Utilizing Conditional Probabilities in Developing Price Expectations for Selecting Optimal Marketing Alternatives for Fixed Resource Cow/Calf Operators in the Texas Panhandle

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Selected Paper prepared for presentation at the Western Agricultural Economics Association Annual Meeting, Denver, CO, July 14, 2003

Partial funding provided by the Dryland Agriculture Institute,
West Texas A&M University, Canyon, Texas.

Abstract

The beef cattle enterprise for most of the 91% of producers in Texas with less than 100 cows represent secondary or supplemental enterprises. In most cases the operator is depending on surplus or discretional labor and the alternate use of the physical resources is limited due to topography or environmental factors. These characteristics transform the decision making process from a variable resource allocation problem to a fixed resource problem. Reliable price and revenue expectation models are critical to selecting marketing alternatives that maximize the return to the fixed resource allocation. Price expectation models using expected values, price and revenue indexes, and conditional probabilities are developed using monthly average prices for 300 to 900 pound stocker steers at Amarillo, TX from 1992-2002.

Beef cattle enterprises represent secondary or supplemental enterprises for the vast majority of Texas' producers. Ninety-one percent of cow/calf producers have 100 or less cows and 78% have fifty or less. The characteristics and availability of resources, and the lack of viable production alternatives limit the sizes of the beef cattle enterprise on most of these operations. Often the livestock enterprise supplements non-farm employment utilizing excess or discretionary labor. Physical resources are typically limited in alternative uses by the topography or susceptibility to erosion and environmental degradation. The cattle enterprise may be utilized to salvage crop residues that have limited alternative uses. These characteristics dictate the parameters of the decision making process and transform it from a variable resource allocation to a fixed resource allocation problem.

Much of the literature on beef cattle marketing alternatives assumes a larger scale of operation and flexibility in resources (Davis et al.; Ethridge et al.; Mathews et al.; Schmitz, and Schroeder et al.). The small size of enterprise greatly restricts the marketing alternatives available to the producer. Marketing strategies developed for larger operations may not be appropriate. For example, multiple marketing alternatives often represent a way to moderate price risk. However, this would result in smaller animal numbers sold each time, and since Mintert et al. has associated small lot size with lower prices this would work to the disadvantage of the small operator. Approaches that focus only on the analysis of price address only part of the decision process by not accounting for the change in the product as the timing of marketing changes (Davis, Sartwelle, and Mintert). Other studies have emphasized the joint consideration of weight and price in marketing decisions (Fausett et al.).

The Texas Panhandle is primarily a short grass prairie with buffalograss and grama grass the primary forage. Precipitation ranges from 15 to 21 inches with a dry midsummer period. Precipitation increases as you move from west to east. The average frost free period ranges from 180-225 days. Studies under similar conditions indicate gains on native Buffalo grass and grama grass range to be from 1.1 to 1.5 pounds per day, under normal to good conditions, depending on stage of growth. On Old World bluestem, Sudangrass, and sorghum-sudangrass hybrids gains vary from 1.5 to 2.5 pounds per day. Gains on wheat pasture vary from 1.5 to 2.2 pounds per day. Forage availability and, therefore, gain

would be reduced under droughty conditions. (Colette, et al.; Colette and Melton; Pharo; National Resource Council; and White and McGinty).

Data and Methodology

Monthly average prices for twelve weight groups of Medium and Large No. 1 Stocker and Feeder Steers representing 50 lb intervals between 300 and 900 lbs for the years 1992 through 2002, as reported by the USDA Market News Service in Amarillo, TX, are used in the analysis.

The general linear model procedure (PROC GLM) of the Statistical Analysis System (SAS) is used for the statistical analysis. Average expected revenues for each weight group and month are calculated by multiplying the monthly average price by the mid-point weight in the weight group. Missing values for price are replaced with linear interpolations between the proceeding and following months to provide values for calculating differences and probabilities.

Market alternatives are based on a spring calving scenario producing a 400-450 lb steer calf in September and maintaining an average daily gain of 2.0 lbs per day during the retained ownership period following weaning.

Index numbers are a ratio calculated to relate the current price or revenue observation to a base period observation (Tomek and Robinson). The base period value is defined as a 400-450 lb stocker steer in September and is given a value of 1.000. All other weight/month index values are expressed as ratios of the current value to the base value.

Conditional probabilities are used to revise prior estimates as additional information becomes available (Levin, et al.). The calculation of the joint probability is shown by the following equation.

$$P(AB) = P(A|B)*P(B)$$

The joint probability of two events, A and B, happening together or in succession is equal to the probability of event A, given that event B has happened, multiplied by the probability of event B. When event B, the September price of 400-450 lb stocker steers, is known the joint probability is equal to the conditional probability.

