Utilizing Expected Revenue in 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 Southern Agricultural Economics Association Annual Meeting, Mobile, Alabama, February 1-5, 2003

Partial funding provided by the Dryland Agriculture Institute,

West Texas A&M University, Canyon, Texas.

Abstract

Beef cattle enterprises for the 91% of Texas producers with less than 100 cows represent secondary or supplemental enterprises. In most cases the operator is depending in 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. Monthly average prices for 300 to 900 pound stocker steers, divided into 50 lb intervals, are analyzed for three market locations for the period 1992-1999. Consistent price roll back is observed as the price per cwt decreases as the weight increases. However, as the reduction in price is more than offset by the increase in value due to additional weight, the expected revenue per animal increases as weight increases.

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

The small size of enterprise greatly restricts the marketing alternatives available to the producer. 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.). Marketing strategies developed for larger operations may not be appropriate. For example, multiple marketing alternatives often are as a way to moderate price risk. However, this would result in smaller animal numbers sold each time. Small lot size has been associated with lower prices (Mintert et al.). 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.

Data

Stocker steer prices from three livestock auction locations; Amarillo, TX; Dalhart, TX; and Oklahoma City, OK; are used to analyze the differences in prices and expected revenues generated by marketing at different time of the year and different weights. Average monthly prices for twelve weight

groups representing 50 lb intervals between 300 and 900 lbs for the years 1992 through 1999, as reported by the USDA Market News Service in Amarillo, TX, are used in the analysis.

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

Market alternatives for the different calving scenarios are determined by applying rates-of-gain corresponding to existing range or pasture condition to the calves (Colette and Melton; Pharo; National Resource Council; and White and McGinty). Under normal to good conditions gains on native Buffalo grass and grama grass range are assume to be from 1.1 to 1.5 pounds per day depending on stage of growth. On Old World bluestem, Sudangrass, and sorghum-sudangrass hybrids gains vary from 1.5 to 2.0 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.

Results and Discussion

The sources of variation in the 3,456 prices representing the average monthly prices for the 12 weight groups at the three market locations is analyzed using PROC GLM, Table 1. Main affects analyzed include location (Loc), year, and weight group (Weight). Two- and three-way interactions include year-by-location, month-by-location, weight-by-location, weight-by-year-by-location, and weight-by-month-by-location. 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 0.8728, indicates that 87% 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, location, year, and weight group ($Pr>F <0.0001$). Significant interactions are identified for Year-by-Loc, Month-by-Loc, Weight-by-Loc, and Weight-by-Year-by-Loc ($Pr>F <0.0001$).

The three major livestock markets, with USDA Market News Service coverage, servicing the needs of the region include the auctions in Amarillo, TX; Dalhart, TX and Oklahoma City, OK. The average prices of stocker steers are statistically different at the three locations. Oklahoma City, OK has the highest average prices while Amarillo, TX has the lowest average prices.

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 to an animal, Table 2. The same patter is observed for all three market locations included in the study. Multiple comparison tests indicate significant price differences for each weight group. The highest price per cwt is observed at the 300-350 lb weight and the lowest price is observed at the 850-900 lb weight group.

The monthly average prices have different patterns at the different market locations, Table 3. However, all three locations fit into the same seasonal pattern. Prices are lowest in the fall when the majority of the spring calves are weaned and marketed for the first time. Demand may also be depressed during this period if the prospects for winter wheat pasture are not favorable. Average stocker prices are the highest during the late winter and early spring. Supplies are depressed during this period as the calves from the relatively small fall calf crop are weaned. Demand during the period is stimulated as producers acquire stockers for summer grazing.

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 when supplies are limited due to smaller fall calf crops. The prices for these lighter weights are lowest during the fall months 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 when supplies are expanded by the previous falls calves reach these weights. Prices for the heavier weights are at their highest during the late summer and early fall months when the supplies are limited to carryover yearlings and calves from the previous fall's calving.

The sources of variation in the 3456 average monthly expected revenues calculated for the 12 weight groups at the three market locations is analyzed using PROC GLM, Table 5. Main affects

analyzed include location (Loc), year, and weight group (Weight). Two- and three-way interactions include year-by-location, month-by-location, weight-by-location, weight-by-year-by-location, and weight-by-month-by-location. 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 0.9642 indicates that over 96% of the variation in expected revenue is explained by the variables in the model

The Type III Sums of Squares indicate that significant differences in expected revenue are identified for each of the main effects, location, year, and weight group (Pr>F <0.0001). Significant interactions are identified for Month-by-Loc and Weight-by-Year-by-Loc (Pr>F <0.0001).

