefords, 9 percent Hereford-Angus crosses, 6 percent Angus, 7 percent Brahman and Brahman crosses, and 24 percent other crosses (Figure 1).

Based on the U.S.D.A. standards, 71 percent of the feeders in the sample of data collected graded good, 15 percent standard, and 14 percent choice (Figure 2). The largest percentage of the lots graded average good. The remainder of the grades above and below average good were nearly normally distributed.

The distributions of lots by grade by individual breed of cattle were not so evenly distributed about the mean. Only 4 percent of the Hereford cattle were judged to be of standard grade, but 45 percent of the Brahman crosses and 35 percent of the other crosses (largely "okie" cattle) were graded

Figure 1

## Distribution of Breeds

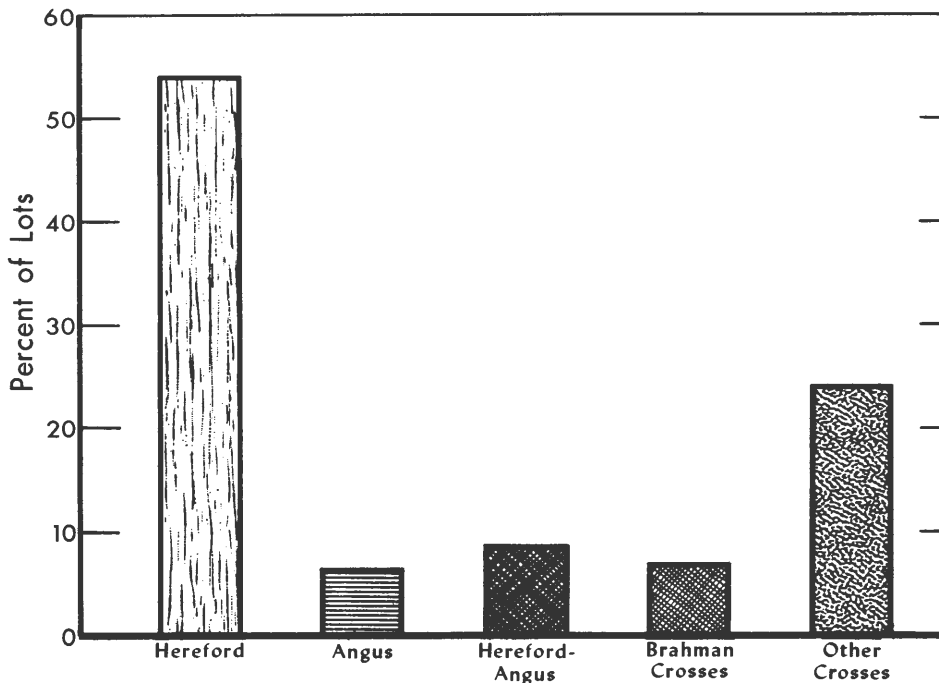
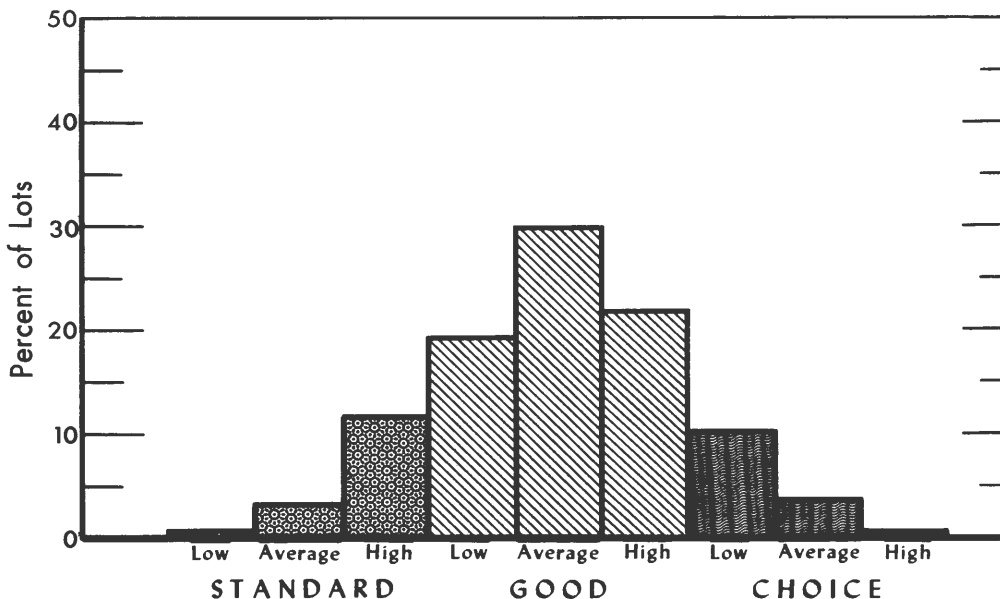