As the price of stocker steers is a stochastic variable and is not known in advance the expected value for the month and weight group is our best starting estimate. Once the marketing season begins the September price or 400-450 lb stocker steers is known. This new information is used to develop revised probabilities to refine the estimate. The joint probability indicates the probability that the current value will be lower, equal to, or higher than the comparison value, given that the base value (the September value for 400-450 lb stocker steers) is known. Two types of information readily available to producers that can be used as the basis for computing probabilities include the price of the period one-year earlier, and the expected value. Conditional probabilities are estimated for each of these base values. Three categories are defined in determining the probabilities: 1) the current value is more than $1 higher than the corresponding value, 2) the current price is more than $1 lower than the corresponding value, and 3) the current price is within plus or minus $1 of the price of the corresponding value. Once the category has been determined for the base value, the conditional probability is calculated for the occurrence of higher, lower or constant prices for the other weight/month marketing alternatives.

Results and Discussion

The sources of variation in the 1,489 prices representing the monthly average prices for the 12 weight groups are analyzed using PROC GLM, Table 1. Main affects analyzed include year (YR), month (MM), and weight group (WTGP). Two-way interactions include year-by-month, year-by-weight group, and weight group-by-month. The ANOVA model for price indicates statistically significant differences at a probability of a greater F of less than 0.0001 (Pr>F <0.0001). The R^2 of 0.9755, indicates that 97% of the variation in price is explained by the variables in the model. The Type III Sums of Squares indicate that significant differences in price are identified for each of the main effects, and each of the two-way interactions (Pr>F <0.0001).

The analysis of variance of the monthly average expected revenue for the 12 weight groups between 1992 and 2002 is analyzed using PROC GLM, Table 2. Main affects analyzed include year (YR), month (MM), and weight group (WTGP). Two-way interactions include year-by-month, year-by-weight group, and weight group-by-month. The ANOVA model for expected revenue indicates

statistically significant differences at a probability of a greater F of less than 0.0001 (Pr>F <0.0001). The R^2 of 0.9890, indicates that approximately 99% of the variation in expected revenue is explained by year, month, and weight group. The Type III Sums of Squares indicate that significant differences in expected revenue are identified for each of the main effects, and each of the two-way interactions (Pr>F <0.0001).

Observation of the annual average prices indicates one complete cattle price cycle is included in the observation period. Cyclical highs are observed in 1993 and 2001. The cyclical low is observed in 1996. The 8-year cycle includes a 3-year downward phase and a 5-year upward phase, Table 3.

The Tukey-Kramer multiple comparison test separates the monthly average prices into three groups. Since the price groups include contiguous months they can be used to identify a seasonal pattern, Table 3. Average stocker prices are the highest during the late winter and early spring (January through April). Demand during the period is increases as cattle feedyards are placing heavy weight feeders on feed to meet the summer demand for beef. The supply of light weight stockers is low reflecting the smaller number of cattle that calve in the fall. Prices are lowest in the fall (September to November) when the majority of the spring calves are weaned and marketed for the first time. Demand also may be depressed during this period if the prospects for winter wheat pasture are not favorable.

Expected revenue per head follows the same monthly pattern as price per cwt, Table 3. Expected revenues per head are lowest in the fall (September and October). Average expected revenues are the highest during the late winter and early spring (January through April).

While most commodities increase in value per unit as they move through the marketing channels, the value of stocker steers as shown by price per cwt declines as weight is added, Table 3. Multiple comparison tests indicate significant price differences between each of the weight groups. The highest average price per cwt, $101.28, is observed at the 300-350 lb weight and the lowest average price, $72.71, is observed at the 850-900 lb weight group.

Although average prices per cwt decrease as weight increases the expected revenue increases as weight increases to each successive weight group between 300 and 900 lbs, Table 3. The Tukey-Kramer multiple comparison tests indicate significant expected revenue differences between each weight group.

The highest expected revenue per head, $634.77, is observed at the 850-900 lb weight and the lowest expected revenue, $329.26, is observed at the 300-350 lb weight group.

Different monthly price pattern are observed for the different weight groups at the Amarillo auction, Table 4 and Figure 1. The lighter weights, 300 to 550 lbs, have their highest prices during the spring months (March and April) when supplies are limited due to smaller fall calf crops. The prices for these lighter weights are lowest during the fall months (September and October) when the supplies of these weights are expanded due to the weaning of the large spring calf crop. In contrast, the prices for the heavier weights, 700 to 900 lbs, are at their lowest in the spring (April and May) when the demand for feedyard placements for the summer beef market has slacker off. Prices for the heavier weights are at their highest during the late summer (July and August) when the supplies are limited to carryover yearlings and calves from the previous fall's calving, and during the Winter (December to February) when the current years calves have not yet reached those weight levels.