The average expected revenues for stocker steers are statistically different at the three market locations. Oklahoma City, OK has the highest average expected revenue while Amarillo, TX has the lowest average expected revenue.

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 6. Multiple comparison tests indicate the same pattern of expected revenue at each location. Significant expected revenue differences are observed for each weight group. The highest expected revenue per head is observed at the 850-900 lb weight and the lowest expected revenue is observed at the 300-350 lb weight group.

The monthly average expected revenues have different patterns at the different market locations, Table 7. However, all three locations follow the pattern of expected prices and fit into the same seasonal pattern. Expected revenues per head are lowest in the fall when the majority of the spring calves are weaned and marketed. Average expected revenues are the highest during the late winter and early spring. Supplies are lower during this period as there are less calves being weaned from the relatively small fall calf crop.

Different monthly average expected revenue patterns are observed for the different weight groups at the Amarillo auction, Table 8 and Figure 2. The heavier weights always 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. The expected revenues for these lighter weights are lowest during the fall months. In contrast, the expected revenues for the heavier weights, 700 to 900 lbs, are at their lowest in the spring and their highest during the late summer and early fall months.

Marketing Alternative Scenarios

Production and marketing decisions under fixed resources and variable resources have both common characteristics and significant differences. In both cases the cost of additional resources and the changes in revenue must be considered. However, the profit maximizing decision uses different information. Under variable resource production profit is maximized when marginal cost is equal to marginal revenue. With fixed resources costs are essentially fixed. Therefore, profits are maximized when revenue is maximizing.

Under the semi-arid conditions in the Texas Panhandle, large year-to-year variations in forage production will be observed due to the availability and distribution of precipitation. The fixed resource producer who has adopted a cow/calf option has already limited the marketing alternatives. The flexibility to adjust to wide changes in forage availability has been greatly reduced. This may be the logical decision, however, as the financial capital, labor, and/or management may not be available to adjust production alternatives to the variable conditions. In this context, very stable operation can be established by setting herd size so that expected forage production is sufficient to maintain the cow herd with calves sold at weaning a high proportion of the time (70% to 90% of the time depending on the ability to carry risk). In years with above normal precipitation and above average forage production marketing of the weaned calves could be delayed to utilize the excess forage. In droughty years early weaning and marketing, and possible temporary herd reduction would be options.

Example marketing options are presented for three production alternatives, Table 8. The first production alternative represents early spring calving in February and March. The steer calves would be expected to gain 2 pounds per day while nursing on high quality forage and be marketable at early weaning at 350-400 lbs in July and August. This would produce expected revenue of $252.76 to $254.64.

Holding the calves until the normal weaning time in September or October would produce 550-600 lb stocker steers that would generate expected revenue of $354.80 to $354.13. If adequate range forage is available, holding the stocker steers would produce a 650-700 lb steer for the November to December market. This would generate expected revenue of $417.96 to $427.33. With the availability of forage, continuing to grow the stocker until January or February would produce a 750-800 lb steer that would be expected to generate $504.60 to $501.00 in revenue.

The second production scenario incorporates the availability of wheat pasture into the first scenario. Following normal weaning in September or October the stocker steer would be placed on wheat pasture in October or November. Rates of gain of 2 to 2.5 lbs per day would produce a 750-800 lb steer in December or January. This would produce expected revenue of $496.89 to $504.60. Continued grazing on wheat pasture would produce an 850-900 lb feeder steer with expected revenue of $547.37 to $541.30 in February or March.

The third scenario involves an early fall calving system with calving in September to October. Early weaning would produce a 300-350 lb stocker in February or March. This would produce expected revenue of $217.31 to $222.41. Normal weaning in April or May would provide a 400-450 lb stocker steer. Sale at weaning would be expected to provide revenue of $308.83 to $291.38. With the availability of good forage, the steers could be held to 550-600 lbs and marketed in June or July for expected revenue of $376.65 to $373.73. Continuing to graze the steer through the summer would produce a 750-800 lb feeder steer in August or September. This would increase the expected revenue to between $500.04 and $495.37.

One of the primary considerations of the fixed resource beef cattle producers in the Texas Panhandle is the maintenance of the productivity of the range or pasture resources. The great variability in precipitation translates to great variability in the availability of forage. Effectively utilizing the available forage while not over grazing and degrading the long term productivity of the range requires active and thoughtful management. The constraints placed on the fixed resource producer by limits on the availability of financial capital, labor, and management make this task much more difficult.

