RANGE COW CULLING: HERD PERFORMANCE

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This article is the first in a series of three articles on range cow culling. The focus of this article is biological performance related to fertility, calf weight, and cull cow weight. The second article will focus on price relationships, while the last article will incorporate both biological and market considerations to present a framework for increasing profits through better culling decisions.

Biological factors determine a cow's ability to produce marketable products, specifically calves and salvage value as slaughter cows. Performance measures for one ranch's herd in Arizona are presented below. Estimates of fertility, calf weights and slaughter cow weights were made from the herd's individual cow records for the years, 1982 to 1989. The results presented below represent an average expected performance for this herd and should be compared to the performance of your herd.

FERTILITY

Fertility encompasses three basic stages before a marketable product is obtained from cow-calf operations. These stages are: 1) conception, 2) calving, and 3) survival of calves until weaning. Fertility percentages for each of these three stages can be calculated for different classes and ages of cows if records are kept on individual cows. These three percentages multiplied by each other give the "marketable fertility." For example, if 85% of the cows in a particular class conceived, 96% of those that conceived had live calves, and 98% of these cows had a live calf at weaning, your marketable fertility for this class of cows would be 80% (i.e., .85 x .96 x .98 = .80). Simply stated, 80% of all the cows in this class produced a marketable calf.

What determines fertility? Some of the major factors are: each cow's individual genetic make-up, body condition, and age. The genetic make-up of your herd can be changed by the selection of replacement cows but is fixed for the year once you have selected the replacements. Cow body condition on the range is influenced by weather fluctuations and forage availability. Because the weather cannot be controlled, supplementing range forage with minerals and/or nutrients may be a wise investment during periods of poor forage availability resulting in improved cow condition and subsequent improved fertility.

As a cow gets older, condition and associated fertility are likely to deteriorate from age factors rather than forage factors. The chance that a cow will die within the next year or become physically unable to produce another calf is related to the cow's age. These probabilities are very influential in the decision of whether to keep or cull a range cow since a cow that dies on the range will bring nothing for "salvage" whereas an older cow that makes it to slaughter will generally bring $400 or better. Also, older cows that become physically unsound tend to have relatively light weights and no sale calf at their side when culled.

The conception rate for the Arizona herd analyzed was calculated for cows that were open with a calf at side and open without a suckling calf at their side. Since the reproductive history and nutrition requirements are different for these two groups of open cows, their conception rates are likely to differ too. To determine fertility rates, calving and weaning records were used, after the fact, to determine which cows had become pregnant. Cow and calf records were linked and sorted by cow tattoo and year. Cows recorded as having a newborn calf (live or dead) in the spring or sale calf in the fall, obviously had to have been pregnant in the previous fall. Cows that were kept in the herd and had no calf show up the following year were obviously open in the fall. Cows that were sold because they were simply open or lost their calf were treated as open cows fit to breed again. Cows that were sold because of bad udder, structural unsoundness, and/or cancer eye were classed in the category of physically unfit to breed. The “dead category” included cows that were recorded as dying or cows that disappeared from the herd.

Figure 1 is a flow chart illustration of how the estimated calving rates (Table 1) and fertility estimates for open cows (Tables 2 and 3) fit into the fall-spring cycle. The Arizona ranch operation analyzed only considered spring calving so that cows which were open

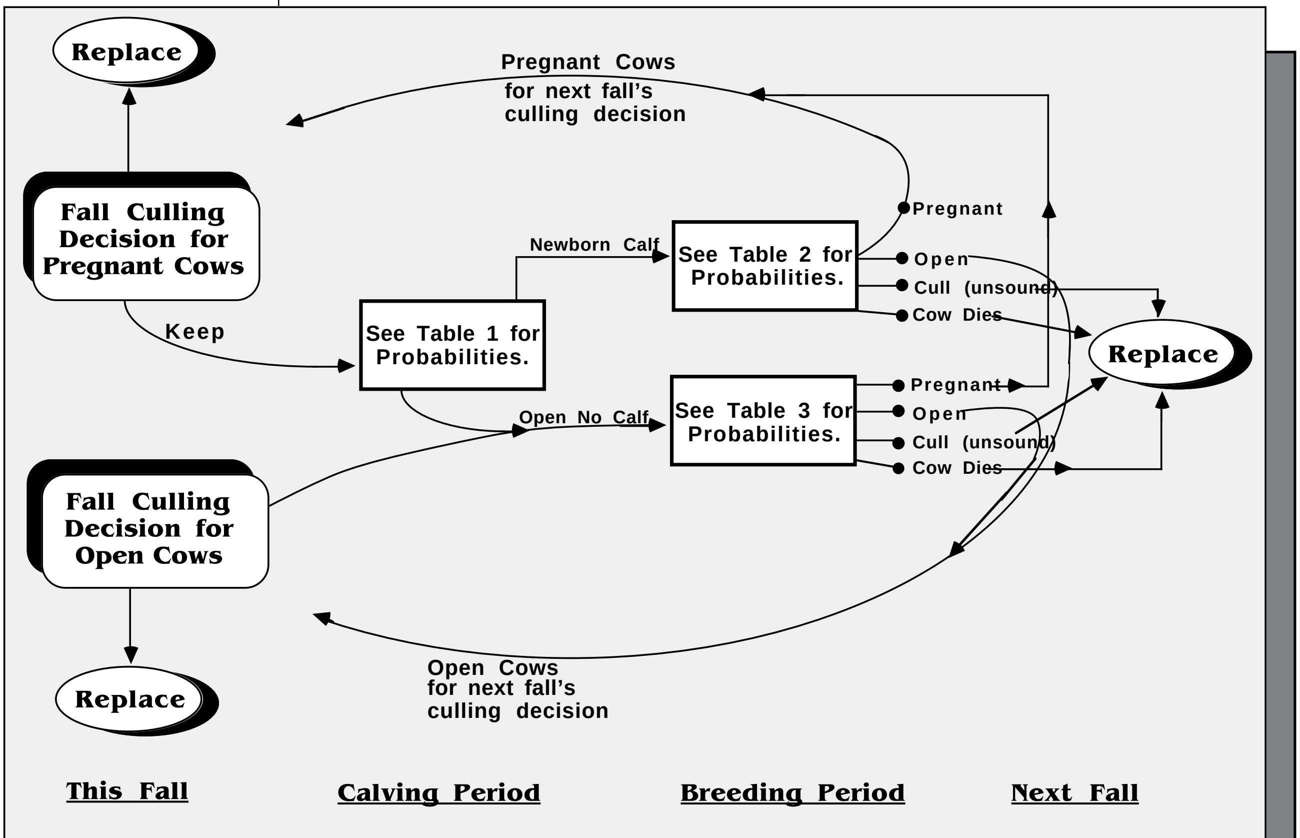

Figure 1. Flow Chart of Herd Fertility.

Table 1. Calving Rates for Pregnant Cows by Age.

Cow Age (year)	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5
	%											
Pregnant to No Calf	2.17	2.78	3.23	3.53	3.68	3.68	3.52	3.22	2.76	2.15	1.39	0.48
Pregnant to live Newborn Calf	97.83	97.22	96.77	96.47	96.32	96.32	96.48	96.78	97.24	97.85	98.61	99.52

Table 2. Estimate Fertility of Open Cows with Calf by Age.

Cow Age (year)	3	4	5	6	7	8	9	10	11	12	13
	%										
Newborn calf at side to Pregnant	81.95	80.80	79.33	77.52	75.39	72.94	70.15	67.04	63.59	59.83	55.73
Newborn calf at side to Open	14.59	14.59	14.59	14.59	14.59	14.59	14.59	14.59	14.59	14.59	14.59
Newborn calf at side to Cull (unsound)	1.40	1.86	2.65	3.77	5.21	6.98	9.08	11.51	14.26	17.35	20.76
Newborn calf at side to Cow Died	2.06	2.75	3.43	4.12	4.81	5.49	6.18	6.87	7.55	8.24	8.93

Table 3. Estimated Fertility of Open Cows with No Calf by Age.

Cow Age (year)	3	4	5	6	7	8	9	10	11	12	13
	%										
Open to Pregnant	70.99	69.26	67.03	64.41	61.52	58.49	55.44	52.49	49.75	47.36	45.43
Open to Open	25.09	24.09	23.08	22.08	21.08	20.08	19.07	18.07	17.07	16.07	15.07
Open to Cull (unsound)	3.32	5.58	8.21	11.09	14.10	17.13	20.04	22.72	25.05	26.90	28.15
Open to Cow Dies	0.60	1.07	1.68	2.42	3.29	4.30	5.44	6.71	8.12	9.67	11.35

in the fall would still be open the following spring. Cows that were pregnant in the fall could have either a live or dead newborn calf in the spring. For example, if a cow is 5.5 years old and pregnant, results indicate that this cow has a 3.53% chance of losing her calf and a 96.47% chance of having a live calf (see Table 1). Because future calving records were used to determine which cows were pregnant, no cows were classed in a pregnant to "dead cow category." All the cow deaths are accounted for in an open to dead cow category.

Table 2 gives the fertility estimates for open cows with a calf at their side. These cows could: 1) remain open, 2) become pregnant (determined by future calving records), 3) become physically unfit to breed, or 4) die. Results show that death and cull rates increase quite sharply for cows greater than eight years of age while the rate of pregnancy drops. The rate for open cows with a calf at side to stay open (structurally sound) was found to remain constant with age and estimated at 14.59%.

Fertility estimates for open cows with no calf at their side are given in Table 3. As shown in Figure 1, these cows could have either lost their calf in the spring or have been open in the previous fall. Similar to the open cows with a calf at their side, these cows could go into the four categories of 1) open, 2) pregnant, 3) physically unfit to breed, or 4) or dead cow. Fertility estimates in Tables 2 and 3 indicate that cows with no calf at their side have a higher chance of failing to conceive than cows that have a suckling calf at their side. Our results are based on data from years with good forage production on the ranch used for the analysis. Other studies have shown that in periods of nutritional stress cows without calves have higher fertility levels than cows with suckling calves.

WEIGHT PERFORMANCE

Since cattle are sold by weight, it is fertility, calf weight and cow weight when culled that determine total production. Weight performance from the cow comes from its annual calf weaning weight and its own weight when sold for slaughter. Although the cow herd is not sold on an annual basis like the calf crop, cow weight is an important consideration for the culling decision since a cow losing weight is equivalent to losing production and a cow gaining weight is equivalent to increasing production.

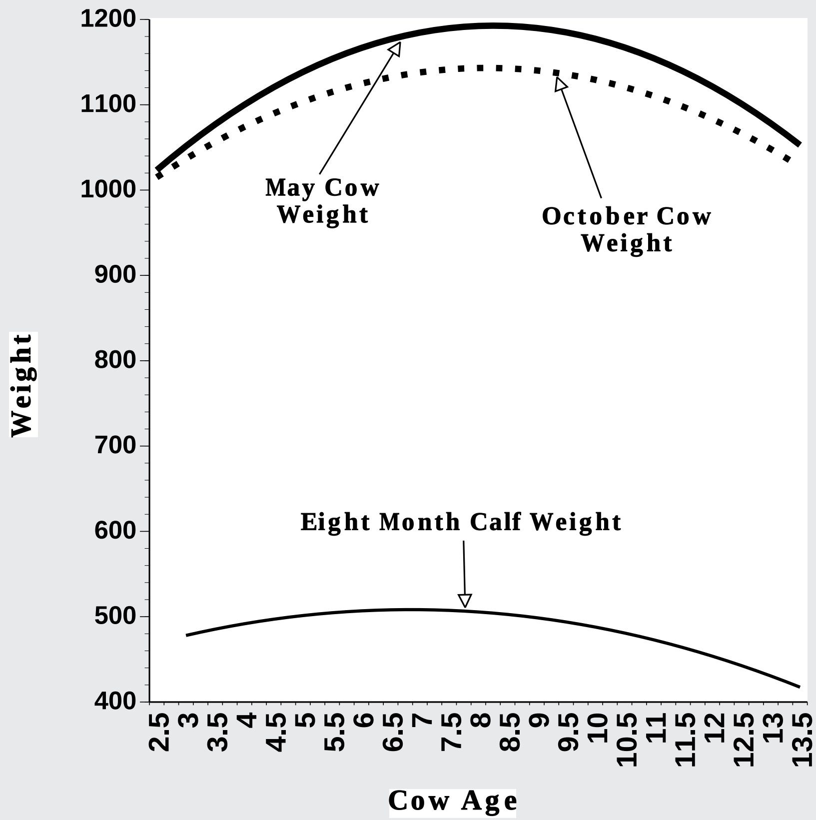

Figure 2. Estimated May and October Cow Weights and Eight Month Calf Weights, all as a Function of Cow Age.

Figure 2 gives the estimated May and October cow weights as well as the eight month calf weight, all estimated as a function of cow age. As expected, calves from the youngest and oldest cows are lighter than calves from cows in their prime age. Estimated calf weights start out at 470 lbs. for heifers that calve when they are three, reach a maximum of 508 lbs. for seven year old cows, and drop off to 431 lbs. for 13 year old cows. Although the expected differential between the “largest” and “smallest” calf may seem small at only 77 lbs., this is about a 15% reduction in gross sale receipts that translates to a much higher percentage reduction in profit. Calf weight is obviously influenced by other factors that are hereditary and related to cow-calf nutrition and range conditions. However, the linkage of calf weight to cow age is especially important to the culling decision since a cow retained in the herd becomes one year older while her genetic make-up remains the same.

Figure 2 shows that May cow weights are greater than October cow weights with the greatest weight differential occurring for cows that are between 6 and 10 years of age. These weights reflect that for the ranch used as the basis for this analysis, good winter forage was available. After cows attain their maximum weight at around 8 years of age (1192 and 1143 pounds for May and October, respectively), weights drop off about 10 lbs. a year until they are 10 and then drop off nearly 30 lbs. a year after that. One needs to consider both the lower slaughter weight for culls and a lower weaning weight when keeping an older cow one more year. Conversely, a young cow will generally increase its own weight and calf weaning weight if kept for another year. However, more nutrients are generally required for cows carrying their first calf to obtain this growth. All these considerations influence the economic decision of whether one should keep or cull a range cow.

Because range, breeding stock, and environment are different for most Arizona ranches, herd fertility and weight performance will vary from ranch to ranch. This variation indicates that your ranch needs to keep good fertility and weight records so that you can make accurate culling decisions on every cow in your herd. If you don't know the performance characteristics of cows in your herd by age class perhaps its time to consider improvements in your record keeping system. The next article in this series will focus more on the economics of the culling decision by looking at market prices. Specifically, current market prices for replacement stock, cull cows, and calves plus the likelihood of increases or decreases in these price relationships are explored in the next article.