Expected revenue increases with weight as each heavier weight group has a higher revenue than the preceding level, Tables 3 and 5. Different monthly average expected revenue patterns are observed for the different weight groups at the Amarillo auction, Table 5 and Figure 2. In each month the heavier weights have higher expected revenues than the lighter weights. Monthly patterns within weight groups show the same patterns as the expected prices for that weight. The lighter weights, 300 to 600 lbs, have their highest expected revenues during the spring months (March and April). The expected revenues for these lighter weights are lowest during the fall months (September to November). In contrast, the expected revenues for the heavier weights, 700 to 900 lbs, are at their lowest in the spring (April and May) and their highest during the summer and early fall months (July to September).

When a great deal of year-to-year variation exists the construction of an index can facilitate refining price expectations. With an index relative prices are expressed as a percentage of a base value. The index of monthly prices for the Amarillo, TX market is based on 400-450 lb stocker steers in September. The index value for 400-450 lb steers in September set to 1.000 or 100.0%. The index values for the other weight groups and months are expressed as a percentage of the base value, Table 6. For

example, based on the expected price index, the price that would be received for 600 lb stocker steers in December would be 86.0% of the September base price. Continuing to hold the stocker for an additional 90 days would produce an 800-850 lb feeder steer in March. The price index is 0.815, indicating that the expected price would be 81.5% of the September price for that steer.

An expected revenue index expresses the relationship between the different marketing alternatives on a percentage basis. The index of monthly expected revenues for the Amarillo, TX market is based on 400-450 lb stocker steers in September, Table 7. The index value for this combination is set to 1.000 or 100.0%. The index values for the other alternatives express their expected values as percentages of the base value. For example, based on the expected revenue index, the expected revenue for a 600-650 lb stocker steer in December would be 126.5% of the September base revenue. Continuing to hold the stocker for an additional 90 days would produce an 800-850 lb feeder steer in March. The expected revenue index is 1.581, indicating that the expected revenue would represent an increase of 58.1% over the expected revenue for September.

The set of marketing alternatives within a given market year are not independent. Production decisions such as the selection of breeding and calving seasons, selection of breed, nutritional level and herd health determine when during the year the calves will reach the different marketing alternatives. The decision to retain ownership after weaning in favor of a later marketing alternative depends on the availability of resources and the comparison of expected net returns between selling at weaning and the alternative. Long run planning decisions can be made based on expected returns but short run decisions need greater refinement. The application of percentage relationships through an index is one method. The application of conditional probabilities is another method. Establishing an observable event near the beginning of the marketing year that can be associated with future values of price or revenue allows the development of conditional probabilities that can be used to refine the price or revenue expectations. One alternative is the relationship between the current year September price for 400-450 lb stocker steers and the price the previous September. The conditional probability can then be used to establish the probabilities that the prices for the heavier weight alternatives will be higher, lower or the same. For

example, establishing that the current September price is more than $1 higher than the previous year, the probability that the January price for 650-700 lb stockers will be at least $1 higher than the previous year is 0.667, Table 8. Therefore, there is an expectation that the January market will be stronger than last year. On the other hand, if the price in September is down more than $1 from the previous year the probability is 0.667 that the January price will be down more than $1 from the previous year.

A second alternative event would reflect the relationship between the current price and the calculated expected value of the price, Table 9. The conditional probability estimates the probability that prices for the heavier weight alternatives will be higher, lower or the same as the expected value given that the September price is higher, lower or equal to the expected value. For example given that the price in September is more than $1 higher than the expected value, the probability that the January price for 650-700 lb stockers will be at least $1 higher than the previous year is 0.714, Table 9. Therefore, there is an expectation that the January market will be stronger than last year. On the other hand, if the price in September is down more than $1 below the expected value the probability is 0.750 that the January price will be down more than $1 below the expected value.

Alternative Price Expectation Scenarios

A comparison of the different price expectation models is shown by the application of the three techniques to a typical production scenario. The scenario involves spring calving with an expected weaning time in September producing a 400-450 lb stocker steer. Assuming an average daily gain of 2.0 lbs per day, retaining the calf for 90 days would produce a 600-650 lb stocker in December. Continuing ownership for an additional 90 days produces an 800-850 lb feeder in March.