Figure 2

## Distribution of Grades



<sup>2</sup>U.S.D.A., Consumer and Marketing Service, Official United States Standards for Grades of Feeder Cattle, Issued March, 1965.

Figure 3  
Distribution of Grade by Breeds

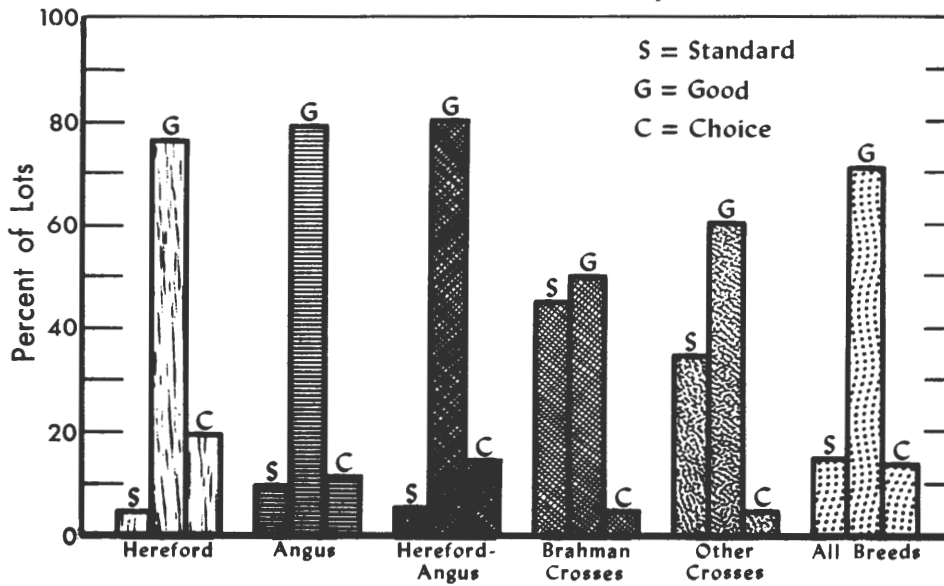
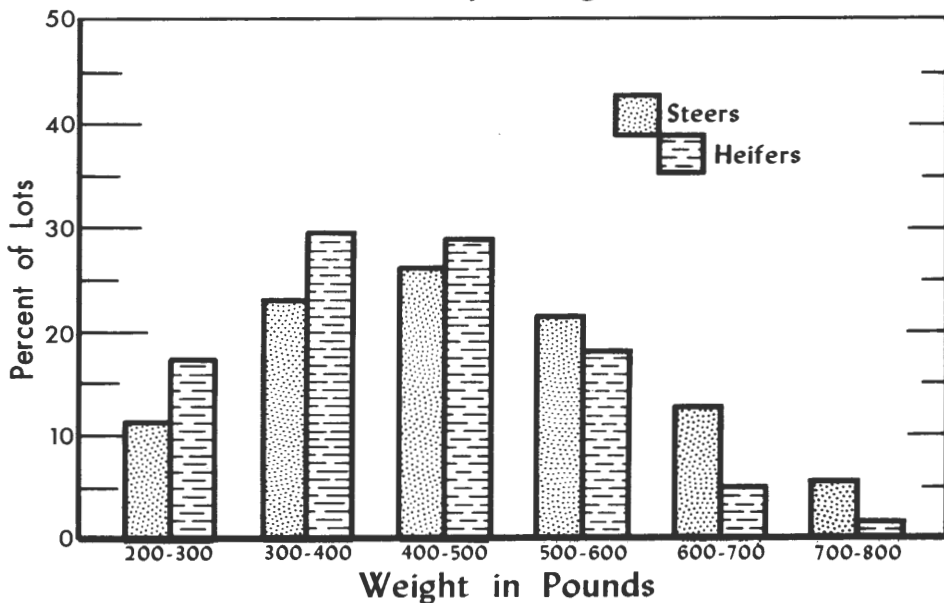