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MARKET IMPACTS ON CULLING DECISIONS

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Biological considerations determine the quantity of product that will reach the market, but economic considerations, particularly market prices and supplemental feed costs need to be combined with biological performance to determine the bottom line of profitability for a culling strategy. (See previous article for a discussion of biological performance.) This article will concentrate on market considerations and profitability of culling strategies. The next article will conclude with our recommendations of optimal culling strategies.

MARKET PRICES AND THE CULLING DECISION

The culling decision has long-term consequences. Each replacement heifer you buy or raise this year will, hopefully, remain productive for at least five years. This lengthy time span complicates calculating the productivity of an existing cow in the herd versus a replacement. In addition to the uncertainty involved with future production, uncertainty exists about future prices.

Each individual rancher is a “price taker.” That is, an individual rancher cannot have any noticeable impact on total livestock supply available or price, even if they are one of the largest ranches in the state. A rancher will receive whatever price the going market rate is at the time livestock are sold or bought. Subsequently, timing in relation to market prices is very crucial to the culling decision. The three market prices of 1) feeder calves, 2) replacement heifers, and 3) slaughter cows are all inter-related and vitally important to the economics of the culling decision.

If culling decisions are made in the fall for a spring calving operation, feeder calf prices may be overlooked as an unimportant market factor. Another year will pass before either the current cow or replacement will have a calf for sale, but there is a substantial association of the feeder calf price level from one year to the next. This is why one should not ignore current calf prices as being important for the culling decision.

Ranches that raise their own replacement stock sometimes overlook replacement prices as being an important market consideration for their culling decisions. But even if one raises their own replacement stock for feed costs that add up to only half the value of the current market price for replacement heifers, current replacement prices (minus any transportation and selling costs) should be utilized as the cost for bringing a heifer into the herd. If one can sell a bred replacement heifer for $650, even though you may only have $450 of total costs into raising the heifer, the cost of bringing the heifer into the herd is $650. ($450 in costs and $200 in forgone profits if the animal is not sold)

Slaughter prices directly enter the decision of whether to cull since a cow culled will be sold for the going market slaughter price. If slaughter prices are high while replacement prices are relatively low, replacing marginal older cows will be more economical (buy low and sell high). Conversely, if replacement prices are high and slaughter prices are relatively low, keeping marginal older cows will be more economical (don't buy high and sell low). It is not just market prices that need to be considered. Since the value of a cull cow is weight times price, market prices need to be considered jointly with weight performance. (See the previous article for a discussion of biological performance.)

If ranchers were able to accurately predict future prices it would be a relatively simple exercise to evaluate alternative culling strategies. However, ranchers aren't the only individuals that have trouble predicting prices. Ag economists have problems predicting prices as well. One reasonable approach to get around the problem of not being able to predict distant future prices exactly, is to calculate the probabilities associated with ranges of future price movements from one period to the next. These price movement probabilities can then be utilized in conjunction with current price levels to evaluate alternative culling strategies. The results are based most heavily on nearest price movements plus the more distant or average consequences expected over a number of years.

These probabilities of future price movements can be calculated from the behavior of past prices. Long-term price levels for calves, calculated as an average of steer and heifer calf prices, and bred replacement heifer prices are shown in Tables 1 and 2. Table 1 shows the percent of the time various price level combinations have occurred for November while Table 2 presents comparable information for May. For example, the historical probability of November calf prices being above 100$/cwt. and replacement prices being above 805 $/head is just over 2% (the bottom right entry in the Table 1). The same value for May prices is over 3% reflecting the normally higher spring calf prices. Over time these probabilities have been observed to follow predictable patterns that are highly dependent upon the level of current prices. It is the prediction of the probabilities of price movements from a current price level which is useful for evaluating culling strategies. For example, consider the following situation:

Table 1. Long-Term Probability Price Levels for November.

		Calf Prices				
		< 70	70-80	80-90	90-100	> 100
Replacement Prices	< 475	0.1018	0.0545	0.0189	0.0013	0.0001
	475-585	0.0789	0.1037	0.0635	0.0096	0.0010
	585-645	0.0393	0.1017	0.1201	0.0356	0.0068
	695-805	0.0085	0.0379	0.0742	0.0445	0.0143
	> 805	0.0009	0.0077	0.0243	0.0295	0.0215

Table 2. Long-Term Probability Price Levels for May.

Replacement Prices	Calf Prices < 70	70-80	80-90	90-100	> 100
< 475	0.0659	0.0645	0.0377	0.0080	0.0007
475-585	0.0343	0.0808	0.1022	0.0339	0.0054
585-645	0.0133	0.0529	0.1400	0.0760	0.0212
695-805	0.0017	0.0113	0.0630	0.0667	0.0352
> 805	0.0001	0.0016	0.0161	0.0301	0.0360

It is May, and we are interested in predicting next fall's calf and replacement prices. The current calf price is 95 $/cwt. and the current replacement price for a bred heifer is 750 $/head. Our calculations, based on the behavior of prices over previous years, lead to the probabilities of price movements as shown in Table 6, panel 4. The probability of the calf price staying in the 90 to 100 $/cwt. range and the replacement price staying in the 695 to 805 $/head range is .1162 (a bit better than 11 chances in 100). The probabilities of the calf price increasing to the more than 100 $/cwt. range and the replacement price decreasing to the 585 to 645 $/head range is only .0003 (3 chances in 10,000) . The probability of both decreasing is much higher, .3797, reflecting the fact that calf and replacement prices almost always move together and that calf prices are generally lower in the fall than spring.

In order to predict future price movements for all ranges of calf and replacement prices, 25 probability tables were calculated for the at May to November price movements and another 25 for the at November to May price movements (Tables 8-12). Besides being necessary to evaluate culling strategies these probability tables provide useful insights into price movements for calves and replacements.

Cull cow prices are also important to the culling decision. But cull cow prices are highly related to calf and replacement prices since an existing cow in the herd has value for either slaughter or replacement stock. Thus, this relationship was exploited for deriving optimal culling decisions — and is why we have focused on just calf and replacement prices in this article.

FEEDING COSTS

Costs directly determine the bottom line of profitability for an operation. Feed costs are generally the largest expense item for a ranching operation, assuming that land costs are considered in the feeding cost calculations. Veterinary, livestock hauling, and marketing costs also affect profits, but are generally much smaller in magnitude. Because the nutrition requirements of young cows, especially those with their first calf, is greater than more mature cows, feed costs directly influence the economics of the culling decision.

Although you may be able to buy a replacement heifer for almost the same amount that you can get in salvage value for an older cow, a differential in feeding costs for the replacement versus the older cow in the subsequent year(s) may be enough to make it more profitable to keep the older cow for another year. This is especially true if you are in a range situation with coarse forage that requires a well developed rumen and doesn't have adequate nutrients, vitamins, and/or minerals for a young cow to grow, raise a calf, and breed back. Supplementation of nutrients, vitamins, and/or minerals is often given as the alternative for improving the young cows performance. However, the added feed costs associated with the younger cow's diet need to be weighed against the performance of an older cow with less feed costs.

The differential in your feed costs for a new replacement versus an older cow is more crucial to the culling decisions than the level of your feeding costs. If the level of your feed costs for all cows is $150/yr. instead of $250/yr., your level of profits will be $100 more for each cow. However, the decision of whether to keep or cull a cow will not change much, if any, since the cost of feeding a replacement will be relatively high (low) if the cost of feeding an older cow is high (low). The differential in feed costs for a replacement versus an older cow is the most crucial cost figure in the culling decision. For example, if the annual feed costs for a replacement are $50/head more than for an older cow, versus say $10/head more, the rancher with a $50/head feed differential is much more likely to keep older cows than one with a $10/head differential.

CONCLUSION

The price probability predictions presented in Tables 1 through 12 describe a small part of the market analysis necessary to evaluate culling strategies. These tables also are useful for predicting price movements for other purposes as well. The variation in cost for different ages of cows is also critical to evaluating culling strategies. The next article in the culling series puts all the pieces together, herd performance, market prices, and costs and present our recommendations of an optimal culling strategy for a reasonably typical Arizona ranch.

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Table 3. May Calf Price <70.

May Replacement Price <475

November	Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
	<475	0.584	0.009	0.000	0	0
	475-585	0.240	0.055	0.003	0	0
	585-695	0.033	0.046	0.015	0	0
	695-805	0	0	0	0	0
	>805	0	0	0	0	0

May Replacement Price 475-585

November	Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
	<475	0.267	0.000	0.000	0	0
	475-585	0.384	0.013	0.000	0	0
	585-695	0.215	0.096	0.017	0	0
	695-805	0	0	0	0	0
	>805	0	0	0	0	0

May Replacement Price 585-695

November	Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
	<475	0	0	0	0	0
	475-585	0.326	0.001	0.000	0	0
	585-695	0.377	0.020	0.000	0	0
	695-805	0.164	0.089	0.017	0	0
	>805	0	0	0	0	0

May Replacement Price 695-805

November	Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
	<475	0	0	0	0	0
	475-585	0	0	0	0	0
	585-695	0.389	0.001	0.000	0	0
	695-805	0.358	0.028	0.001	0	0
	>805	0.120	0.080	0.017	0	0

May Replacement Price >805

November	Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
	<475	0	0	0	0	0
	475-585	0	0	0	0	0
	585-695	0.121	0.000	0.000	0	0
	695-805	0.333	0.003	0.000	0	0
	>805	0.413	0.107	0.018	0	0

Table 4. May Calf Price 70-80.

May Replacement Price <475

November	Calf Price <70	70-80	80-90	90-100	>100
Replacement Price <475	0.495	0.095	0.006	0	0
475-585	0.097	0.155	0.046	0	0
585-695	0.004	0.034	0.055	0	0
695-805	0	0	0	0	0
>805	0	0	0	0	0

May Replacement Price 475-585

November	Calf Price <70	70-80	80-90	90-100	>100
Replacement Price <475	0.262	0.011	0.000	0	0
475-585	0.276	0.112	0.010	0	0
585-695	0.070	0.161	0.097	0	0
695-805	0	0	0	0	0
>805	0	0	0	0	0

May Replacement Price 585-695

November	Calf Price <70	70-80	80-90	90-100	>100
Replacement Price <475	0	0	0	0	0
475-585	0.314	0.018	0.000	0	0
585-695	0.249	0.134	0.015	0	0
695-805	0.046	0.131	0.092	0	0
>805	0	0	0	0	0

May Replacement Price 695-805

November	Calf Price <70	70-80	80-90	90-100	>100
Replacement Price <475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0.366	0.030	0.001	0	0
695-805	0.214	0.151	0.021	0	0
>805	0.029	0.103	0.085	0	0

May Replacement Price >805

November	Calf Price <70	70-80	80-90	90-100	>100
Replacement Price <475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0.126	0.001	0.000	0	0
695-805	0.290	0.044	0.002	0	0
>805	0.193	0.238	0.105	0	0

Table 5. May Calf Price 80-90.

May Replacement Price <475

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0.515	0.078	0.004	0
475-585	0	0.114	0.148	0.036	0
585-695	0	0.006	0.038	0.049	0
695-805	0	0	0	0	0
>805	0	0	0	0	0

May Replacement Price 475-585

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0.265	0.008	0.000	0
475-585	0	0.296	0.095	0.007	0
585-695	0	0.085	0.160	0.083	0
695-805	0	0	0	0	0
>805	0	0	0	0	0

May Replacement Price 585-695

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0.319	0.014	0.000	0
585-695	0	0.271	0.116	0.010	0
695-805	0	0.057	0.134	0.079	0
>805	0	0	0	0	0

May Replacement Price 695-805

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0.374	0.023	0.001	0
695-805	0	0.237	0.134	0.015	0
>805	0	0.036	0.107	0.074	0

May Replacement Price >805

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0.127	0.001	0.000	0
695-805	0	0.300	0.034	0.001	0
>805	0	0.221	0.228	0.088	0

Table 6. May Calf Price 90-100.

May Replacement Price <475

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0.532	0.062	0.003
475-585	0	0	0.132	0.138	0.028
585-695	0	0	0.008	0.041	0.044
695-805	0	0	0	0	0
>805	0	0	0	0	0

May Replacement Price 475-585

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0.268	0.005	0.000
475-585	0	0	0.315	0.078	0.004
585-695	0	0	0.101	0.158	0.070
695-805	0	0	0	0	0
>805	0	0	0	0	0

May Replacement Price 585-695

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0.323	0.010	0.000
585-695	0	0	0.292	0.098	0.007
695-805	0	0	0.069	0.134	0.067
>805	0	0	0	0	0

May Replacement Price 695-805

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0	0.380	0.017	0.000
695-805	0	0	0.260	0.116	0.011
>805	0	0	0.045	0.109	0.063

May Replacement Price >805

November Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0	0.127	0.001	0.000
695-805	0	0	0.309	0.026	0.001
>805	0	0	0.249	0.215	0.074

Table 7. May Calf Price >100.

May Replacement Price <475

November		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0.316	0.230	0.050
	475-585	0	0	0.021	0.129	0.148
	585-695	0	0	0.000	0.010	0.083
	695-805	0	0	0	0	0
	>805	0	0	0	0	0

May Replacement Price 475-585

November		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0.214	0.056	0.004
	475-585	0	0	0.123	0.208	0.066
	585-695	0	0	0.013	0.105	0.211
	695-805	0	0	0	0	0
	>805	0	0	0	0	0

May Replacement Price 585-695

November		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0	0	0
	475-585	0	0	0.245	0.081	0.007
	585-695	0	0	0.098	0.213	0.086
	695-805	0	0	0.007	0.075	0.187
	>805	0	0	0	0	0

May Replacement Price 695-805

November		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0	0	0
	475-585	0	0	0	0	0
	585-695	0	0	0.272	0.112	0.012
	695-805	0	0	0.075	0.206	0.106
	>805	0	0	0.004	0.051	0.162

May Replacement Price >805

November		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0	0	0
	475-585	0	0	0	0	0
	585-695	0	0	0.116	0.012	0.000
	695-805	0	0	0.179	0.136	0.020
	>805	0	0	0.055	0.221	0.260

Table 8. November Calf Price <70.