Utilizing the calculated expected value to establish price expectations for evaluating marketing alternatives indicates a price of $89.89 at weaning, Table 4. The expected revenue is $382.04, Table 5. Holding the stocker steers 90 days until December produces a 600-650 lb stocker with a price expectation of $77.33 and expected revenue of $483.30. Continuing to hold for an additional 90 days produces an 800-850 lb steer for the March market that would sell for an expected price of $73.23 with expected revenue of $604.12. As can be seen, as ownership is retained and the calf is held for later marketing the

expected price decreases but the expected revenue increases. This method is excellent for long-run planning but makes no adjustment for year-to-year variability. Since the calculated expected values are seldom observed utilization of price and revenue indexes or conditional probabilities may be more helpful in making short-run marketing decisions.

Utilizing an index to establish price expectations assumes that prices will maintain the same relative relationships and will change proportionally. The index values for both price and revenue at weaning in September are equal to 1.000, Tables 6 and 7. The indexes associated with holding the stocker steers 90 days until December are 0.860 for price and 1.265 for revenue. The indexes associated with continuing to hold for an additional 90 days and marketing an 800-850 lb steer in March are 0.815 for price and 1.581 for revenue. If the September price is equal to the calculated expected value then this method returns the same values as the expected value method. However, if the observed September price is different from the expected value, then all of the value will be different. For example, Given that the price of 400-450 lb stocker steers in September is $86.74 with a revenue of $368.64, the December indexs would translate into price and revenue expectations of $74.60 and $466.34. Applying the March index values to the September price and revenue gives predicted values of $70.69 for price and $582.83 for revenue.

Applying conditional probabilities provides the probabilities of values falling in specified ranges of values. With the observable event defined on the relationship between the current price for 400-450 lb stocker steers and the expected value for September establishes the probability that prices for the heavier weight alternatives will be higher, lower or the same as the expected value given that the observed September value is higher, lower or equal to the expected value. Using the same values of $86.74 and $368.64 for September price and revenue as in the above example, the observed September price of $86.74 is more than $1 lower than the expected value of $89.89. Therefore the observable event is that the current price is more than $1 lower. The conditional probabilities for December from Table 9 indicate there is a probability of 1.00 that the price will be more than $1 below the expected value for December. Converting back to prices and revenues indicates that the December price will be below $76.33 and the

revenue less than $477.06. The conditional probabilities for the March alternative indicate that there is a 0.25 probability that the price will be more than $1 higher than the expected value and a 0.75 probability that the price will be more than $1 lower than the expected value. This translates into a 0.25 probability that the price will be greater than $74.23 and the revenue greater than $612.40, and a 0.75 probability that the price will be less than $72.23 and the revenue less than $595.90.

The availability of better price expectation models is important to the management decision makers for fixed resource beef cattle producers since optimization is obtained by maximizing revenue. Two years, 1994 and 2002, are used to evaluate the indicated methods. The observed prices in 1994-1995 for 400-450 lb steers in September, 600-650 lb steers in December, and 800-850 lb steers in March were $86.74, $75.57, and $66.07 respectively. The expected values were $89.89, $77.33, and $73.23. Using the index the predicted values were $86.74, $74.60 and $70.69. The index method improved the price expectation predictions over the expected value method. The conditional probability method correctly categorized both the December and March prices.

The observed prices in 2002-2003 for 400-450 lb steers in September, 600-650 lb steers in December, and 800-850 lb steers in March were $102.46, $86.97, and $74.20 respectively. The predicted values were $89.89, $77.33, and $73.23. Using the index the expected values were $102.46, $88.12 and $83.50. The index method improved the price expectation predictions for December but was not as accurate as the expected value method for March. The conditional probability method correctly categorized both the December and March prices.

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Table 1. Analysis of Variance of price of 300-900 lb stocker steers, Amarillo, TX, 1992-2002.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	373	365,657.37	980.31	118.89	<.0001
Error	1,116	9,201.99	8.25		
Corrected Total	1,489	374,859.36			

R-Square	CV	Root MSE	Price Mean
0.9755	3.4232	2.8715	83.88

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YR	10	189,989.99	18,999.00	2,304.16	<.0001
WTGP	11	128,616.05	11,692.37	1,418.03	<.0001
MM	11	4,319.66	392.70	47.63	<.0001
YR*WTGP	110	15,365.53	139.69	16.94	<.0001
YR*MM	110	22,633.29	205.76	24.95	<.0001
WTGP*MM	121	4,732.86	39.11	4.74	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YR	10	164,776.21	16,477.62	1,998.38	<.0001
WTGP	11	124,016.28	11,274.21	1,367.31	<.0001
MM	11	3,783.67	343.97	41.72	<.0001
YR*WTGP	110	14,147.79	128.62	15.60	<.0001
YR*MM	110	22,535.80	204.87	24.85	<.0001
WTGP*MM	121	4,732.86	39.11	4.74	<.0001