Figure 4  
Distribution by Weight and Sex



standard. Less than 5 percent of Brahman crosses and "okie" cattle were graded choice, whereas over 19 percent of the Herefords, 11 percent of the Angus, and 15 percent of the Hereford-Angus crosses were in this category (Figure 3; and Appendix Table 1).

The average weight of the lots ranged from 200 to over 800 pounds. For 73 percent of the lots, average weight was between 300 to 600

pounds. It was less than 300 pounds for 13 percent and more than 600 pounds for 14 percent of the lots. Proportionately more heifer lots were in the lighter weight groupings than steers. Only 6 percent of the heifer lots, compared to 18 percent of the steer lots, averaged 600 pounds or heavier. The average weight for 47 percent of the heifer lots and 34 percent of the steer lots was under 400 pounds (Figure 4; and Appendix Table 2).

### Statistical Analysis

Multiple regression analysis utilizing dummy variables<sup>3</sup> was used to estimate the influence of the following six groups of variables on feeder cattle price: (1) animal weight, (2) grade, (3) sex, (4) breed, (5) size of lot, and (6) current fat cattle price.

The specific variables included in the model were:

1. Weight
2. Weight squared
3. Weight for heifer adjustment
4. Number of head in lot
5. Hereford
6. Angus
7. Hereford-Angus crosses
8. Brahman crosses
9. Other crosses
10. Low standard grade
11. Average standard grade
12. High standard grade
13. Low good grade
14. Average good grade
15. High good grade
16. Low choice grade
17. Average choice grade
18. High choice grade
19. Fat cattle price
20. Fat cattle price-heifer adjustment
21. Fat cattle price-heifer adjustment squared

Variables 1-3 allowed for the effect of animal weight on price. The inclusion of variable 3, specifically for the weight of heifers, allowed a differential influence of weight on price depending upon the sex of the animals. Variable 4 was simply the number of head sold in any one auction lot.

Variables 5-9 allowed for price differentials between different breeds of animals. Due to statistical necessity it was assumed the Hereford price differential was zero. All other breed price differentials can be interpreted as the price difference between the specific breed and Hereford cattle holding all other characteristics constant.

Variables 10-18 allowed for price differentials between grades. Again due to statistical necessity, the effect of one grade, low choice in this case, was specified to be zero. The coeffi-