November Replacement Price <475

May		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0.325	0.225	0.047	0	0
	475-585	0.023	0.132	0.143	0	0
	585-695	0.000	0.011	0.082	0	0
	695-805	0	0	0	0	0
	>805	0	0	0	0	0

November Replacement Price 475-585

May		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0.217	0.053	0.003	0	0
	475-585	0.129	0.206	0.062	0	0
	585-695	0.014	0.108	0.206	0	0
	695-805	0	0	0	0	0
	>805	0	0	0	0	0

November Replacement Price 585-695

May		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0	0	0
	475-585	0.249	0.078	0.006	0	0
	585-695	0.104	0.212	0.081	0	0
	695-805	0.008	0.078	0.184	0	0
	>805	0	0	0	0	0

November Replacement Price 695-805

May		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0	0	0
	475-585	0	0	0	0	0
	585-695	0.277	0.108	0.011	0	0
	695-805	0.079	0.206	0.101	0	0
	>805	0.004	0.053	0.159	0	0

November Replacement Price >805

May		Calf Price				
		<70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0	0	0
	475-585	0	0	0	0	0
	585-695	0.116	0.011	0.000	0	0
	695-805	0.185	0.132	0.018	0	0
	>805	0.059	0.225	0.253	0	0

Table 9. November Calf Price 70-80.

November Replacement Price <475

May		Calf Price <70	70-80	80-90	90-100	>100
Replacement Price	<475	0.099	0.256	0.241	0	0
	475-585	0.001	0.030	0.267	0	0
	585-695	0.000	0.001	0.093	0	0
	695-805	0	0	0	0	0
	>805	0	0	0	0	0

November Replacement Price 475-585

May		Calf Price <70	70-80	80-90	90-100	>100
Replacement Price	<475	0.095	0.133	0.046	0	0
	475-585	0.015	0.136	0.246	0	0
	585-695	0.000	0.019	0.309	0	0
	695-805	0	0	0	0	0
	>805	0	0	0	0	0

November Replacement Price 585-695

May		Calf Price <70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0	0	0
	475-585	0.101	0.163	0.069	0	0
	585-695	0.010	0.115	0.273	0	0
	695-805	0.000	0.011	0.258	0	0
	>805	0	0	0	0	0

November Replacement Price 695-805

May		Calf Price <70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0	0	0
	475-585	0	0	0	0	0
	585-695	0.105	0.191	0.101	0	0
	695-805	0.006	0.091	0.290	0	0
	>805	0.000	0.006	0.211	0	0

November Replacement Price >805

May		Calf Price <70	70-80	80-90	90-100	>100
Replacement Price	<475	0	0	0	0	0
	475-585	0	0	0	0	0
	585-695	0.068	0.051	0.008	0	0
	695-805	0.040	0.165	0.130	0	0
	>805	0.004	0.071	0.462	0	0

Table 10. November Calf Price 80-90.

November Replacement Price <475

May	Calf Price				
Replacement Price	<70	70-80	80-90	90-100	>100
<475	0	0.119	0.267	0.210	0
475-585	0	0.001	0.038	0.258	0
585-695	0	0.000	0.001	0.092	0
695-805	0	0	0	0	0
>805	0	0	0	0	0

November Replacement Price 475-585

May	Calf Price				
Replacement Price	<70	70-80	80-90	90-100	>100
<475	0	0.109	0.128	0.036	0
475-585	0	0.021	0.154	0.222	0
585-695	0	0.001	0.025	0.302	0
695-805	0	0	0	0	0
>805	0	0	0	0	0

November Replacement Price 585-695

May	Calf Price				
Replacement Price	<70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0.117	0.160	0.056	0
585-695	0	0.014	0.133	0.250	0
695-805	0	0.000	0.015	0.254	0
>805	0	0	0	0	0

November Replacement Price 695-805

May	Calf Price				
Replacement Price	<70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0.122	0.191	0.083	0
695-805	0	0.009	0.108	0.270	0
>805	0	0.000	0.008	0.208	0

November Replacement Price >805

May	Calf Price				
Replacement Price	<70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0.075	0.046	0.006	0
695-805	0	0.051	0.173	0.111	0
>805	0	0.005	0.088	0.444	0

Table 11. November Calf Price 90-100.

November Replacement Price <475

May: Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0.140	0.274	0.182
475-585	0	0	0.002	0.049	0.247
585-695	0	0	0.000	0.001	0.092
695-805	0	0	0	0	0
>805	0	0	0	0	0

November Replacement Price 475-585

May: Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0.124	0.121	0.028
475-585	0	0	0.029	0.171	0.198
585-695	0	0	0.001	0.032	0.295
695-805	0	0	0	0	0
>805	0	0	0	0	0

November Replacement Price 585-695

May: Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0.134	0.154	0.045
585-695	0	0	0.020	0.151	0.227
695-805	0	0	0.001	0.020	0.249
>805	0	0	0	0	0

November Replacement Price 695-805

May: Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0	0.141	0.187	0.068
695-805	0	0	0.013	0.126	0.248
>805	0	0	0.000	0.012	0.205

November Replacement Price >805

May: Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0	0.082	0.041	0.004
695-805	0	0	0.064	0.178	0.093
>805	0	0	0.008	0.105	0.424

Table 12. November Calf Price >100.

November Replacement Price <475

May — Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0.023	0.142	0.432
475-585	0	0	0.000	0.003	0.295
585-695	0	0	0.000	0.000	0.093
695-805	0	0	0	0	0
>805	0	0	0	0	0

November Replacement Price 475-585

May — Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0.028	0.111	0.134
475-585	0	0	0.001	0.037	0.360
585-695	0	0	0.000	0.002	0.326
695-805	0	0	0	0	0
>805	0	0	0	0	0

November Replacement Price 585-695

May — Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0.03	0.12	0.18
585-695	0	0	0.00	0.03	0.37
695-805	0	0	0.00	0.00	0.27
>805	0	0	0	0	0

November Replacement Price 695-805

May — Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0	0.030	0.132	0.235
695-805	0	0	0.000	0.018	0.369
>805	0	0	0.000	0.000	0.216

November Replacement Price >805

May — Replacement Price	Calf Price <70	70-80	80-90	90-100	>100
<475	0	0	0	0	0
475-585	0	0	0	0	0
585-695	0	0	0.025	0.064	0.038
695-805	0	0	0.005	0.074	0.256
>805	0	0	0.000	0.011	0.525

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OPTIMAL ECONOMIC RANGE COW CULLING DECISIONS: BIOLOGICAL AND MARKET FACTORS COMBINED

Russell Tronstad [1] and Russell Gum [2]

This is the third in a series of three articles addressing culling decisions. The first article addressed biological considerations while the second article focused on market considerations. This article focuses on combining the biological and market considerations to increase profits. These decisions must take into account the dynamic aspects associated with the culling decision. That is, cows kept in the herd will become one year older and on average have a different; chance of calving, calf weaning weight, cow weight, and chance of remaining fit for the herd. Also, future returns and expenses are discounted so that all economic comparisons are made with current dollars.

Optimal economic culling decisions are made for two basic scenarios. The first scenario assumes that the rancher has the ability to only calve cows once a year (i.e., spring calving). The second scenario assumes that a rancher has the ability to breed and calve cows at two different times during the year (i.e., spring and fall calving). The latter scenario has about a six month time lead for bringing an open cow back into production. For example, if a cow is tested open in the fall, this cow couldn't be bred until the following summer with only spring calving. Whereas, if calving is possible in both fall and spring, this cow has the opportunity to be bred in late fall and brought into production six months earlier than with only spring calving possible. When looking at culling decisions, six months has a noticeable difference on economic profitability.

On average, market price conditions are higher for eight month old weaned calves sold in the spring than in the fall as pointed out in the second article on market conditions. However, calves born in the fall and weaned in the spring are expected to be five percent lighter than calves sold in the fall from spring calving. These differences, among others pointed out in the previous two articles, are accounted in the optimal economic culling decisions.

Costs associated with selling a cull cow and bringing a replacement into the herd are also important. For the costs associated with selling a cull cow, this analysis used a 4% shrink, $.01/lb. trucking cost, and a sale commission equal to 1.5% the gross selling price. The cost of bringing a bred replacement heifer on the ranch was $10/head for veterinary costs and $10/head for trucking costs.

The optimal culling decisions and associated economic results are presented in Figure 1 through Figure 3b as decision trees. A decision tree is simply a branched structure where a choice must be made at each branch. Imagine a cat climbing a tree. At each branch the cat must make a decision on which way to go. Decision trees are simply upside down trees where at each branch you must decide which way to go. For the culling decision model presented, the decision of which way to go at each branch is determined by: cow age, cull cow prices, calf prices, or replacement cow prices. When you run out of branches the decision on whether to cull or keep a cow is revealed. For example, consider the case of open cows in the fall with both spring and fall calving possible. This situation is depicted in the decision tree in Figure 2. If current replacement prices are $850/head, current calf prices average $95 and cull cow values are $650/head, should a 5 year old open cow be kept or culled? A "replace" is put in the top box of Figure 2 indicating that the optimal economic decision would be to replace an open cow if no further criteria was utilized. But the first decision on which direction to go is made on the basis of age. The cow was identified as 5 years old so the left branch is chosen (i.e., 5 < 7.5 years of age). Replacement prices determine the direction to take at the next branch. Since the current replacement price of $850/head is greater than $695, the right branch is chosen. Calf prices determine the direction for the next branch. Calf prices are $95/cwt., thus the right branch should be taken. Another decision is made on replacement prices. Replacement prices are greater than $805/head so the right branch is chosen. Cull cow values determine the direction at the final decision branch. If your cow's cull value is less than $768/head, which it is at $650/head, our economic model says that you should keep this cow. The terminal box or node for this scenario is box #13.

Table 1. Economic Values that are Associated with the Terminal Boxes from Figure1.

Terminal Box Number	Optimal Cull Value	Cost of Mistake	Chance of Box Occurring
1	$1,552	$49	0.1057
2	$1,464	$24	0.0044
3	$1,557	$3	0.0024
4	$1,779	$7	0.0046
5	$1,771	$13	0.0061
6	$1,592	$99	0.4649
7	$1,384	$500	0.0144
8	$1,917	$23	0.0007
9	$1,830	$74	0.0139
10	$1,873	$14	0.0001
11	$1,984	$12	0.0003
12	$1,762	$179	0.0062
13	$1,784	$95	0.0645
14	$1,873	$108	0.0196
15	$1,841	$19	0.0030
16	$1,794	$26	0.0064
17	$1,598	$246	0.0032

Tables 1 through 3 give the optimal expected returns for each terminal box or node displayed in Figure 1 through Figure 3b. For example, Table 2 and box #13 gives an optimal value of $1,574. This optimal decision value represents our estimated value for this slot in the herd for the next 15 years when a correct (keep for box #13) decision is made, given our initial price conditions. The expected cost of making a mistake is also given. This cost is a "one year" culling mistake since it is assumed that optimal culling decisions are made after the "one year" mistake. If the same culling decision mistake is made year after year the costs will add up. The cost of making a "one year" mistake at box #13 is $43/head.

Tables 1 through 3 also give the chance that on average a cow would end up in a box. These chances are based on the herd fertility and market conditions presented in the first two articles. Thus, the chance of being in any box is dependent on the chance of a cow falling into a given age bracket, the odds of a cow being open or pregnant, and the chance of market conditions represented by every terminal node existing. The sum of all chances occurring from both pregnant and open cows doesn't sum to 1

Table 2. Economic Values that are Associated with the Terminal Boxes from Figure 2.

Terminal Box Number	Optimal Cull Value	Cost of Mistake	Chance of Box Occurring
1	$1,412	$12	0.0098
2	$1,367	$46	0.0114
3	$1,548	$34	0.0245
4	$1,426	$32	0.0119
5	$1,474	$2	0.0020
6	$1,640	$32	0.0116
7	$1,438	$67	0.0118
8	$1,416	$43	0.0011
9	$1,580	$8	0.0015
10	$1,549	$33	0.0005
11	$1,545	$19	0.0015
12	$1,693	$31	0.0042
13	$1,574	$43	0.0030
14	$1,703	$13	0.0020
15	$1,505	$106	0.0622

because these chances only include cows that were fit to breed (i.e., these chances don't include cows that died or became unfit to remain in the herd). Terminal boxes that have a relatively high chance of occurring and a large "cost of mistake" should be given close attention. However, the culling decision is often more obvious for these cases. For example, terminal box #6 from Table 1 has a "cost of mistake" at $99 and a relatively high chance of occurring at about 47% probability. This decision rule reinforces the economic reality that under typical price conditions it makes economic sense to keep a pregnant cow. Box # 7 from Table 1 indicates that the cost of keeping a cow beyond the age of 13.2 years of age is quite large at $500 since it was assumed that the cow would die if kept beyond 14 years of age.

Even if some market price and cow age situations rarely occur, large "cost of mistake" values are important on an individual cow basis when found in those specific situations. For example, terminal box #23 from Table 3 and Figure 3b indicates that the cost of keeping a pregnant cow with spring only calving is quite high at $221. For box #23, market prices are such that replacement prices are less than $805/head, calf prices are less than $80/cwt., cull cow values are above $493/head, and the cow exceeds 11.75 years in age. When replacement values are not real high and the odds of getting a high priced calf out of an older cow are not great (i.e., calf price less than $80/cwt.), economic results suggest that you should replace this cow, even though she is pregnant.

Figures 1 and 2 plus Tables 1 and 2 represent culling decisions where both spring and fall calving are possible. Our economic results indicated that the value expected for an average slot in the herd for the next 15 years was $1,561 when both spring and fall calving were possible. However, this value slipped by $100 to $1,461 when only spring calving was possible. This translates to an estimated 6.8% increase in herd profitability by having both spring and fall calving instead of just spring calving. Much of the difference between these two calving systems is attributed to the economic profitability of the open cow. When only spring calving is considered, our results indicate that it is never optimal to keep an open cow. Irrespective of how high replacement prices may be and even if the cow is at a prime age, our economic model indicates that it is always more

Table 3. Economic Values that are Associated with the Terminal Boxes from Figures 3a and 3b.

Terminal Box Number	Optimal Cull Value	Cost of Mistake	Chance of Box Occurring
1	$1,444	$48	0.0748
2	$1,396	$9	0.0053
3	$1,643	$13	0.0049
4	$1,517	$19	0.0109
5	$1,720	$30	0.0068
6	$1,494	$74	0.1373
7	$1,794	$19	0.0023
8	$1,625	$7	0.0072
9	$1,796	$20	0.0019
10	$1,559	$129	0.2778
11	$1,467	$42	0.0216
12	$1,720	$10	0.0019
13	$1,650	$34	0.0038
14	$1,786	$13	0.0001
15	$1,899	$31	0.0004
16	$1,781	$104	0.0196
17	$1,769	$11	0.0024
18	$1,717	$41	0.0025
19	$1,355	$118	0.0310
20	$1,309	$14	0.0032
21	$1,415	$29	0.0108
22	$1,245	$26	0.0040
23	$1,256	$221	0.0068
24	$1,335	$6	0.0037
25	$1,317	$25	0.0078
26	$1,146	$20	0.0004
27	$1,283	$91	0.0050
28	$1,532	$120	0.0437
29	$1,461	$21	0.0031
30	$1,636	$56	0.0072
31	$1,460	$42	0.0049
32	$1,315	$15	0.0015
33	$1,504	$15	0.0013
34	$1,640	$4	0.0009
35	$1,621	$32	0.0017
36	$1,331	$680	0.0015

profitable to replace an open cow in the fall with a bred replacement heifer. The six month time jump associated with bringing an open cow into production under a dual calving season translates into almost a 7% increase in herd profitability, for the herd estimated.