Table 2. Analysis of variance of revenue of 300-900 lb stocker steers, Amarillo, TX, 1992-2002.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	373	18,401,102.78	49,332.72	268.54	<.0001
Error	1,116	205,018.39	183.71		
Corrected Total	1,489	18,606,121.17			

R-Square	CV	Root MSE	Revenue Mean
0.9890	2.8106	13.5539	482.24

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YR	10	4,794,852.99	479,485.30	2,610.04	<.0001
WTGP	11	12,581,390.24	1,143,762.75	6,225.97	<.0001
MM	11	102,981.95	9,362.00	50.96	<.0001
YR*WTGP	110	107,497.66	977.25	5.32	<.0001
YR*MM	110	681,827.69	6,198.43	33.74	<.0001
WTGP*MM	121	132,552.25	1,095.47	5.96	<.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YR	10	5,071,737.40	507,173.74	2,760.76	<.0001
WTGP	11	11,680,564.35	1,061,869.49	5,780.20	<.0001
MM	11	86,585.66	7,871.42	42.85	<.0001
YR*WTGP	110	94,213.90	856.49	4.66	<.0001
YR*MM	110	676,504.27	6,150.04	33.48	<.0001
WTGP*MM	121	132,552.25	1,095.47	5.96	<.0001

Table 3. Least square means for price and revenue for 300-900 lb stocker steers by year, by month, and by weight group, Amarillo, TX, 1992-2002.*

	Price ($)		Revenue ($)	
Year				
1992	88.24	E	513.47	E
1993	92.87	C	540.66	C
1994	84.42	F	491.01	F
1995	70.20	J	411.98	J
1996	60.43	K	358.53	K
1997	81.47	H	474.60	H
1998	77.98	I	452.22	I
1999	82.82	G	479.96	G
2000	96.05	B	553.68	B
2001	98.58	A	570.59	A
2002	91.63	D	526.54	D
Month				
JAN	85.38	A	497.35	A
FEB	85.91	A	497.92	A
MAR	86.20	A	497.74	A
APR	86.56	A	497.43	A
MAY	83.97	B	485.83	B
JUN	83.93	B	487.70	B
JUL	83.87	B	490.58	B
AUG	83.13	B	486.24	B
SEP	82.33	B	480.11	B
OCT	80.97	C	472.70	C
NOV	82.62	B	481.30	B
DEC	83.89	B	486.80	B
Weight Group				
300-350	101.28	A	329.26	L
350-400	99.39	B	372.83	K
400-450	93.40	C	396.94	J
450-500	90.65	D	430.60	I
500-550	84.56	E	443.99	H
550-600	82.40	F	473.69	G
600-650	79.24	G	495.34	F
650-700	78.12	H	527.22	E
700-750	77.02	I	558.40	D
750-800	75.96	J	588.63	C
800-850	74.05	K	610.03	B
850-900	72.71	L	634.77	A

*LSMeans for Price and Revenue in each category followed by the same letter are not considered statistically different at alpha = 0.05.

Table 4. Least square price for stocker steers by weight group and month between 1992 and 2002, Amarillo, TX.

Weight Group (lbs.)	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	($)											
300-350	102.53	103.92	105.65	106.80	101.79	101.00	99.03	98.76	97.40	96.76	98.83	102.94
350-400	100.75	102.21	103.68	106.28	99.84	99.08	96.75	97.91	96.87	93.23	96.91	99.17
400-450	94.14	96.31	97.98	100.14	95.05	92.34	90.42	90.24	89.89	89.49	91.43	93.32
450-500	92.13	93.23	95.29	98.09	92.59	90.34	88.52	88.19	85.90	85.43	88.70	89.33
500-550	85.05	87.97	88.37	89.31	86.11	85.49	84.29	82.14	80.63	79.58	82.17	83.58
550-600	83.51	85.18	86.06	87.16	83.18	83.39	82.47	80.68	79.11	78.40	79.25	80.42
600-650	80.35	80.77	81.14	80.92	79.90	79.63	80.25	79.75	78.06	76.18	76.56	77.33
650-700	79.42	79.09	78.98	78.59	77.84	78.59	78.68	77.89	77.50	76.10	76.61	78.17
700-750	78.22	77.88	76.68	75.88	75.33	76.26	78.35	77.63	76.99	76.48	76.65	77.91
750-800	77.56	76.93	74.98	73.70	73.70	75.64	77.31	76.01	76.97	75.54	76.11	77.01
800-850	75.82	74.77	73.23	71.66	72.05	73.57	76.05	75.05	74.66	72.83	74.45	74.42
850-900	75.13	72.66	72.35	70.18	70.24	71.81	74.36	73.30	73.94	71.67	73.80	73.05

Table 5. Least square mean revenue for 300-900 lb stocker steers by weight group and month between 1992 and 2002, Amarillo, TX.