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Table 1. Analysis of variance for price for 300 to 900 lb stocker steers at three market locations, 1992-1999

Source	DF	Sum of Squares	Mean Square	F - Value	Pr > F
Model	683	640875.51	938.32	27.85	<.0001
Error	2772	93406.80	33.69		
Corrected Total	3455	734282.31			

R-Square	Coeff Var	Root MSE	Price Mean
0.8728	7.1154	5.8049	81.581

Source	DF	Type III SS	Mean Square	F - Value	Pr > F
Loc	2	7364.2765	3682.1382	109.27	<.0001
Year	7	326749.8832	46678.5547	1385.26	<.0001
Weight	11	256957.4548	23359.7686	693.24	<.0001
Yr*Loc	14	656.9509	46.9251	1.39	0.1478
MM*Loc	33	8317.9119	252.0579	7.48	<.0001
Weight*Loc	22	1117.4934	50.7952	1.51	0.0607
Weight*Yr*Loc	231	26513.4352	114.7768	3.41	<.0001
Weight*MM*Loc	363	13198.1052	36.3584	1.08	0.1605

Table 2. Overall and market location least square means for price for 300 to 900 lb stocker steers by weight groups, 1992-1999

Weight (lbs)	Overall	Market		
		Amarillo	Dalhart	Oklahoma
300-350	96.77 a	94.25 a	97.76 a	98.30 a
350-400	95.38 b	93.32 b	94.94 b	97.89 b
400-450	90.54 c	87.83 c	90.30 c	93.48 c
450-500	87.57 d	85.56 d	87.75 d	89.40 d
500-550	82.88 e	80.20 e	82.85 e	85.59 e
550-600	80.39 f	78.17 f	80.57 f	82.43 f
600-650	77.44 g	75.57 g	77.30 g	79.44 g
650-700	76.00 h	74.60 h	75.91 h	77.49 h
700-750	74.85 I	73.78 i	74.59 i	76.17 i
750-800	73.94 j	73.12 j	73.78 j	74.91 j
800-850	72.40 k	71.17 k	72.41 k	73.60 k
850-900	70.84 l	70.00 l	70.73 l	71.79 l

[a] Means, within groups, followed by the same letter are not considered different at alpha = 0.05

Table 3. Overall and market location least square means for price for 300 to 900 lb stocker steers by month, 1992-1999.

Month	Overall	Market Location		
		Amarillo	Dalhart	Oklahoma City
JAN	82.36	81.10 d	83.09 d	84.16 e
FEB	83.61	81.66 c	84.23 a	84.95 c
MAR	83.75	81.86 b	83.78 c	85.62 b
APR	83.27	82.17 a	83.66 b	85.64 a
MAY	81.81	80.18 e	81.57 e	83.69 f
JUN	81.47	79.97 g	80.85 h	83.60 g
JUL	81.52	80.03 f	81.41 f	83.12 I
AUG	81.29	79.59 h	81.01 g	83.27 h
SEP	79.88	77.92 j	79.96 j	81.75 k
OCT	78.85	76.78 l	79.07 l	80.70 l
NOV	79.94	77.64 k	79.61 k	82.57 j
DEC	81.22	78.66 i	80.66 i	84.34 d

[a] Means, within groups, followed by the same letter are not considered different at alpha = 0.05

Table 4. Average price for stocker steers by weight group and month between 1992 and 1999 for Amarillo.

Weight	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
300-350	94.71	96.58	98.29	98.85	95.86	94.06	92.08	94.20	91.64	89.09	91.63	94.06
350-400	94.77	95.57	96.92	99.96	94.15	94.81	91.91	92.60	90.08	87.50	90.16	91.37
400-450	89.36	90.65	92.05	95.03	89.66	88.01	85.51	84.76	85.64	83.97	84.64	84.74
450-500	87.32	87.67	90.09	92.60	88.80	86.28	83.99	82.74	81.40	80.18	81.76	83.90
500-550	80.66	83.30	84.04	84.93	82.40	81.43	80.17	79.02	76.21	75.18	77.11	77.95
550-600	79.24	80.72	81.84	82.00	79.32	79.29	78.68	77.09	74.69	74.55	74.24	76.33
600-650	76.63	77.59	77.46	77.22	76.60	76.16	76.50	76.45	74.19	72.48	72.25	73.29
650-700	75.72	75.59	75.14	75.16	74.20	75.34	75.52	75.19	73.29	73.09	72.69	74.32
700-750	75.41	74.81	73.53	72.23	72.48	73.04	75.12	74.67	73.18	73.04	73.22	74.65
750-800	74.76	74.22	72.38	71.23	70.85	72.27	74.91	74.08	73.39	72.18	73.60	73.61
800-850	72.58	72.64	70.77	68.99	69.80	70.29	73.72	72.80	71.47	70.27	70.58	70.17
850-900	72.07	70.63	69.85	67.86	68.02	68.63	72.31	71.47	69.91	69.84	69.86	69.55

Table 5. Analysis of variance for revenue for 300-900 lb stocker steers at three market locations, 1992-1999.