A simple culling rule is to cull all cows that are open and keep all cows that are less than 12.5 years of age and pregnant in the fall. However, a representative slot in the herd has a value of only $1,414 for this type of culling strategy, with only spring calving possible. This translates into 3% less profit than if culling decisions were made optimal with spring only calving (Figures 3a and 3b for pregnant cows plus culling all open cows) and over 10% less profit than if optimal culling decisions were made given that both spring and fall calving were possible (i.e., Figures 1 and 2).

It should also be pointed out that the culling decisions and economic values presented are for cows with production potentials as reported in the first article of this series. A particular cow could have either a better or worse production potential. The best use for this information is as a guide to help you judge whether individual cows in your herd should be kept or replaced. If our model recommends culling a specific cow but the cost of making a mistake (according to the model) is low then you should feel free to use your own knowledge and judgment to determine whether this cow should be culled or kept. On the other hand, if our model projects a large cost of making a mistake and your judgment does not agree with the model then you should try to find out why the model is wrong. Review the first article in this series to check if our biological productivity estimates and costs by age group are representative of your particular situation? Review the second article to check if our market price predictions are out of line with your expectations. Calculate the expected economic profits of replacing or keeping a particular cow. Going through such a process should help you fine tune your culling strategy for your specific conditions. It might even convince you that there is value on having information quickly available to you at culling time on past cow performance and cow age.

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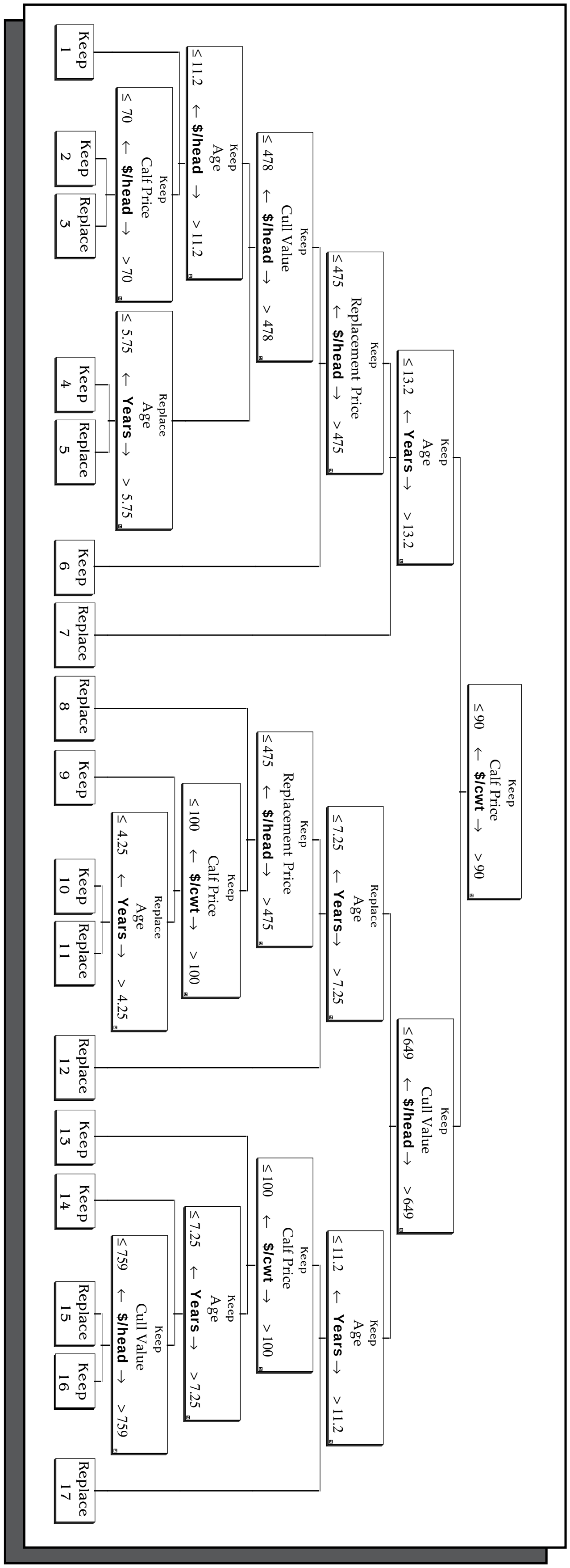


Figure 1. Decision Tree for Pregnant Cows in the Fall when Spring and Fall Calving are Possible.

Figure 2. Decision Tree for Open Cows in the Fall when Spring and Fall Calving are Possible.

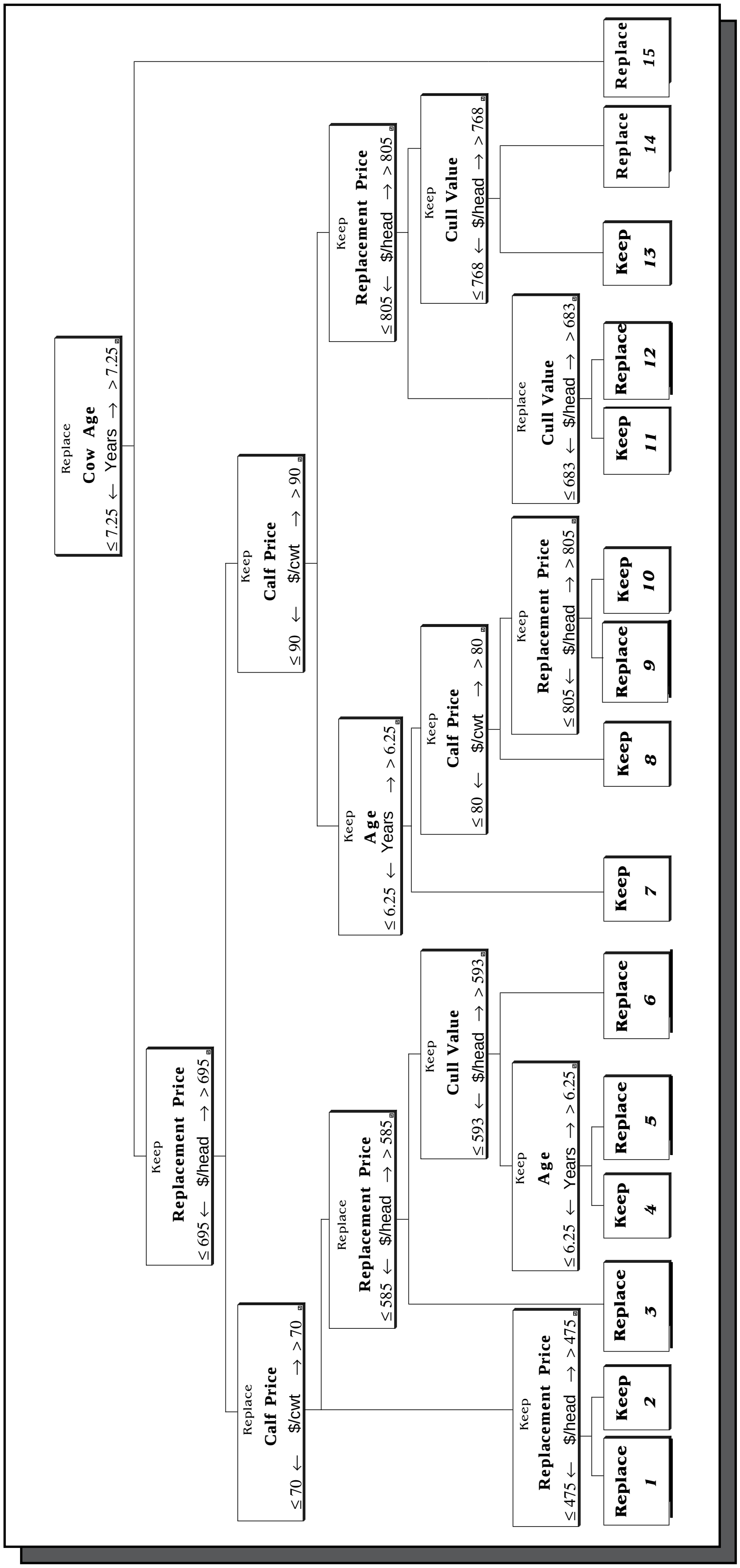


Figure 3a. Decision Tree for Pregnant Cows in the Fall that are Younger than 8.75 Years of Age when only Spring Calving is Possible.

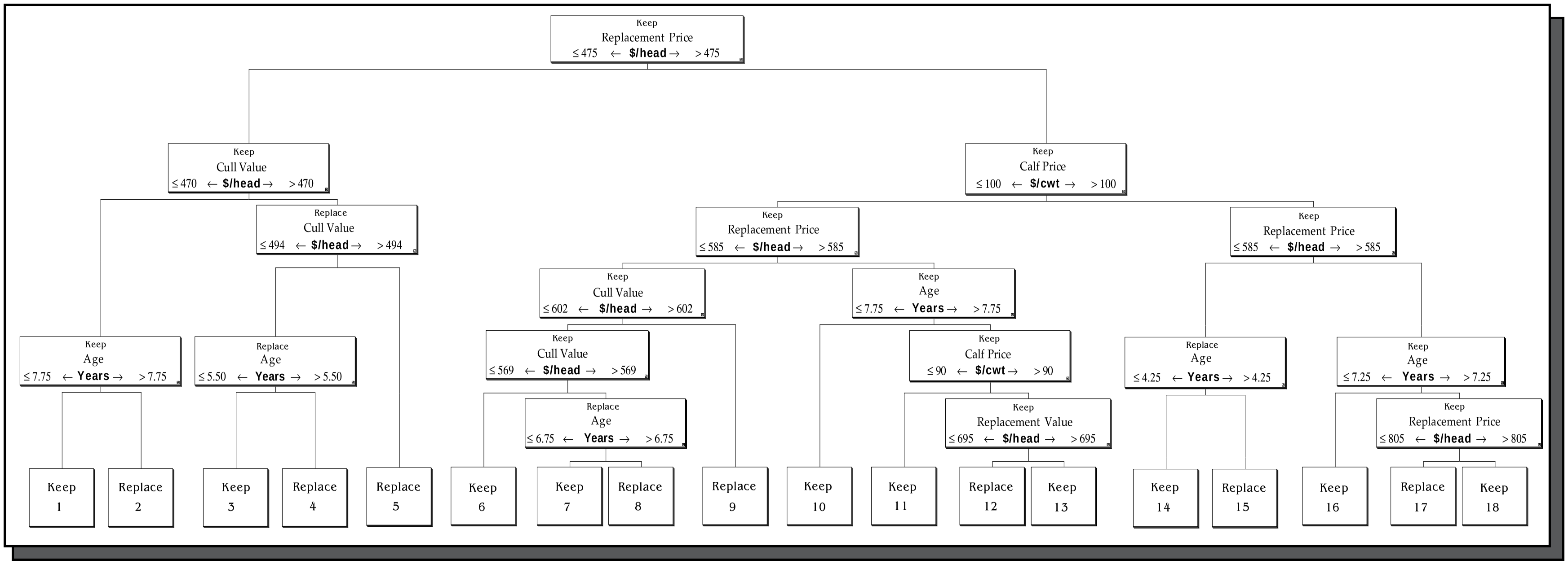
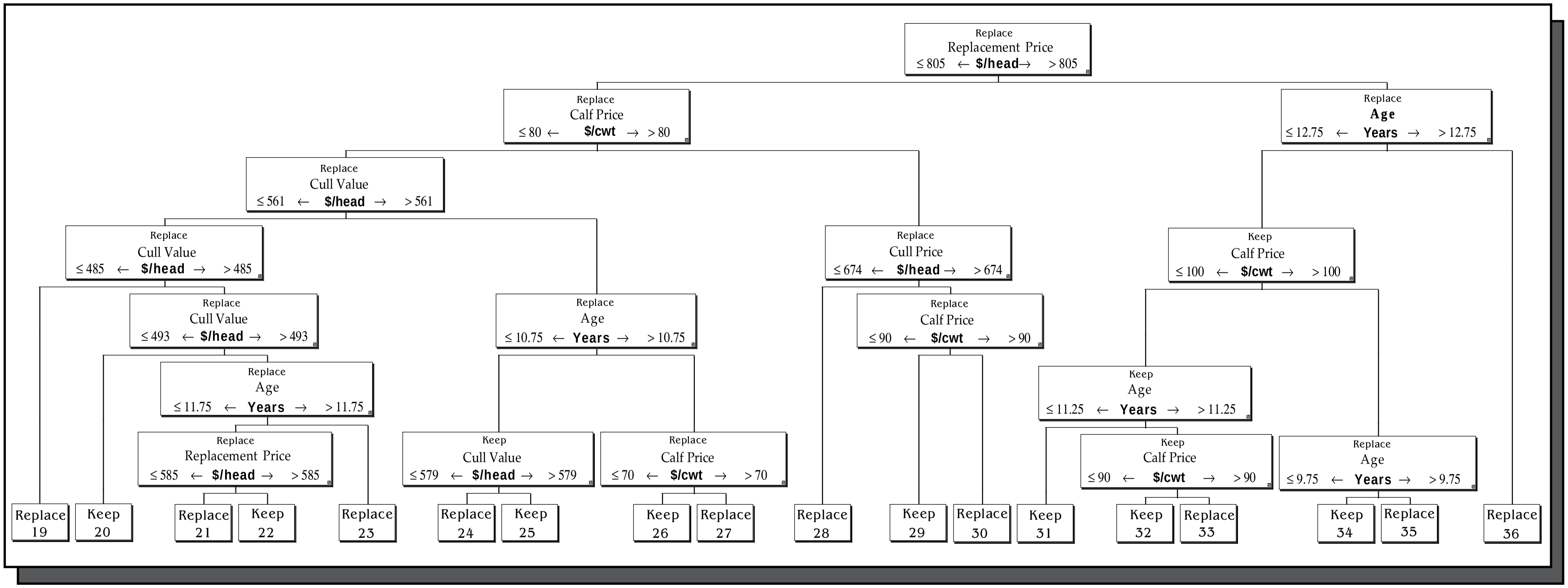


Figure 3b. Decision Tree for Pregnant Cows in the Fall that are Older than 8.75 Years of Age when only Spring Calving is Possible.