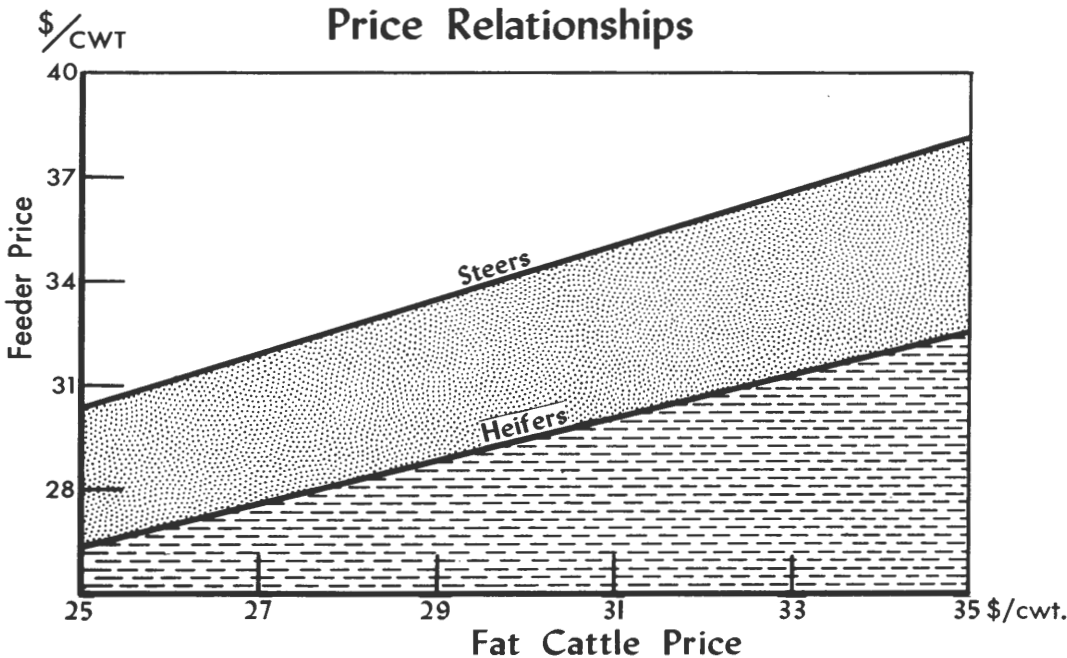
<sup>3</sup>The variable, if applicable, takes on a value of "one"; if not applicable, it becomes "zero". See Appendix Tables 3 and 4, for examples illustrating the dummy variable usage.

**Table 1. Results of the Statistical Analyses**

Name	Units	Max.	Min.	Coefficient	Standard Error	t-test
Weight	431.37 lbs.	875	200	-0.0434	.00171	-25.42
Weight Squared				0.0000234	.00000242	9.65
Weight for Heifer Adjustment				0.00765	.000603	12.70
Number Head in Lot	9.69 head	125	1	0.0234	.00242	9.65
Hereford	54.13 %			0.0		
Angus	6.29 %			0.270	.146	1.85
Hereford-Angus Cross	8.67 %			0.370	.126	2.94
Brahman Cross	6.94 %			0.891	.148	6.04
Other Crosses	23.97 %			0.279	.0941	2.97
Low Standard Grade	.48 %			-8.89	.513	-17.32
Average Standard Grade	2.99 %			-6.79	.234	-29.00
High Standard Grade	11.56 %			-4.35	.161	-27.03
Low Good Grade	19.28 %			-2.84	.139	-20.32
Average Good Grade	29.83 %			-1.59	.128	-12.43
High Good Grade	21.93 %			-0.454	.131	-3.46
Low Choice Grade	10.23 %			-0.0		
Average Choice Grade	3.60 %			1.05	.226	4.65
High Choice Grade	.10 %			2.11	1.08	1.94
Fat Cattle Price	\$27.69	34.25	26.72	0.781	.0266	29.31
Fat Cattle Price for Heifer Adjustment				-0.369	.0361	-10.21
Fat Cattle Price Squared for Heifer Adjustment				0.00352	.00119	2.94
Price	\$29.86	48.00	16.40			
Intercept	25.78					
R Squared	.819					
Standard Error of Estimate	1.86					

Figure 5

**Price Relationships**



coefficients of the grade variables are interpreted as the differences between the specified grade and the low choice grade, all other characteristics being constant.

Variable 19, the fat cattle price at Phoenix on the day of the sale, was included as a method of removing

most of the effects of general price level differences for cattle over the different time periods during which the auction data were collected.

Variables 20-21 were specific for heifers and allowed the effect of fat cattle prices to be different for heifers and steers.

**Results of Analysis**

The results of the "best" model found in the analysis are presented below. Table 1 lists the specific variables used in the final model and the relevant statistical information estimated. The variables considered in the study explained 82 percent ( $R^2 = .819$ ) of the variation in price found for the feeder cattle in the sample. The standard error of the estimate was \$1.86 per hundredweight above and below the mean. The coefficients associated with each variable are measures of the effect of the variable on price. (For examples of the use of the data in Table 1, see Appendix Tables 3 and 4).