Weight Group (lbs.)	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	($)											
300-350	333.22	337.73	343.37	347.09	330.82	328.24	321.83	320.98	316.56	314.47	321.21	334.56
350-400	377.80	383.28	388.81	398.56	374.42	371.56	362.81	367.17	363.26	349.63	363.43	371.90
400-450	400.09	409.32	416.42	425.58	403.97	392.45	384.30	383.54	382.04	380.34	388.58	396.59
450-500	437.62	442.82	452.64	465.92	439.82	429.10	420.49	418.92	408.02	405.80	421.32	424.33
500-550	446.52	461.85	463.96	468.88	452.08	448.83	442.54	431.24	423.33	417.78	431.38	438.79
550-600	480.20	489.80	494.85	501.15	478.26	479.51	474.21	463.88	454.88	450.81	455.68	462.39
600-650	502.19	504.80	507.14	505.75	499.36	497.70	501.59	498.43	487.85	476.15	478.47	483.30
650-700	536.07	533.85	533.13	530.51	525.44	530.45	531.06	525.76	523.10	513.69	517.13	527.62
700-750	567.11	564.62	555.91	550.16	546.18	552.90	568.07	562.79	558.14	554.50	555.72	564.88
750-800	601.05	596.22	581.13	571.18	571.17	586.23	599.17	589.06	596.49	585.42	589.87	596.85
800-850	625.49	616.85	604.12	591.22	594.44	606.95	627.42	619.15	615.97	600.82	614.18	613.95
850-900	657.43	635.79	633.06	614.11	614.57	628.31	650.64	641.39	646.98	627.07	645.72	639.22

Table 6. Price index for 300-900 lb stocker steers by weight group and month, Amarillo, TX, 1992-2002.

Weight Group (lbs.)	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
300-350	1.141	1.156	1.175	1.188	1.132	1.124	1.102	1.099	1.084	1.076	1.099	1.145
350-400	1.121	1.137	1.153	1.182	1.111	1.102	1.076	1.089	1.078	1.037	1.078	1.103
400-450	1.047	1.071	1.090	1.114	1.057	1.027	1.006	1.004	1.000	0.996	1.017	1.038
450-500	1.025	1.037	1.060	1.091	1.030	1.005	0.985	0.981	0.956	0.950	0.987	0.994
500-550	0.946	0.979	0.983	0.994	0.958	0.951	0.938	0.914	0.897	0.885	0.914	0.930
550-600	0.929	0.948	0.957	0.970	0.925	0.928	0.917	0.897	0.880	0.872	0.882	0.895
600-650	0.894	0.898	0.903	0.900	0.889	0.886	0.893	0.887	0.868	0.848	0.852	0.860
650-700	0.883	0.880	0.879	0.874	0.866	0.874	0.875	0.866	0.862	0.847	0.852	0.870
700-750	0.870	0.866	0.853	0.844	0.838	0.848	0.872	0.864	0.856	0.851	0.853	0.867
750-800	0.863	0.856	0.834	0.820	0.820	0.841	0.860	0.846	0.856	0.840	0.847	0.857
800-850	0.843	0.832	0.815	0.797	0.802	0.818	0.846	0.835	0.831	0.810	0.828	0.828
850-900	0.836	0.808	0.805	0.781	0.781	0.799	0.827	0.815	0.823	0.797	0.821	0.813

400-450 lb steers in September = 1.000

Table 7. Revenue index for 300-900 lb stocker steers by weight group and month, Amarillo, TX, 1992-2002.