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Arizona Ranchers' Management Guide
Russell Gum, George Ruyle, and Richard Rice, Editors.
Arizona Cooperative Extension

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THE INFLUENCE OF LOT SIZE ON FEEDER CATTLE PRICES AT ARIZONA AUCTIONS

Russell Gum[1] and
Lew Daugherty [2]

One of the decisions that ranchers must make when marketing their cattle at auctions is what size lots to sort their cattle into. Experience and previous research has shown that lots of a size equal to the capacity of a cattle truck (about 60 head for feeder cattle) will receive a premium over lots of fewer head. At the same time, experience and limited research suggest that uniform lots will sell at a premium over non-uniform lots. The rancher is faced with a choice. Large lot sizes and less uniformity or smaller lots with more uniformity. Another alternative which has become more popular in recent years is to combine your cattle with other ranchers cattle to be able to sell large uniform sized lots.

How much difference can lot size make? Data on each lot of cattle sold from 1984 to 1991 at the Gila and Mohave spring yearling cattle sales were statistically analyzed to gain insights into the influence of lot size on feeder cattle prices. The results are displayed in Figure 1. The form of the results is in terms of the price received for lots of varying sizes compared to the price received for lots of average size (15 head) at the same sale. Adjustments were made to remove the influence of weight and sex from the results. As shown in the figure very small lots (1 to 5) head tend to have a price about 3% below the sale average for animals of the same sex and weight. Lots at or near truckload capacity tend to have a price of about 4 to 5% higher than the sale average for animals of the same sex and weight. The difference between the smallest lots and truckload sized lots is over 8%. This difference should not be overlooked in planning your marketing strategy, but don't forget that uniformity in lots is also valued.

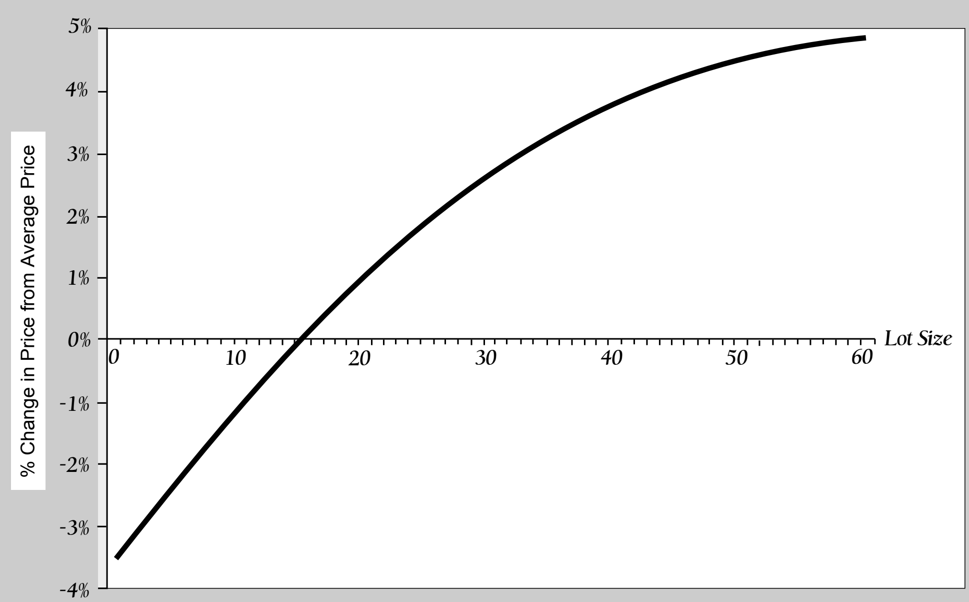

Figure 1. Comparison of Lot Size Impacts.

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THE ECONOMICS OF SHRINKAGE

Russell L. Gum[1]

Shrinkage is of economic importance to ranchers in two ways. First, as you move and handle your animals in the process of selling them they will lose weight due to the combination of stress and of not having feed and water readily available. Because they will lose this weight before they are weighed at sale time, the gross returns to the rancher will be reduced by the shrinkage if price does not depend upon shrinkage. However, shrinkage does affect price, and further is often an important element in the negotiations of a cattle sale. This linkage of shrinkage into the negotiations is the second way in which shrink becomes economically important.

DESCRIPTION

Shrinkage occurs due to the elimination of digestive track contents and urine, and as a result of dehydration and other loss of tissue. Part of this loss can be rapidly regained by the animals, and thus, has little long run effect upon the animals. However, the loss due to tissue shrinkage is the result of prolonged stress and is difficult to replace. Estimates of the proportion of easily regained loss vary from 35% to 50% (St. Clair, 1976) (Self and Gay, 1972) (W. Gordon Kerl, 1987).

Shrinkage depends on handling methods, weather, time off feed and other factors. General estimates of expected shrinkage expressed as a function of the distance that cattle are shipped are displayed in Figure 1. Gross shrinkage is the total shrinkage and net shrinkage is that part of the shrinkage which cannot easily and quickly be regained by the animals.

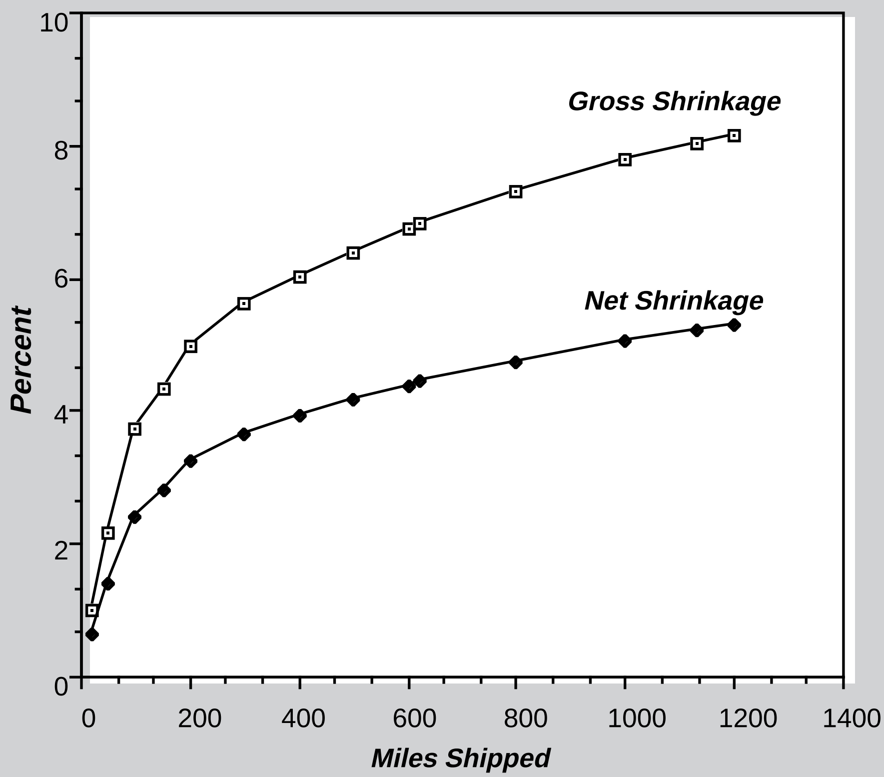

Figure 1

COMPARING OFFERS

Comparing prices with varying allowances for shrink is sometimes necessary to determine the best bid for your cattle. The simplest way to do this is with a calculator. For example if a buyer offers you $80/cwt for your 500 lb. steers and wants a 4% pencil shrink, this will result in a price per head of 500 times 96% (100% - 4%) times $80 ($384 per head) If another buyer offers you $79 with a 2% shrink this will result in a price per head of 500 times 98% (100% - 2%) times $79 ($387.10 per head). Even though the price is lower the second offer is obviously better as it results in more money per head.

Another way to make the same comparsion is to use the **less shrink table**. The first offer was $80 with 4% shrink, while the second had 2% less shrink and was $79. From the table an $80 price is equivalent to a $78.40 price with 2% less shrink. Since this is less than the $79 offer it should be rejected.

By use of a calculator or the Less Shrink Table alternative offers for your cattle can easily be compared. If the conditions of handling the cattle differ then considerations of the actual difference in shrinkage as well as any pencil shrink must be made. For example if you have an offer where the cattle will be weighed at the ranch on the day the cattle are gathered and another alternative where the cattle will be weighed after being shipped 100 miles, you will need to estimate the actual difference in shrink to correctly compare these alternatives. From the shrink figure a 100 mile shipment results in approximately a 4% shrinkage. You must consider this shrinkage in comparing the two offers. In fact you can consider it in exactly the same manner as a pencil shrink. The less shrink table can be used to show that an offer of $84 at the ranch is equivalent to an offer of $87.50 with weighing 100 miles away.

CONCLUSIONS

Be sure to consider both actual and pencil shrink when you are considering alternative offers or ways to market your cattle. A sharp pencil or calculator will help you to make the most from your cattle.

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BREAKEVEN PRICES
EQUIVALENT PRICE WITH LESS SHRINK

PRICE WITH SHRINK	-1%	-2%	-3%	-4%	-5%	-6%
50	49.50	49.00	48.50	48.00	47.50	47.00
51	50.49	49.98	49.47	48.96	48.45	47.94
52	51.48	50.96	50.44	49.92	49.40	48.88
53	52.47	51.94	51.41	50.88	50.35	49.82
54	53.46	52.92	52.38	51.84	51.30	50.76
55	54.45	53.90	53.35	52.80	52.25	51.70
56	55.44	54.88	54.32	53.76	53.20	52.64
57	56.43	55.86	55.29	54.72	54.15	53.58
58	57.42	56.84	56.26	55.68	55.10	54.52
59	58.41	57.82	57.23	56.64	56.05	55.46
60	59.40	58.80	58.20	57.60	57.00	56.40
61	60.39	59.78	59.17	58.56	57.95	57.34
62	61.38	60.76	60.14	59.52	58.90	58.28
63	62.37	61.74	61.11	60.48	59.85	59.22
64	63.36	62.72	62.08	61.44	60.80	60.16
65	64.35	63.70	63.05	62.40	61.75	61.10
66	65.34	64.68	64.02	63.36	62.70	62.04
67	66.33	65.66	64.99	64.32	63.65	62.98
68	67.32	66.64	65.96	65.28	64.60	63.92
69	68.31	67.62	66.93	66.24	65.55	64.86
70	69.30	68.60	67.90	67.20	66.50	65.80
71	70.29	69.58	68.87	68.16	67.45	66.74
72	71.28	70.56	69.84	69.12	68.40	67.68
73	72.27	71.54	70.81	70.08	69.35	68.62
74	73.26	72.52	71.78	71.04	70.30	69.56
75	74.25	73.50	72.75	72.00	71.25	70.50
76	75.24	74.48	73.72	72.96	72.20	71.44
77	76.23	75.46	74.69	73.92	73.15	72.38
78	77.22	76.44	75.66	74.88	74.10	73.32
79	78.21	77.42	76.63	75.84	75.05	74.26
80	79.20	78.40	77.60	76.80	76.00	75.20
81	80.19	79.38	78.57	77.76	76.95	76.14
82	81.18	80.36	79.54	78.72	77.90	77.08
83	82.17	81.34	80.51	79.68	78.85	78.02
84	83.16	82.32	81.48	80.64	79.80	78.96
85	84.15	83.30	82.45	81.60	80.75	79.90
86	85.14	84.28	83.42	82.56	81.70	80.84
87	86.13	85.26	84.39	83.52	82.65	81.78
88	87.12	86.24	85.36	84.48	83.60	82.72
89	88.11	87.22	86.33	85.44	84.55	83.66
90	89.10	88.20	87.30	86.40	85.50	84.60
91	90.09	89.18	88.27	87.36	86.45	85.54
92	91.08	90.16	89.24	88.32	87.40	86.48
93	92.07	91.14	90.21	89.28	88.35	87.42
94	93.06	92.12	91.18	90.24	89.30	88.36
95	94.05	93.10	92.15	91.20	90.25	89.30
96	95.04	94.08	93.12	92.16	91.20	90.24
97	96.03	95.06	94.09	93.12	92.15	91.18
98	97.02	96.04	95.06	94.08	93.10	92.12
99	98.01	97.02	96.03	95.04	94.05	93.06
100	99.00	98.00	97.00	96.00	95.00	94.00

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POTENTIAL PROFITS FROM WILDLIFE

Russell Gum[1]

As ranchers look for ways to increase profitability the possibility of marketing wildlife resources is often thought of as an additional product that might generate income. In Texas the income of many ranchers depends heavily upon the marketing of wildlife resources. In Wyoming many ranchers serve as big game guides as a means of supplementing their income from ranching. Is there a possibility that wildlife resources could become a source of income for Arizona ranchers?

WAYS OF MARKETING WILDLIFE RESOURCES

There are many ways to market wildlife resources. Possibilities include:

1. Selling access to hunters.
2. Selling guided hunts.
3. Raising wildlife for the restaurant market.
4. Raising exotic game for hunters.
5. Selling hunting permits.

ACCESS

Selling access to hunters is probably the most common means of marketing wildlife resources. The basic requirements to be able to sell access is to have both private land and a means to control access to this land. If you can meet these requirements then you have to find a way to market the product.

GUIDED HUNTS

Since ranchers typically have the equipment and knowledge of their area required to perform guiding service, many ranchers have turned to guiding as a means of generating income. However, guiding requires both excellent hunting abilities and the ability to take care of camp and get along with the hunters paying for the guiding services.

RAISE WILDLIFE FOR THE RESTAURANT MARKET

A small but growing number of fancy restaurants are now serving wild game. Producing game meat for this select market is a possibility. Not only do you need to be able to produce and market this product, you will need processing facilities and the ability to operate under a large number of regulations with respect to selling wild game.

RAISING EXOTICS FOR HUNTERS

Another possibility is to raise exotics for hunters. Obviously in addition to being able to raise the animals, you will need fencing to be able to keep the animals on your ranch. You will also face exotic disease problems and regulations on game farms. The marketing of exotics is also a potential problem. You can't just take them to the local auction.

SELL PERMITS

At the present time, hunting permits in Arizona are the property of the state and are allocated by a lottery. Under this arrangement there is little incentive for ranchers to manage their resources in a manner that will increase wildlife. A logical change in the system would be to reward ranchers for management practices which increase wildlife resources. For example, the state could allocate permits to ranchers and allow the ranchers to sell these big game permits as compensation for the ranchers efforts to increase wildlife resources. If as a result of a ranchers actions an additional 10 elk permits could be justified in an area, why not allow the rancher to sell these permits as a reward. Such a system has been tried in California. The major problem of course is to document the increase in wildlife due to the ranchers management actions.