**Steer-Heifer Price Differentials**

Steers and heifers were found to differ in price relationships both as a function of the weight of the animals and of the fat cattle price at the time of the sales.

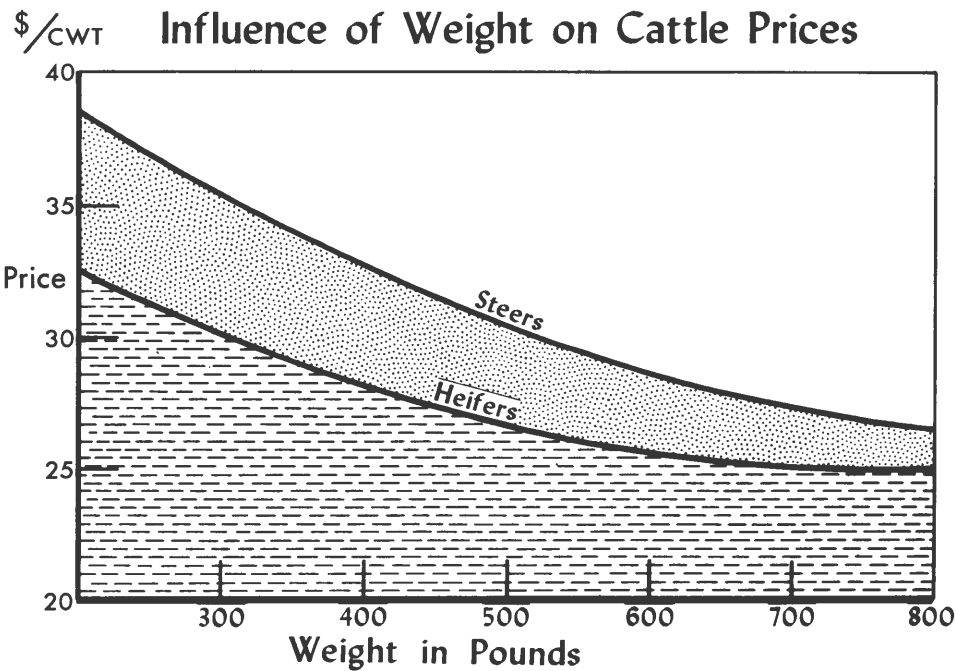
**Influence of Fat Cattle Price:** The higher the fat cattle price at the time of the feeder sale, the greater the discount for heifers relative to steers and vice versa (Figure 5). Thus, as the

Table 2. Effects of Weight on Price, Steers and Heifers<sup>1</sup>

	Weights in Pounds						
	200	300	400	500	600	700	800
	Prices in Dollars per Hundredweight						
Steers	38.55	35.37	32.67	30.44	28.67	27.37	26.54
Heifers	32.50	30.10	28.16	26.69	25.69	25.16	25.09
Difference	6.05	5.27	4.51	3.75	2.98	2.21	1.45

<sup>1</sup>Assumes Hereford cattle of average good grade, sold in lots of 10 head, with a fat cattle price of \$28.00 per hundredweight.

Figure 6



relative price level for cattle declines, steer prices decline at a faster rate than heifer prices.

The per hundredweight decline in feeder steer prices was approximately \$0.78 for each \$1.00 drop in fat cattle prices over the entire range of fat cattle prices.<sup>4</sup> For heifers, however, the decline is dependent upon the level of the fat cattle price.

**Influence of Weight:** The influence of weight upon the price is an important factor in determining the value of the animal. For both steers and heifers there is an inverse relationship

between weight and price. However, the price decrease for steers is more rapid than for heifers as weight increases. As a result, over the range of weights of animals included in this study, the steer-heifer price differential declines from \$6.05 per hundredweight for 200-pound animals to \$1.45 for 800 pound animals when the fat cattle price is \$28.00 per hundredweight (Figure 6, Table 2).

The weight-price relationship is non-linear for both steers and heifers. In both instances prices decline at a decreasing rate as weight increases. In fact, heifer prices appear to remain relatively constant, in terms of weight, beyond 700 pounds. Steer prices continue to decline up to the limit of weights observed.