Source	DF	Sum of Squares	Mean Square	F - Value	Pr > F
Model	683	43449108.46	63615.09	109.44	<.0001
Error	2772	1611263.59	581.26		
Corrected Total	3455	45060372.05			

R-Square	Coeff Var	Root MSE	Rev Mean
0.9642	6.1282	24.1094	$393.42

Source	DF	Type III SS	Mean Square	F - Value	Pr > F
Loc	2	149043.87	74521.93	128.21	<.0001
Year	7	6881883.17	983126.17	1691.36	<.0001
Weight	11	35771432.11	3251948.37	5594.62	<.0001
Yr*Loc	14	10214.73	729.62	1.26	0.23
MM*Loc	33	115771.97	3508.24	6.04	<.0001
Weight*Loc	22	10278.69	467.21	0.80	0.72
Weight*Yr*Loc	231	274877.83	1189.95	2.05	<.0001
Group*MM*Loc	363	235606.10	649.05	1.12	0.08

Table 6. Overall and market location least square means for revenue for 300 to 900 lb stocker steers by weight groups, 1992-1999

Weight	Overall	Market Location		
		Amarillo	Dalhart	Oklahoma City
	$			
300-350	217.73 l[a]	212.07 l	219.95 l	224.49 l
350-400	262.30 k	256.62 k	261.08 k	269.21 k
400-450	294.24 j	285.46 j	293.48 j	303.80 j
450-500	328.39 I	320.85 i	329.06 i	335.24 i
500-550	352.23 h	340.84 h	352.10 h	363.74 h
550-600	381.85 g	371.29 g	382.73 g	391.52 g
600-650	406.55 f	396.74 f	405.83 f	417.08 f
650-700	437.01 e	428.97 e	436.50 e	445.55 e
700-750	467.79 d	461.13 d	466.18 d	476.06 d
750-800	499.07 c	493.58 c	498.00 c	505.62 c
800-850	524.87 b	516.00 b	525.00 b	533.61 b
850-900	549.02 a	542.50 a	548.16 a	556.39 a

[a] Means, within groups, followed by the same letter are not considered different at alpha = 0.05

Table 7. Overall and market location least square means for revenue for 300 to 900 lb stocker steers by month, 1992-1999

Month	Overall	Market Location		
		Amarillo	Dalhart	Oklahoma City
JAN	398.35	392.43 c	400.84 b	401.77 h
FEB	401.09	393.79 a	403.12 a	406.36 c
MAR	399.86	392.65 b	399.62 c	407.32 b
APR	397.46	391.64 d	398.16 d	402.58 e
MAY	391.96	384.93 h	390.83 i	400.12 i
JUN	393.02	385.29 g	390.87 g	402.89 d
JUL	395.77	389.43 e	395.56 e	402.31 f
AUG	393.51	386.37 f	391.97 f	402.18 g
SEP	387.20	378.32 j	387.90 j	395.39 k
OCT	382.48	373.63 l	382.63 l	391.17 l
NOV	387.24	376.74 k	385.74 k	399.23 j
DEC	393.12	380.83 i	390.84 h	407.68 a

[a] Means, within market location, followed by the same letter are not considered different at alpha = 0.05

Table 8. - Average revenue for stocker steers by weight group and month between 1992 and 1999 for Amarillo.

Weight	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
300-350	213.11	217.31	221.14	222.41	215.68	211.63	207.17	211.94	206.19	200.45	206.17	211.62
350-400	260.63	262.81	266.54	274.88	258.91	260.73	**252.76**	**254.64**	247.73	240.63	247.94	251.27
400-450	290.43	294.60	299.17	308.83	291.38	286.02	277.91	275.47	278.33	272.90	275.08	275.39
450-500	327.45	328.77	337.82	347.24	333.00	323.56	314.96	310.26	305.25	300.68	306.60	314.63
500-550	342.79	354.02	357.18	360.95	350.19	346.08	340.71	335.84	323.89	319.49	327.70	331.27
550-600	376.38	383.41	388.73	389.48	376.79	376.65	373.73	366.17	**354.80**	**354.13**	352.63	362.54
600-650	402.33	407.36	406.64	405.40	402.14	399.85	401.64	401.36	389.47	380.51	379.33	384.79
650-700	435.41	434.62	432.06	432.17	426.64	433.23	434.21	432.34	421.40	420.26	417.96	427.33
700-750	471.28	467.58	459.55	451.44	453.02	456.48	469.47	466.70	457.40	456.49	457.62	466.53
750-800	**504.60**	501.00	488.57	480.77	478.21	487.85	505.66	500.04	495.37	487.22	496.77	**496.89**
800-850	526.20	526.65	513.10	500.19	506.04	509.58	534.48	527.78	518.16	509.47	511.68	508.70
850-900	558.53	**547.37**	**541.30**	525.89	527.16	531.85	560.41	553.90	541.81	541.29	541.41	539.03