Such a system could, in theory, also be applied to public lands. Suppose a rancher has a lease which allows him to graze 400 cows. Why couldn't he only graze 300 cows and manage for an additional 200 elk? If his management did in fact result in an additional 200 elk, which justified say an additional 50 permits, why not charge him grazing fees for the additional elk and allow him to sell the additional 50 permits?

CONCLUSIONS

Marketing wildlife has potential to increase rancher income. However, just as with any new enterprise, there are many obstacles to be overcome. First, there are a multitude of rules and regulations which apply to marketing wildlife. Second, all of the methods of marketing wildlife require more marketing effort than just taking cows to the auction. Third, many of the methods of marketing wildlife require skills and abilities in working with people not normally required in managing a cattle ranch. Guiding hunters, for example, requires skills similar to a golf pro at a resort. While marketing wildlife is certainly not a quick fix for low profits in ranching, it does offer potential for increasing ranch income in well thought out and well managed situations.

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LEAST COST FEED RATIONS ON YOUR PERSONAL COMPUTER

Russell Gum and Gary Thompson[1]

Mathematical programming models are routinely used to calculate everything from minimum-cost feed rations to scheduling plane flights and blending petroleum products in refineries. A revolution in the software necessary to solve these powerful models has occurred in the past couple of years. Now anyone owning the latest version of most commercial spreadsheets such as Microsoft Excel or Quattro Pro has computational power which only Fortune 500 companies possessed a decade ago. Putting this enhanced computational power to work, however, requires the ability to put together a useful mathematical programming model.

All mathematical programming models have two critical elements: something to be *maximized* or *minimized*, and *constraints* or limitations which reflect production requirements and the availability of resources. In the minimum-cost feed ration, the costs of mixing a nutritional feed are minimized. The constraints in the feed mix problem are the nutritional requirements necessary to maintain good health and assure weight maintenance or gain.

Once the objective to be maximized or minimized is identified, the constraints or limitations directly affecting the objective must be recognized. Most constraints identify scarce resources and biological, physical, or financial requirements. Scarce resources are often easily recognized. In a grazing operation, the extent of available range land limits the number of head that can be grazed. The number of acres a farmer owns and leases limit the area planted in crops. Biological, physical, and financial requirements are sometimes more difficult to quantify. Finding the nutritional requirements for targeted weight gain may not be easy. Determining the proper fertilizer dosage for the targeted yield may require some searching.

A SIMPLE EXAMPLE

Most real life problems involve many complex interrelationships. The simple example presented here should give you an idea of the kinds of problems which could be solved. The details of the example are necessarily simplified.

The problem is the classic feed mix problem. The objective is to find a feed formulation that meets given nutritional requirements at minimum cost. Our possible ingredients are hay, corn, barley and meal. Their nutritional analysis is as shown in the spreadsheet table below. The hay used for this simple example is assumed to have 15 percent protein and 50 percent TDN by weight. The nutritional analysis for corn, barley and meal are 8, 7, and 40 percent protein and 85, 78, and 75 percent TDN, respectively.

A simple spreadsheet can be set up to calculate the protein energy and cost of any possible ration by simply defining the appropriate formulas for

	A	B	C	D	E	F
1		hay	corn	barley	meal	ration
2	% protein	0.15	0.08	0.07	0.40	.1595
3	% energy	0.50	0.85	0.78	0.75	.6355
4	cost $/LB	0.05	0.10	0.08	0.15	.0755
5	lbs	50	0	35	15	100.0000

the ration column. If % protein is in A2 then a formula of: (B2*B$5+C2*C$5+ D2*D$5+E2*E$5)/F$5 will define the % of protein in the ration and if copied down will mutate to define the % energy and cost per pound as well. The pounds in ration (F5) is simply the sum of the pounds of each individual ingredient, i.e., (B5+C5+D5+E5).

Once you have this simple spreadsheet set up you could then simply try different combinations of ingredients until you found a combination of ingredients that met the nutritional requirements at a reasonable cost. Such a solution is shown in the above table. However, this brute force approach might take a fair amount of time.

A much better way is to use the "solver" option of your spreadsheet. The mechanics of using this option in Microsoft Excel are as follows: (other brands of spreadsheets with solver options have very similar mechanics)

1. Set up your spreadsheet to calculate the necessary values, as described above.

2. Choose the **Solver Option** from the menu.

3. Enter the cell you want to minimize in the **Set Cell Box** (F4, ration cost per pound).

4. Click on the **Minimize Button**.

5. Enter the cells you want to solve for in the **By Changing Cells Box** (B5:E5, the pounds of possible ingredients).

6. Add the following constraints by clicking on the **Add Button**:

F2 > = .12	(Protein level must be greater than or equal to 12 percent)
F3 > = .60	(Energy level must be greater than or equal to 60 percent)
F5 = 100	(You want to mix 100 pounds of ration)
B5:E5 > = 0	(Negative weights are hard to measure out in formulating a ration. This insures only positive or zero values)

At this point, you have told the computer what cell describes your objective function (F4). You have given it instructions to minimize this value subject to a set of constraints by varying the amount of the various ingredients in your ration. Click on solve and the computer should return the following results.

	A	B	C	D	E	F
1		hay	corn	barley	meal	ration
2	% protein	0.15	0.08	0.07	0.40	.1214
3	% energy	0.50	0.85	0.78	0.75	.6000
4	cost $/LB	0.05	0.10	0.08	0.15	.0607
5	lbs	64.285714	0	35.7142865	0	100.0000

As you can see, the computer found a cheaper ration meeting all requirements than was found by simply fiddling with the original spreadsheet. Further, additional information is available in the form of a sensitivity report.

What is a Reduced Gradient or a Lagrange Multiplier? These terms are just techno babble for expressing what happens if you make a small adjustment to the optimum solution the computer found. For example, if you were to add one pound of meal to the solution and let the computer recalculate the ration so that the original constraints were still met the cost per pound of this modified ration would be

Changing Cells

Cell	Name	Final Value	Reduced Gradient
B4	lbs hay	64.28571398	0
C4	lbs corn	0	.0000357036
D4	lbs barley	35.71428654	0
E4	lbs meal	0	.000732134

Constraints

Cell	Name	Final Value	Lagrange Multiplier
F2	protein constraints	.1214	.0000
F3	energy constraints	.6000	.1071
F5	lbs constraints	100.0000	.0000

.000732134 $/lb higher than the original ration. Adding a pound of corn would increase the cost even less. If instead of adjusting the ingredients you made small changes in the constraints the Lagrange multipliers indicate how the optimum cost would change. For example a small increase in the protein requirement (say to 12.1 percent) would not change the cost at all. This is because the optimal solution already has more than 12.1 percent protein. A larger change to any value above 12.4 percent would increase the cost and the model would need to be re-optimized to calculate the new optimum and its associated new sensitivity values. Increasing the energy requirement to .61 percent would raise the ration cost .001071 $/lb. (We raised the constraint by .01 units so we must multiply the Lagrange multiplier by .01.)

Could this mathematical modeling stuff be of any real use on a ranch? Is it as easy as the simple model above? The answer to the first question is yes. The simple ration mix problem might even be useful on your ranch. The answer to the second question is Nope. Even the simple ration problem becomes more complex in reality. For example, are the analyses based on dry matter weights or at the feed scale weights? How many different ingredients are reasonable to consider? Most importantly, how should I decide on what the protein, energy, minerals, etc. content of the ration should be. The bottom line is that the current high end spreadsheets have capabilities to help you think about and solve some of the management problems common in ranching today.

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COMPARISON OF LIVESTOCK MARKETING ALTERNATIVES

Russell Tronstad[1]

An evaluation of marketing alternatives is complicated by the fact that less traditional marketing avenues like electronic auctions are difficult to directly compare with more traditional selling methods like local auction markets. This article discusses economic criteria for evaluating livestock marketing methods. Criteria are discussed for 1) electronic marketing, 2) private treaty, 3) local auction, 4) special auctions, 5) cooperative arrangements, 6) Chicago Merchantile Exchange (CME) Futures, and 7) CME Options.

ECONOMIC CRITERIA

Economic criteria are divided into tangible and non-tangible items. Physical terms of a marketing method such as shrinkage (refer to The Economics of Shrinkage article), trucking costs, overnight water and feed restrictions, commissions, interest costs, are tangible items that need to be calculated when determining a net selling price. The combined selling costs to the buyer and seller can range from between 8% and 10% of the gross animal value (Bailey). More intangible factors like the number of legitimate buyers in a market, riskiness of receiving full payment, the degree of convenience offered, and certainty in obtaining a targeted price level are economic criteria that also need to be considered when choosing a marketing method. Both tangible and intangible factors need to be evaluated jointly when deciding which marketing method or "road map" will best meet goals and target price levels set. Target price levels must be realistic with current market factors and price trends. Costs of production and breakeven prices should be identified and utilized as a reference mark for marketing. These tangible and non-tangible economic criteria are discussed below in conjunction with six different marketing methods.

ELECTRONIC MARKETING

Electronic marketing is a mechanism for marketing beef cattle by a description of standardized terms and/or videotape with virtually instantaneous communication between buyers and sellers, regardless of physical location between both people and cattle. Electronic marketing methods hope to increase the number of legitimate buyers by decreasing the transaction costs of inspecting, shipping, and buying cattle. This reduction in transaction costs is hoped to translate into a higher net price for the rancher and lower cost for the buyer. The degree that transaction costs will be decreased depends greatly on information, volume, location, and trucking costs.

Standardized information regarding terms, grades, and descriptions are necessary for electronic pricing efficiency. If one lot of cattle is sold under different terms than another comparable lot of cattle, it is difficult to make a direct comparison as to which buyer is offering the "best deal." Common or standardized terms allow for an equal comparison of bids and is a necessary condition for a market to be price efficient. Electronic marketing terms are the same for all buyers, allowing for improved price efficiency over individual private treaty bids that may have different terms. Standardized terms require that a trained grader make an accurate representation of your livestock compared to other livestock.

The grading reputation of an electronic auction needs to be evaluated closely since a misrepresented grade that has been lowered will cost a rancher more than if no grade had been given at all.

Adequate volume is necessary to attract many buyers so that top dollar is paid for all lots sold. If buyers discover that low numbers of livestock are offered for sale at an electronic auction, they may be unwilling to invest the resources for getting into a particular electronic auction. Prices could also fall significantly lower than the prevailing market, if available volume exceeds the number of orders that buyers have to fill. Lack of sufficient participation in electronic markets is one of the chief concerns among both sellers and buyers. When considering an electronic market, buyer participation expected for each specific sale needs to be examined carefully. An advantage of electronic markets is that a minimum selling price can be specified prior to the sale, but a fee comparable to regular commission rates will still be charged if the minimum selling price is not met.

Locational considerations that relate to shrink, trucking costs, and disease endangerment are potentially beneficial features of electronic auctions over local auctions. First, trucking costs can be lowered significantly by a more direct route, and the elimination of one unloading and loading of the livestock. Remote ranch areas can significantly reduce their shrink by having livestock weighed on or closer to the ranch. Reducing the livestock's exposure to diseases gives the buyer an advantage, especially if the cattle are going to a feedlot with cattle from only one or two ranches.

Primary disadvantages of electronic auctions to local auctions are the frequency of sales and discounts incurred for small lots. Any lot that doesn't make a full truckload (generally 50,000 lbs.) can expect to be discounted. Commission charges are often higher too to cover costs associated with grading and the electronic auction. Specific electronic markets of a) tele-auction, b) video auction, and c) computer auction are further discussed below.

Tele-Auction

Many times ranchers will join a marketing cooperative with a tele-auction so that more sellers are committed to market through the cooperative. This organization and seller commitment is given to attract more prospective buyers. Livestock are graded on each individual's ranch by a trained grader. Load lots are then assembled on paper according to location, number, weight, quality grade, and other noteworthy descriptions. After buyers receive this written description of cattle offered for sale, a prearranged conference phone call connecting potential buyers and an auctioneer must be set up. The auctioneer offers each lot for sale with buyers calling out their identification number over the phone if they wish to bid at the current asking price. A lot is sold when no higher bid is received, unless the seller's minimum price set before the auction is not obtained.

Video Auction

A video auction is very similar to the tele-auction except that more information is given to potential buyers. Two components comprise the video auction — a visual component provided by a video and a written component given by a sale catalogue. A videotape of animals sold is generally made by a regional representative of the video auction company prior to soliciting buyers. About a $2.00/head videotaping fee is required and this fee is generally included in the sales commission. Sales catalogue descriptions are prepared by the seller and regional video representative when the cattle are videotaped.

The sale is conducted with buyers assembled in one or more rooms looking at a large screen TV monitor — possibly connected by satellite to other buyers at very distant locations. Buyers must register with the auction and go through a credit check and clearance before the sale like in telephone and computer auctions. Videotapes of about two minutes in duration are shown while an auctioneer solicits bids. During the sale, buyers bid on livestock over the telephone like in a tele-auction but they also “see” the animals when bidding. The video auction representative oversees delivery and is responsible for ensuring contract compliance with both seller and buyer.

Cows and heifers that are guaranteed bred and/or with a negative bangs test are to be tested prior to delivery. This requires certification from a licensed veterinarian and these costs are usually paid for by the seller, unless stated otherwise. Although many efforts are made to ensure that the “catalog” description and terms are up-to-date, all announcements from the auction block take precedence over previously printed matter.

Computer Auction

Computer auctions are similar to video and tele-auctions except that information and bidding is conducted with electronic computers. Cattle are described before the sale with information transmitted via computer connections. When the sale is conducted, buyers indicate a bid by activating the bid key on a computer terminal. Initially, the offering price for a lot of cattle may drop by $1.00/cwt. every 5 seconds until a buyer activates their bid key. This buyer has the bid until another buyer raises the bid. Bids are generally raised in smaller increments than they are lowered. The Electronic Auction Market (TEAM) from Calgary Stockyards increases bids by $.25/cwt. and drops the price by $1.00/cwt. to secure a bid (Rust and Bailey). If a higher bid is not received within the buying interval for bid increases (e.g. 20 seconds), the lot is declared sold. Unlike video and tele-auction, buyers have no way of telling who they are bidding against in the absence of any collusion. With the conference call associated with video and tele-auction, the voice signals of prominent bidders can be recognized fairly quickly. The computer identifies who has made every bid to the auctioneer but buyer bids are not identifiable to other buyers.