Due to the effect of weight on price, the expected total returns for an animal is not a linear function of price. For example, assuming Hereford cattle of average good grade, a fat cattle price of \$28 per hundredweight, and feeder cattle sale lots of 10 head, the total returns per head vary by weight as indicated in Figure 7.

A 200-pound heifer would return \$65.00, whereas a 700-pound heifer would return about \$176.12. The same weights for steers would return \$77.10 and \$191.59, respectively. Although the prices decline as weight rises, the total returns increase. Producers making decisions as to when to sell will have to estimate costs associated with the weight added and the loss in price per pound to be expected. Since it will take some time to put on additional weight, of course, general market prices may move up or down, providing an additional variable. However, assuming the fat cattle price level of \$28 per hundredweight as used in the calculations above, the price of a 300-pound steer would be \$35.37 per hundredweight providing a gross return of \$106.11. The price of a 400-pound steer would only be \$32.67, and would bring a gross return of \$130.68. The difference in returns would be \$24.57 per head, based on price levels and market relationships as observed in this study.<sup>5</sup>

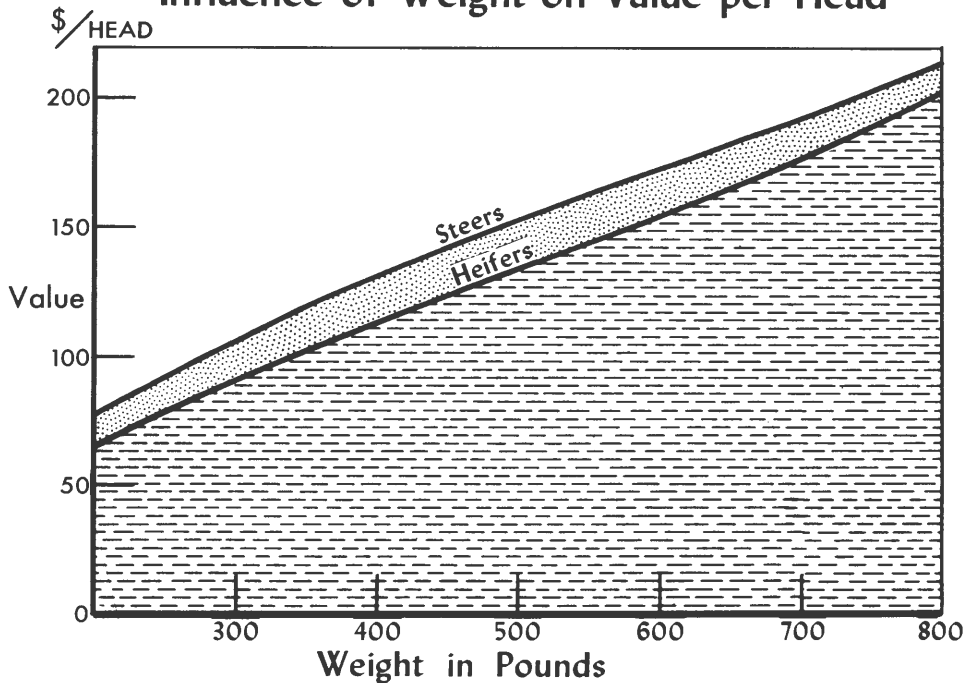
<sup>4</sup>While this relationship held for the market prices considered in this analysis, it is recognized that the specific ratios between feeder and fat cattle prices may differ from the above as a result of changing market conditions.

<sup>5</sup>NOTE: In the spring of 1972, with choice fat cattle prices as high as \$36-\$37 per hundredweight and 200-300 pound feeder calves ranging from \$50 to \$70, there have been indications that the differentials between feeder and fat cattle prices have widened as well as between grades of feeder cattle.