Scenario one – early spring calving, range

Scenario two – early spring calving, range wheat pasture

Scenario three – early fall calving

Figure 1. Average price for stocker steers by weight group by month, Amarillo, 1992-1999

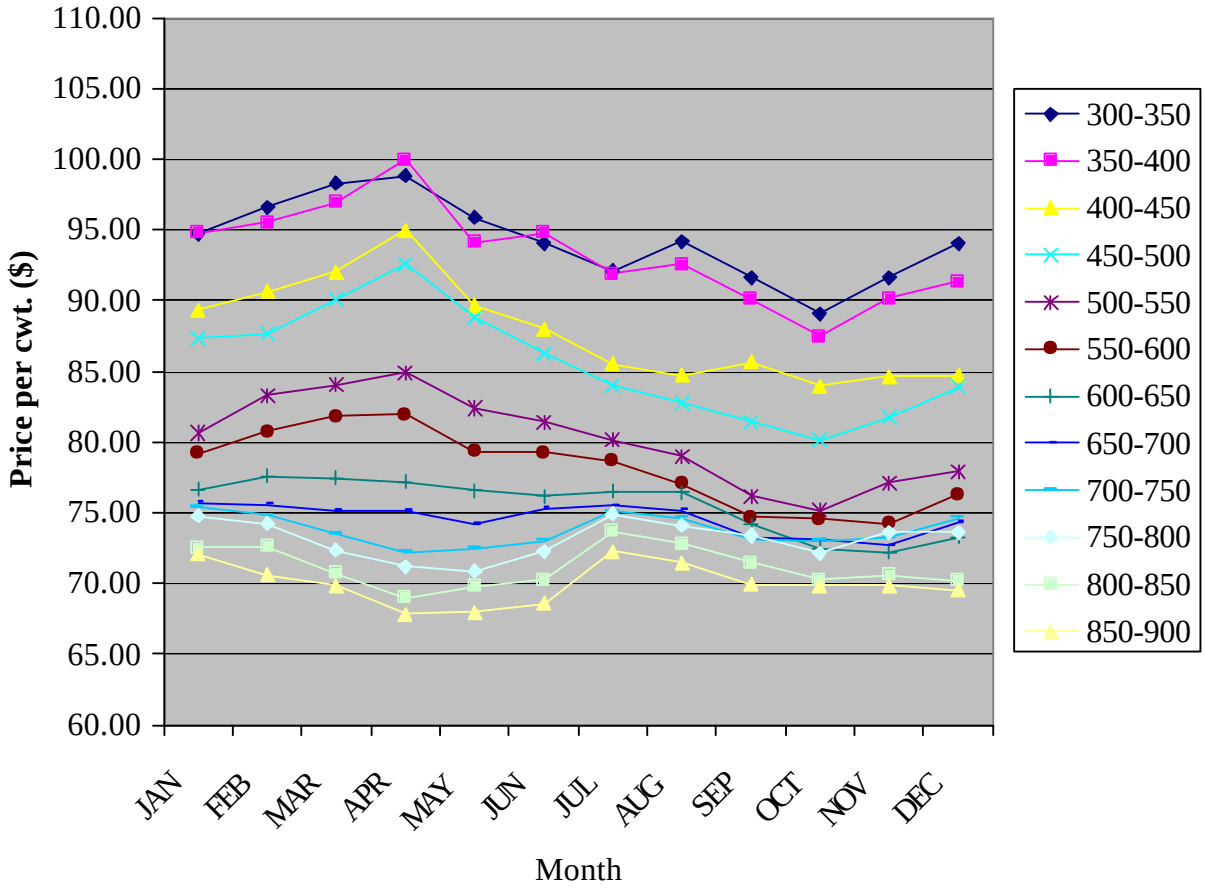

Figure 2. Average revenue for stocker steers by weight group and month, Amarillo, 1992-1999.