Weight Group (lbs.)	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
300-350	0.872	0.884	0.899	0.909	0.866	0.859	0.842	0.840	0.829	0.823	0.841	0.876
350-400	0.989	1.003	1.018	1.043	0.980	0.973	0.950	0.961	0.951	0.915	0.951	0.973
400-450	1.047	1.071	1.090	1.114	1.057	1.027	1.006	1.004	1.000	0.996	1.017	1.038
450-500	1.145	1.159	1.185	1.220	1.151	1.123	1.101	1.097	1.068	1.062	1.103	1.111
500-550	1.169	1.209	1.214	1.227	1.183	1.175	1.158	1.129	1.108	1.094	1.129	1.149
550-600	1.257	1.282	1.295	1.312	1.252	1.255	1.241	1.214	1.191	1.180	1.193	1.210
600-650	1.314	1.321	1.327	1.324	1.307	1.303	1.313	1.305	1.277	1.246	1.252	1.265
650-700	1.403	1.397	1.395	1.389	1.375	1.388	1.390	1.376	1.369	1.345	1.354	1.381
700-750	1.484	1.478	1.455	1.440	1.430	1.447	1.487	1.473	1.461	1.451	1.455	1.479
750-800	1.573	1.561	1.521	1.495	1.495	1.534	1.568	1.542	1.561	1.532	1.544	1.562
800-850	1.637	1.615	1.581	1.548	1.556	1.589	1.642	1.621	1.612	1.573	1.608	1.607
850-900	1.721	1.664	1.657	1.607	1.609	1.645	1.703	1.679	1.693	1.641	1.690	1.673

400-450 lb steers in September = 1.000

Table 8. Conditional probabilities that the price for the indicated alternative marketing month (i) and weight will be higher than, lower than, or constant with the price from the previous year; given the September price of 400-450 lb stocker steers is higher than, lower than, or constant with the previous September price.

Month	Projected Weight[a] (lbs.)	Weight Group (lbs.)	Given that SEP Price > $1 higher than previous SEP		
			$P(D_i > \$1)$	$P(D_i < -\$1)$	$P(-\$1 < D_i < \$1)$
OCT	510	500-550	0.667	0.000	0.333
NOV	570	550-600	0.667	0.333	0.000
DEC	630	600-650	1.000	0.000	0.000
JAN	690	650-700	0.667	0.333	0.000
FEB	750	700-750	0.667	0.333	0.000
MAR	810	800-850	0.667	0.333	0.000
APR	870	850-900	0.667	0.333	0.000
MAY	930	850-900	0.667	0.333	0.000
			Given that SEP Price > $1 lower than previous SEP		
			$P(D_i > \$1)$	$P(D_i < -\$1)$	$P(-\$1 < D_i < \$1)$
OCT	510	500-550	0.167	0.833	0.000
NOV	570	550-600	0.167	0.667	0.167
DEC	630	600-650	0.167	0.667	0.167
JAN	690	650-700	0.333	0.667	0.000
FEB	750	700-750	0.333	0.667	0.000
MAR	810	800-850	0.333	0.667	0.000
APR	870	850-900	0.333	0.667	0.000
MAY	930	850-900	0.333	0.667	0.000
			Given that SEP Price is within +/- $1 of previous SEP		
			$P(D_i > \$1)$	$P(D_i < -\$1)$	$P(-\$1 < D_i < \$1)$
OCT	510	500-550	1.000	0.000	0.000
NOV	570	550-600	0.000	0.000	1.000
DEC	630	600-650	0.000	0.000	1.000
JAN	690	650-700	1.000	0.000	0.000
FEB	750	700-750	1.000	0.000	0.000
MAR	810	800-850	1.000	0.000	0.000
APR	870	850-900	1.000	0.000	0.000
MAY	930	850-900	1.000	0.000	0.000

[a] Based on a 450 lb steer calf in September and an average daily gain of 2 lbs.

D_i is the difference between the current price of the month and weight group indicated on the line and the corresponding price one year previously.

Table 9. Conditional probabilities that the price for the indicated alternative marketing month (i) and weight will be higher than, lower than, or constant with the expected value; given the September price of 400-450 lb stocker steers is higher than or lower

Month	Projected Weight[a] (lbs.)	Weight Group (lbs.)	Given that SEP Price > $1 higher than previous SEP		
			$P(D_i > \$1)$	$P(D_i < -\$1)$	$P(-\$1 < D_i < \$1)$
OCT	510	500-550	1.000	0.000	0.000
NOV	570	550-600	0.857	0.143	0.000
DEC	630	600-650	0.857	0.143	0.000
JAN	690	650-700	0.714	0.286	0.000
FEB	750	700-750	0.714	0.286	0.000
MAR	810	800-850	0.714	0.286	0.000
APR	870	850-900	0.571	0.429	0.000
MAY	930	850-900	0.714	0.286	0.000
			Given that SEP Price > $1 lower than previous SEP		
			$P(D_i > \$1)$	$P(D_i < -\$1)$	$P(-\$1 < D_i < \$1)$
OCT	510	500-550	0.000	1.000	0.000
NOV	570	550-600	0.000	1.000	0.000
DEC	630	600-650	0.000	1.000	0.000
JAN	690	650-700	0.250	0.750	0.000
FEB	750	700-750	0.250	0.750	0.000
MAR	810	800-850	0.250	0.750	0.000
APR	870	850-900	0.250	0.500	0.250
MAY	930	850-900	0.000	0.750	0.250

[a] Based on a 450 lb steer calf in September and an average daily gain of 2 lbs.