Figure 7

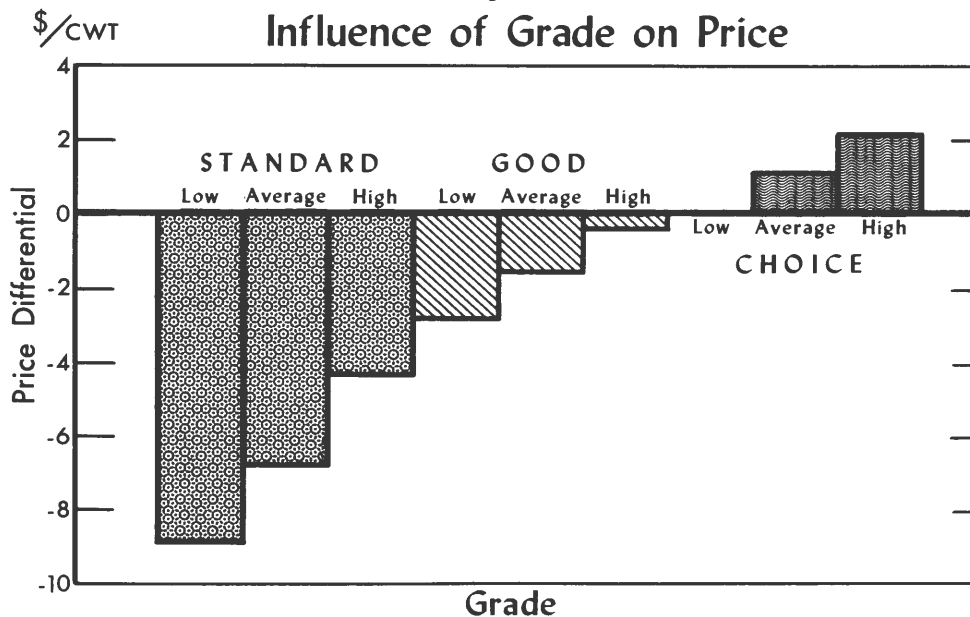
### Influence of Weight on Value per Head



price over the range of observations in the study. Lot size ranged from 1 to 125 animals with the average for all lots being 9.69 head. For each increase in lot size of one animal, the price was estimated to increase by an average of \$0.0234 per hundredweight. Thus, assuming other factors to be held constant, prices for similar animals sold in a lot of 100 would be expected to return on the average of \$2.34 per hundredweight more than if they were sold as single animals. Since the tests showed the addition of size of lot squared to be nonsignificant, it is assumed that the relationship between the number of animals in the lot and the price was approximately linear over the range of observations considered. (Extrapolations beyond the limits of the observations may not continue to be linear.)

Figure 8

### Influence of Grade on Price



The positive relationship between lot size and price is probably largely explained by the fact that feedlot buyers are usually seeking fairly large numbers of animals. They wish to minimize administrative details and handling problems including shipping. Truck or rail facilities are more likely to be available at lower rates per head on a volume basis than where small numbers are involved.

#### Grade Differentials

The difference in price between low standard and high choice grades based on the average received for each grade amounted to \$11 per hundred weight. Differences between grades tended to decline as the quality improved from low standard to low choice (Figure 8). For example, the

difference in price between low and average standard was \$2.13 per hundredweight, while the difference between high good and low choice was only \$0.45 per hundredweight.

#### Lot Size Effects

Lot size had a significant effect on

#### Effects of Breed on Price

Breed differences had a relatively small effect on price. When all factors other than breed were held constant the following price differentials were found by the analysis: Prices received for Brahman crosses were \$0.89 per hundredweight greater than those received for Herefords; prices for Angus, Hereford-Angus crosses and "okie" cattle were \$0.27, \$0.37 and \$0.28 per hundredweight greater than for Herefords (Table 1).

While the above differences are small and are based only on this limited set of data, the results do raise some questions which should be of concern to Arizona ranchers. Further market-price studies would appear warranted for the purpose of substantiating or refuting the above findings.

## Summary and Conclusions

The analysis based on data collected on feeder cattle sales at Arizona auctions supports all of the original hypotheses made in this study. Price was found to decline at a decreasing rate as animal weight increased. Improvements in grade, increased size of sale lot, and higher levels of fat cattle prices all were reflected in higher feeder cattle prices. Price differences based on breed were not large but were statistically significant. Discounts were found to exist for heifers relative to steers and were found to be significantly larger both with higher fat cattle price levels and with lighter weights of animals.