Slide Considerations

Virtually all feeder cattle are sold on a sliding scale when sold electronically or direct. A slide establishes the discount or premium from a base price depending on differences in actual base weight (after shrink) from those expected. Since heavier weight feeders generally sell for less than light feeders, a slide is part of the terms of trade. Many contracts allow for a small weight allowance of like 10 lbs./head before any weight adjustment is made. A slide is defined in $/cwt. and can have a range from $0.00/cwt. to $10.00/cwt.

The slide is effective for both over and under weight cattle so that light (heavy) weight cattle will receive a premium (discount) from the bid price. The net price received can be calculated as follows:

1) Determine if the weight after shrink is within the weight allowance. If within weight allowance then,

   net price = bid price x (1.0 - shrink %).

2) If heavier than the maximum weight allowed after shrink before the slide is effective then,

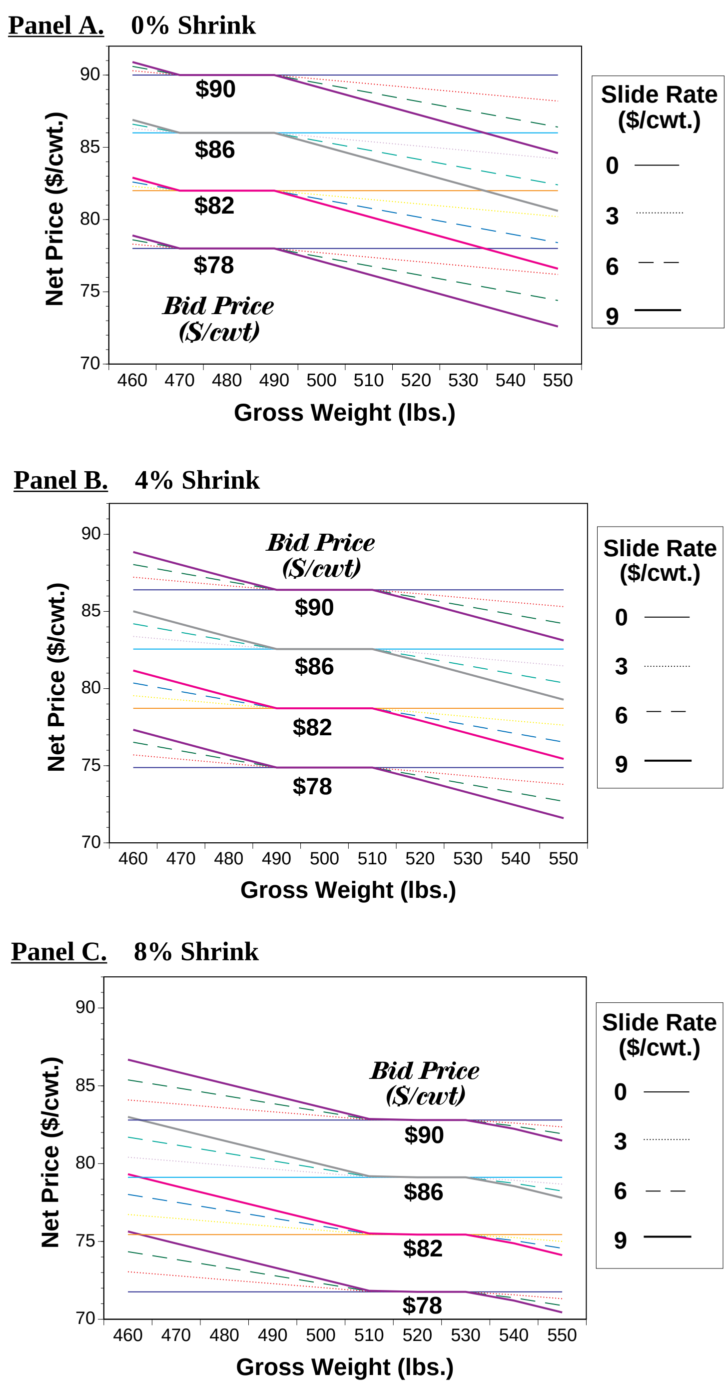
   net price = {bid price - [weight after shrink - max. weight allowed] x slide/100} x (1.0 - shrink %).

3) If lighter than the minimum weight specified after shrink before the slide is operative then,

   net price = {bid price + [min. weight specified - weight after shrink] x slide/100} x (1.0 - shrink %).

For example, what is the net price received if the bid price is $80/cwt., the base weight after shrink is 480 lbs. with a 10 lb. weight allowance and 4% shrink, and a slide of $4.00/cwt. is utilized? A calf weighing 510 lbs. would have a net weight after shrink of 489.6 lbs. (510 x .96), within 10 lbs. of the specified base weight of 480 lbs. Thus, the net price would be $76.8/cwt. ($80/cwt. x .96) or $391.68/head. If the calf had a gross weight of 550 lbs., the net price received would be $75.34/cwt. ({80 - [(528-490) x 4.0/100]} x (1.0 - .04)). If the calf weighed only 480 lbs. on the scale, the net selling price would be $77.15/cwt. ({80 + [(470 - 460.8) x 4/100]} x (1.0 -.04)). The figures to the left net price of cattle with different shrinkage rates, bids, and slides illustrates how net prices vary based on gross weight.

Net Price Received on Gross Weight with a 480 lb. Base Weight (after shrink), and 10 lb. Weight Allowance.



All livestock are weighed on certified scales and sell FOB (not including transportation charges) at the ranch, unless otherwise stated. Any cuts made from a pen are made after the cattle are weighed.

PRIVATE TREATY

Private treaty refers to individual buyers and sellers negotiating one-on-one the terms and price of sale. This method generally works best when the buyer knows the quality of livestock available and the rancher knows that the reputation of the buyer is reliable. Under these conditions, negotiations can occur over the telephone without the need for travel and inspection of animals.

Price efficiency is generally lacking under a private treaty method due to insufficient information. All potential buyers don't have adequate and equal information on a particular rancher's livestock and all rancher's don't have full information on the trustworthiness and legitimacy of all buyers. In general, buyers must be bonded and licensed in order to buy livestock. Verify that these qualifications are met. Insist upon a wire transfer of funds, certified check, letter of credit, or cashiers check to lower the risk of not receiving full payment. A personal check is the least expensive for the buyer, but also a high risk for the rancher selling livestock. It is always a safe practice to retain title of livestock until the final payment has cleared the buyer's financial institution. If a personal check doesn't perform in full the seller has to pursue legal procedures in order to obtain funds. Legal fees can add up in a hurry and when livestock are removed from the state of origin it is very difficult to even repossess them. An example of what a "Livestock Bill of Sale and Contract" (Bahn, Brownson, and Rust) might include is noted on the following page.

LOCAL AUCTION

Local auctions are a centralized market where buyers, sellers, and animals merge to a particular location and specific time. Livestock are generally sorted so that each lot is somewhat uniform. The disadvantage of sorting animals into more uniform lots is that smaller lot sizes receive a discounted price (Gum and Daugherty). Sellers may be able to combine small lots with one another in order to avoid some of this price discount, but this requires more organization, weighing, and agreement that all cattle are of equal quality and value.

Livestock are generally displayed in a round ring or pen at the local auction while buyers look on and call out bids. Animals are weighed immediately before or right after they enter the sale ring. Modern sale rings often display the total and average weight of a pen simultaneously while bids are requested by the auctioneer. Buyers generally don't see the cattle until they enter the ring but they develop a very trained eye for weight, yield, grade, and other characteristics.

Marketing costs of a local auction are relatively high due to increased transportation costs, higher shrink/weight losses, and the costs of maintaining facilities and staff to run a local auction. However, a local auction provides good liquidity to ranchers with sales occurring on a much more frequent basis than other marketing methods. Also, the auction insures the legitimacy of buyers rather than the seller as in a private treaty sale. The magnitude of strengths and weaknesses for a local auction are often site, animal, and season specific.

_____________________19 ____

LIVESTOCK BILL OF SALE AND CONTRACT

This certifies that __________________________ of ____
full address and phone

has this date bargained and agreed to sell to _________________ of _______________________________
full address and phone

____________________ head of _________ to be delivered F.O.B.___________________________________
location and method

on or before the ____ day of ________ 19___ at $_____ per head or at $_____ per cwt., to be weight on _____ hours

shrink or ____% shrink at _____ with _____% cut back. Received as part payment $ ______, with balance of $______

to be paid on delivery, I hereby guarantee title thereto, viz:

No. Head	**Description**	**Brands**	**Location of Brands**	**Price Per Head**

1. On the delivery date specified above, the seller hereby reserves the right to demand full payment for the described livestock by a) cash, b) wire transfer of funds to the seller's requested destination, c) cashier's check drawn on purchaser's financial institution, d) certified check drawn on purchaser's financial institution.
2. The seller further stipulates that title does not change on the above described livestock until the payment is made in full. Therefore, the seller retains title to the above described livestock until payment is made in full.
3. Should the purchaser fail to meet any of the above noted terms, the down payment will be forfeited to the seller.
4. All of the above stock is free from encumbrances, except as noted in paragraph 5 below, including taxes for year of delivery, and will pass federal and state inspection for interstate shipment. Health and brand certificates will be furnished to the purchaser, free of charge, on delivery.
5. The stock is subject to encumbrance(s) held by the following named person(s) with address and nature of encumbrances set forth as follows:

____

____

6. Time is of the essence in this agreement, and this agreement shall apply to and bind the heirs, executors, administration, successors and assigns of the respective parties and constitutes the entire agreement between the parties herein.
7. The law of the State shall govern the constriction and interpretation of this agreement.

(Seal)______________________________Seller

Witness ______________________________ ____
date *signature*

________________________________Purchaser

Billsale.chr/file/5/20/90/pcr

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Source: Great Plains Beef Cattle Handbook, GPE-4115.4.

For example, many buyers may be bidding for heifer calves in the spring but few in the fall.

SPECIAL AUCTION

Special auctions are generally feeder cattle sales that are held seasonally or on an infrequent basis. A special auction usually has more publicity and promotional efforts to increase the number of sellers and buyers at the auction. A livestock association will often sponsor a special sale. The association can give greater credibility to the quality and quantity of livestock available for sale. Assuring buyers of quantity and quality is centered at increasing buyer attendance. An additional small commission fee is usually charged with a special auction to cover greater advertisement and promotional efforts.

Similar to local auctions, the magnitude of strengths and weaknesses are usually sale specific. If a special feeder auction occurs every year about when your calves are weaned, the liquidity of special auctions may be adequate. One disadvantage of following a rigid special auction marketing strategy is that you may sell all of your "crop" at the low price for the year. Spreading out the timing of sales can diversify some of the price risk associated with marketing, but may make shipping livestock more difficult and costly. Utilization of CME futures and options is one way ranchers can "enter the market" at different times and still ship all of your livestock on the same day.

COOPERATIVE ARRANGEMENTS

Cooperative arrangements for marketing can range anywhere from a formal cooperative agreement to a marketing "pool" with a rather loose commitment. Cooperative legislation was initiated in the early 1900s with the general goal of enabling producers to "empower themselves" to provide goods and services required by member patrons. The Capper-Volstead Act places no size on the market share that can be attained by a cooperative and be legal. Thus, all the cattle in Arizona could be marketed through one cooperative and not be subject to any anti-trust legislation. Ownership and control of a cooperative must be in the hands of those that utilize its services and business operations shall be conducted so as to approach a "cost basis." Cooperatives operate for a profit motive like a private company but the return on capital accumulations are limited. Profits are distributed back to member patrons through a dividend that is generally in proportion to the dollar patronage by members. Chief control of a cooperative lies with a Board of Directors elected by patron-owners. Voting is generally 1 vote for each member although some cooperatives vote in relation to dollar patronage. Liability of the cooperative is generally limited to the assets of the cooperative.

Cooperatives have not been a big tool for ranchers marketing livestock in the US. In 1986, it was estimated that 8% of all livestock and livestock products were sold through cooperatives. This compares relatively low to dairy products (83%), cotton (41%), fruits and vegetables (35%), and grains and soybeans (34%) (Kohls and Uhl). Nonetheless, they may still be the best avenue available for some ranchers at attaining top dollar for their products.

Obtaining the initial equity for something like a livestock cooperative can be difficult. The sale of common or preferred stock often provides capital for cooperatives but the market for such stock must come primarily from cooperative members. Preferred stock customarily has a fixed dividend and no voting rights. Although limited, it is often the best tool for attracting "outside capital." Various methods and rules apply from one association to another for owners withdrawing capital. Usually a member can sell his stock and/or earnings to another member, subject to approval of the board. Some cooperatives have a fixed time for redeeming stock certificates as well. This is often referred to as the "use of a revolving fund" since these funds generally do not accrue interest. Disbanding an entire cooperative can be a long and complicated process with many legal fees. Ranchers in an area need to know for sure that a marketing cooperative is what they want before making the commitment to start a marketing cooperative. USDA, Agricultural Cooperative Service has put together a 31 minute videotape on "How to Start a Cooperative." This videotape is a good starting place and something all ranchers should watch together as a group and discuss before taking the first steps to forming a cooperative. A copy of the videotape can be obtained by sending a $25 check or money order payable to Agricultural Cooperative Service, and mail to ACS, P.O. Box 96576, Washington, DC 20090-6576.

A more informal organizational structure for marketing livestock could be an association sale or "pool." An association or pool generally commits ranchers to bringing a specific product like yearling bulls, steer calves, bred heifers, lambs, or wool for a particular sale. The association spends money on advertising and soliciting buyers for everyone so that these costs can be reduced on a per unit basis. These costs are generally covered by charging a small percentage of the gross selling price. The success of association or pooling sales largely depends on the ability and reputation of assuring buyers that a sufficient volume of an identified class of livestock or livestock products will be sold. A legally binding commitment may be necessary for the initial sale years to attract a "competitively viable" number of buyers. Increasing buyer attendance is key to attaining higher sale prices and better ranch profits.

CHICAGO MERCHANTILE EXCHANGE (CME) FUTURES

CME futures is a method for hedging price risk that is similar in form to forward contracting. Because they are similar one may ask why utilize the CME? A chief reason for utilizing the CME is liquidity. A decision to sell can be made immediately knowing that the prevailing market price on the exchange will be received. The CME consists of many traders that are receiving buy and sell orders from individuals all over the world. Because all contracts are standardized, no differentiation is made between offers and bids. All bids and offers are made with vocal outcries so that all traders in the pit have equal price trading information. Standardization of contracts and equal information are necessary conditions for a market to operate in a price efficient manner.