D_i is the difference between the current price of the month and weight group indicated on the line and the corresponding price one year previously.

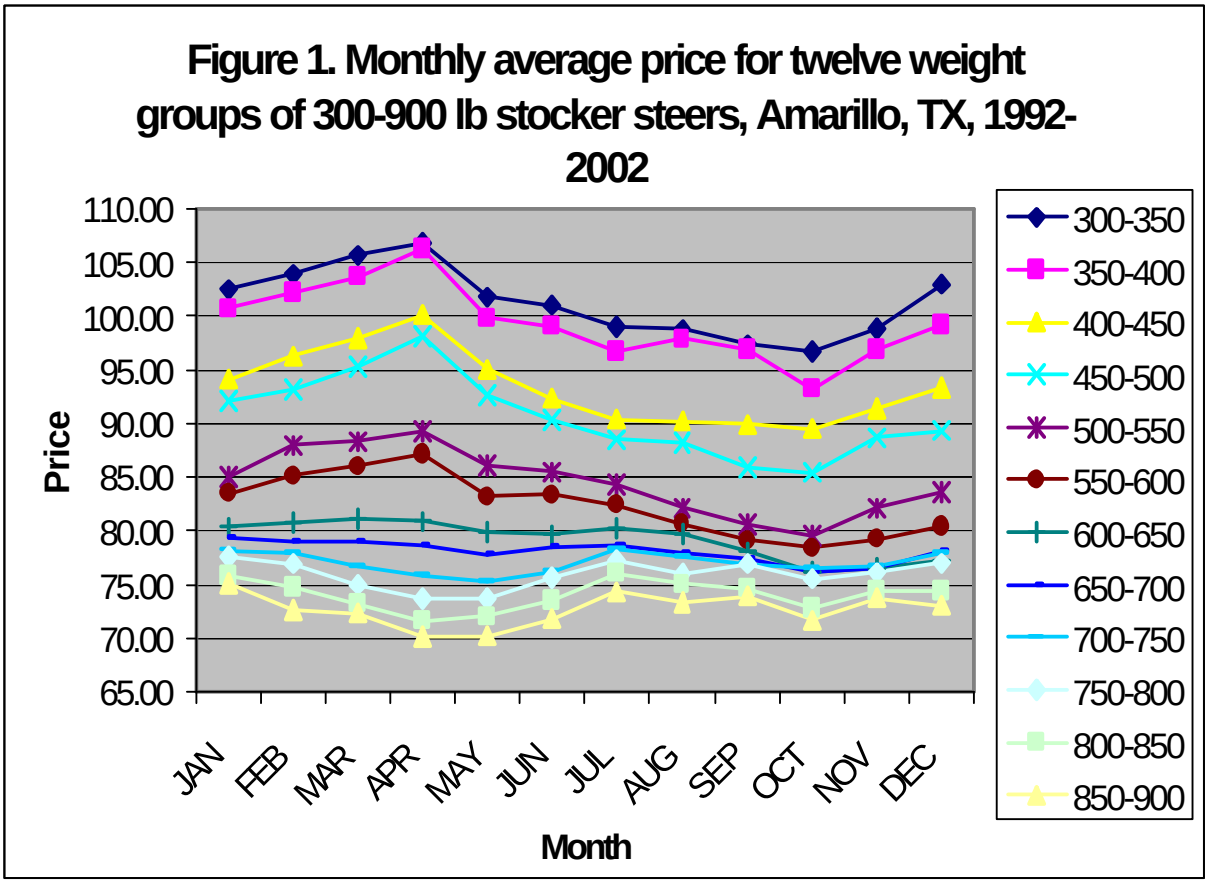
Figure 1. Monthly average price for twelve weight groups of 300-900 lb stocker steers, Amarillo, TX, 1992-2002
110.00
105.00
100.00
95.00
90.00
85.00
80.00
75.00
70.00
65.00
Price
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
Month
300-350
350-400
400-450
450-500
500-550
550-600
600-650
650-700
700-750
750-800
800-850
850-900

Figure 2. Average revenue for 12 weight groups of 300-900 lb stocker steers by month, Amarillo, TX, 1992-2002