The sample description suggests a number of possibilities for improvement of producer incomes in the light of the above results. However, for the information to be useful to ranchers the proper economic decision framework must be understood. First, it should be obvious that we studied only six factors which influence the returns side of cattle ranching and more specifically the price received for cattle at specific auctions. Other information necessary for making economically sound decisions must include the costs involved for various alternatives.

It was found, for example, that there were 11 percent of the lots of steer calves sold at weights between

200 and 300 pounds. Assuming they were average good, 250-pound Herefords, auctioned in lots of 10 head, and the price level for fat cattle was \$28 per hundredweight, the gross returns per head would be \$92.25 (Figure 7). If these calves had been held to 500 pounds, the return would have been \$152.20 each; at 600 pounds, \$172.02 each. In the first instance above, the value of the added weight amounted to \$23.98 per hundredweight; whereas when the weight increased from 500 to 600 pounds, the net value added amounted to only \$19.82 per hundredweight. Then, the question each producer must answer is whether or not the added returns as determined exceed the additional production costs.

Since prices decline at a diminishing rate as weight increases, calculations must be made at each weight level to determine the additional gross returns at that level. In addition to estimating cost-price relationships for differing weights the producer must consider the risk involved. If calves are held to heavier weights, unless contracts are made, there will be some speculation involved with respect to price levels at the time of sale.

Producers may influence their returns by improving grade. Indications are this may be done by shifting breeds and/or by differing management practices. According to the analysis, Herefords tend to fall into higher grade categories, but the analysis also shows that the market gives some premium for other breeds when grades

are held constant. These effects must be considered in making any policy decision if net returns are to be maximized. Any attempt to improve the grade level must be balanced against costs associated with making the improvement.

At least one area of potential increased returns appears to be largely a function of management at the time of sale. Lot size tends on the average to be relatively small, yet indications are that returns are significantly improved by selling at the auctions in larger numbers.

The grading system employed here appeared to have economic significance, to be consistent with market expectations and to be useful as a guideline for producer decisions. However, some members of the Animal Science Department, University of Arizona, and other reviewers have suggested that alternative grading methods would more precisely reflect the value of feeder cattle. While the current system undoubtedly could be refined, research needs to be conducted to determine what changes, if any, would produce better results. Meanwhile, the system used, as the basis for the analysis, is the only one available and is currently used nationwide in price reporting for feeder cattle. Producers do need this grade-price data in order to better understand market demands, to reflect those demands in production decisions, and to assure that they are receiving a fair price for their product.

## Appendices

**Appendix Table 1. Distribution of Grades by Breed**

Grade	Breed					All Breeds
	Hereford	Angus	Hereford-Angus	Brahman Crosses	Other Crosses	
	Percentage					
Standard Low	.12	0.0	0.0	.49	1.56	.47
Standard Average	.62	1.56	2.70	6.86	7.80	2.99
Standard High	3.70	3.92	7.02	37.74	25.67	11.56
Good Low	15.13	14.90	19.45	27.94	27.65	19.27
Good Average	32.78	36.47	31.89	16.17	24.11	29.81
Good High	28.20	28.62	27.56	5.88	8.51	21.93
Choice Low	12.93	13.33	10.27	4.90	4.53	10.23
Choice Average	6.28	1.17	1.08	0.0	.14	3.60
Choice High	.18	0.0	0.0	0.0	0.0	.10

**Appendix Table 2. Distribution of Weight by Sex**

Weight (Pounds)	Number of Lots					
	Total	Percent	Steers	Percent	Heifers	Percent
200-300	395	13.4	211	11.3	184	17.2
300-400	746	25.4	431	23.0	315	29.5
400-500	798	27.1	490	26.1	308	28.9
500-600	594	20.2	402	21.5	192	18.0
600-700	289	9.8	237	12.6	52	4.9
700-800	119	4.0	103	5.5	16	1.5
	<u>2941</u>		<u>1874</u>		<u>1067</u>	