The CME market is considered a "base point" or reference market for local markets throughout the world. Trading occurs for the months of January, April, May, August, September, October, and November for feeder cattle. Contracts trade in 50,000 lb. increments, up from 44,000 lbs. prior to January 1993. Because local markets follow the CME, a rancher can hedge by taking a position in the futures market that is opposite of his cash position. After January 1993, feeder cattle futures contracts can be "cash settled" to the new CME Composite Weighted Price for 700-799 pound a) Medium Frame #1 and b) Medium and Large Frame #1. Feeder futures contracts were previously settled to the U.S. Feeder Steer Price (USFSP) for 600-800 pound feeder steers as calculated by Cattle-Fax. The new cash settlement index is expected to have a lower basis variability than the previous USFSP index.

Some reasons why basis variability should be lower with the new index are:

1) The weight range has been narrowed from 600-800 lbs. to 700-799 lbs., eliminating more price variation due to weight.

2) The region from which sale transactions are used to calculated the index has been narrowed. Feeder cattle transactions have been reduced from 27 states to the 12 states of Colorado, Iowa, Kansas, Missouri, Montana, Nebraska, North Dakota, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming. A smaller and more homogeneous geographic region is expected to make the cash settlement index better for the feeding industry, but the impact of a reduced geographic region for Arizona's ranchers and feedlots is more ambiguous.

3) The new index is a true volume-weighted average price rather than a regional weighting formula. That is, there is no distinction between boundaries or cattle sold at a local auction, direct sale, or electronic market. Every pound of livestock sold has equal impact in determining the CME Composite Weighted Average Price. All direct and electronic sales included are quoted on an FOB basis, 3% equivalent standing shrink.

4) The description of cattle used in calculating the index has been changed. The new index will include livestock of Medium Frame #1 and Medium and Large Frame #1, as determined by Federal-State Market News reporters. The old criteria was a "60-80% choice grade criteria" that was inconsistent terminology for current USDA grading definitions.

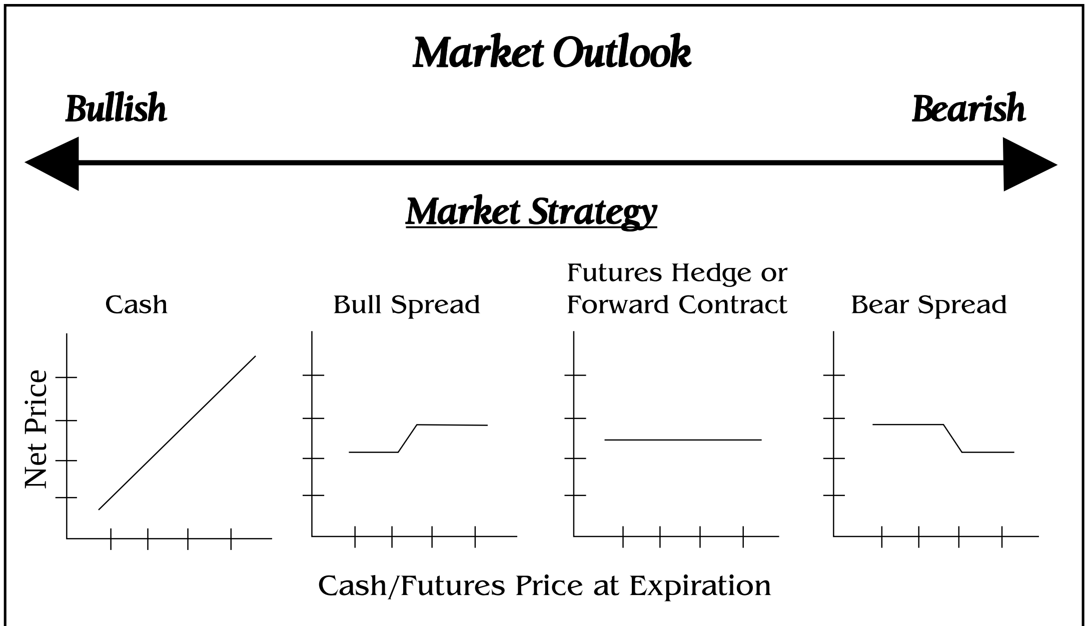
For hedging an October weaned calf crop in the summer, one could sell an October feeder contract in the summer through a local broker. Then at weaning in October, concurrently buy an October feeder contract while selling in the local cash market. If the differential between the cash market and futures (basis) is the same when October futures were sold as when they were bought back, a "perfect hedge" is said to have occurred. Thus, a $5 cwt. price decline in the cash market would be offset by a $5 cwt. gain in the futures market (i.e., buy back at $5 cwt. lower in the futures than sold for) with a constant basis or "perfect hedge." An increasing basis (cash minus futures) would be desirable for the rancher hedging with futures but a decreasing basis would decrease a rancher's net price received. Understanding what the basis will be when a hedge is completed is key to predicting a final net price.

As previously mentioned, one advantage of hedging with futures is that futures can allow one to enter the market at several different times throughout the year but still have one delivery date. Because futures are sold in 50,000 lb. increments, approximately 100 head of feeder cattle are "sold" with every contract. If one has a herd of 200, a strategy for reducing price risk could be to sell one futures contract in the spring and one later in the summer, rather than selling both at the same time in the spring or summer.

Because hedging with futures "locks in a price" the net price received will only be affected by changes in the basis rather than the general price level. This is desirable when the price level is declining but prices can increase too. Not selling 100% of your anticipated feeder sales on the futures market is one way of reducing the "risk" of not benefiting from price increases in the market. But another approach is to hedge utilizing CME options.

CHICAGO MERCHANTILE EXCHANGE (CME) OPTIONS

An option is the right but not the obligation, to sell or buy a commodity traded on the futures market for a limited time period at a specified price. In order to obtain the right to sell feeder cattle or live cattle futures (put option) on the CME at a pre-specified price level or strike price, a premium must be paid. A put option works very much like auto or accident insurance. The premium you pay for auto insurance will depend on the driving record of other drivers in your class (e.g., neighborhood, age, distance of daily commute) and level of insurance. Similarly, the premium you would pay for a put option depends on how volatile market conditions have historically been and the level of insurance or strike price (how much above or below current futures prices). More distant time horizons will require a higher premium than nearby contracts, due to more uncertainty. If feeder cattle futures remain or fall below the previously specified strike price, a put option will be exercised like an insurance claim would be filed if one had an auto accident. That is, futures can be sold at a higher price (strike price) than the current futures price so the option is exercised. If futures rise about the strike price purchased, the option is left to expire and the cost of the premium is absorbed in the same way that an auto insurance holder absorbs the cost of a premium when a policyholder is not involved in any accidents. If prices drop, a put option will give price protection much like an auto insurance policy provides coverage for an auto accident. The amount of coverage in a put option depends on the strike price (i.e., higher the strike price the higher the premium and level of coverage) and time period covered.



MARKET OUTLOOK

An individual's financial position, risk aversion, market outlook, and personal preferences need to be accounted for in developing a marketing plan. The figure above illustrates how market strategy and tools utilized will differ depending on a rancher's market outlook. Market strategies of cash sale, bull spread, forward pricing, and bear spread are compared.

Cash Marketing: A bullish market outlook is consistent with the cash marketer since the rancher receives the full benefit of any price advances. Cash marketing is appealing in that minimal transaction costs are required, and the method is straightforward and familiar. On the down side, the rancher also absorbs the full risk of any price declines in the market. Another disadvantage is that a rancher can only sell when delivery is possible. This limits the ranchers ability to reduce price risk. If a rancher can market livestock throughout the year, cash marketing is somewhat diversified and risk averse in that an average price somewhere between the high and low seasonally adjusted price for the year is realized. But marketing a few animals at a time throughout the year has increased round-up, transportation, calving, and other management considerations that generally make this strategy prohibitive. Other price risk management tools that don't require delivery to "enter the market" are briefly described below.

Bull Spread: Bull and bear spreads are very common market positions taken by future traders and equivalent positions are available to ranchers. A bull spread is appealing in that a rancher is protected from a price decline but can still benefit from higher prices, albeit less than the cash marketer if prices increase a lot. A rancher can take a bull spread position by: 1) writing a call option (right to buy at a specified strike price) for say November with a strike price that is above current November Futures, and 2) buying a November put option (right to sell at a specified strike price) that is below the November Futures price. The spread will be determined by how much the strike prices of the call and put options differ. In writing a call option, one receives a premium — amount associated with taking the risk that November Futures will increase above the specified strike price before November. ***The premium received from writing the call option can offset all or most of the premium required for purchasing the put option.*** But when writing a call option, margin calls have to be made if November Futures advance above the strike price. Losses incurred when the market advances above the call option's strike price are offset by advances made from feeders on the ranch that will be sold in the spot market. This is why the figure shows a net price ceiling for large market advances. Similarly, the net price received is a price floor for large market declines. The put option purchased increases in value as the market declines, offsetting losses incurred from selling feeders in the spot market at a lower price.

Forward Pricing: As described earlier, forward contracting or hedging with futures are two common ways to "lock in a price." Forward contracting has a simple and straightforward approach with appeal similar to cash marketing. Forward contract specifications can be written so that a rancher's net price is known for certain when the contract is signed, providing weight, and specified standards are met. Pricing terms should describe a schedule of discounts and premiums that is at least as detailed as that described in the "Livestock Bill of Sale Contract" discussed under private treaty sales. Forward contracting is no better than the reliability of the contractor and terms specified. Hedging with futures has an edge over forward contracting in liquidity. That is, numerous buyers and sellers trade in a competitive environment on the Chicago Merchantile Exchange, insuring that a fair market price is obtained whenever buy and sell decisions are made.

Bear Spread: A bear spread uses the same tools as a bull spread. A rancher can take a bear spread position by: 1) writing a call option for a strike price that is below the prevailing November Futures price and 2) purchasing a November put option that is above the current November Futures price. As above, the magnitude of the "spread" will be determined by how much the strike prices of the put and call options differ. The spread is bearish since the strike price of the put purchased is above the strike price specified on the call written. Both put and call options are "in-the-money" since they both have value if exercised now. The put and call options for a bull spread are both "out-of-the-money" since they have no immediate value if exercised. Most options are traded out-of-the-money so that trading is often very thin for a bear spread. A licensed broker can provide up-to-date information on the volume or liquidity for a specified option. As above, market declines are offset by an increase in value from the put option purchased and market advances are reduced by decreases in value from the call option written.

When hedging with futures or following a bear or bull spread market strategy using options, a rancher's net price can be reduced or increased from basis (cash minus futures) fluctuations. If the basis declines (increases), the net price received by the rancher will decrease (increase). The basis for Arizona steers and heifers of varying weight classes are described for feeder contracts of November and May in Figures 1 and 2, respectively, on the following pages. These graphs illustrate that the basis can vary greatly depending on sex, weight, and year. However, the range in basis values for 700-799 lb. steers, what

Figure 1. November Basis (Cash-Futures) Range and Average, 1980-93.

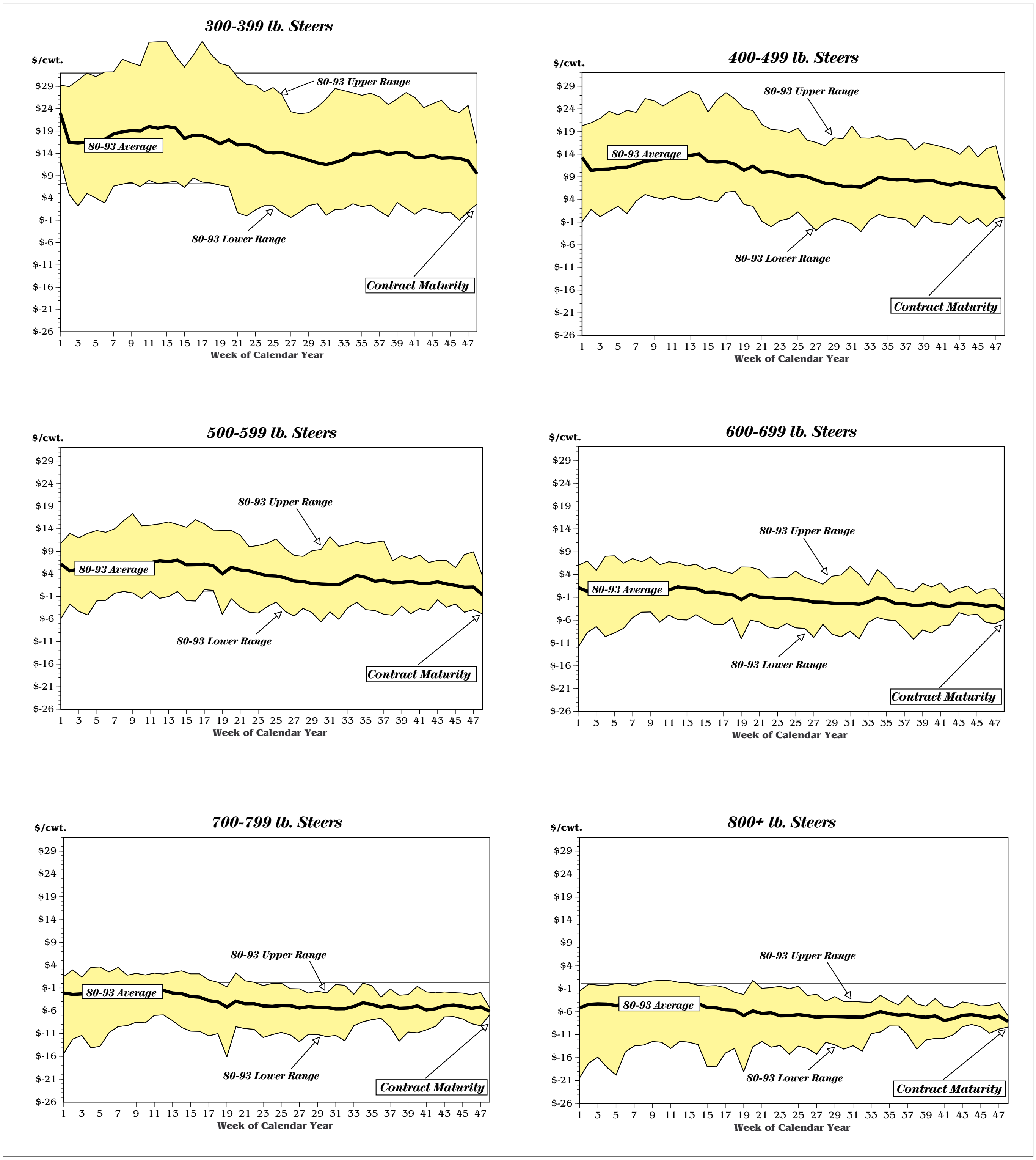
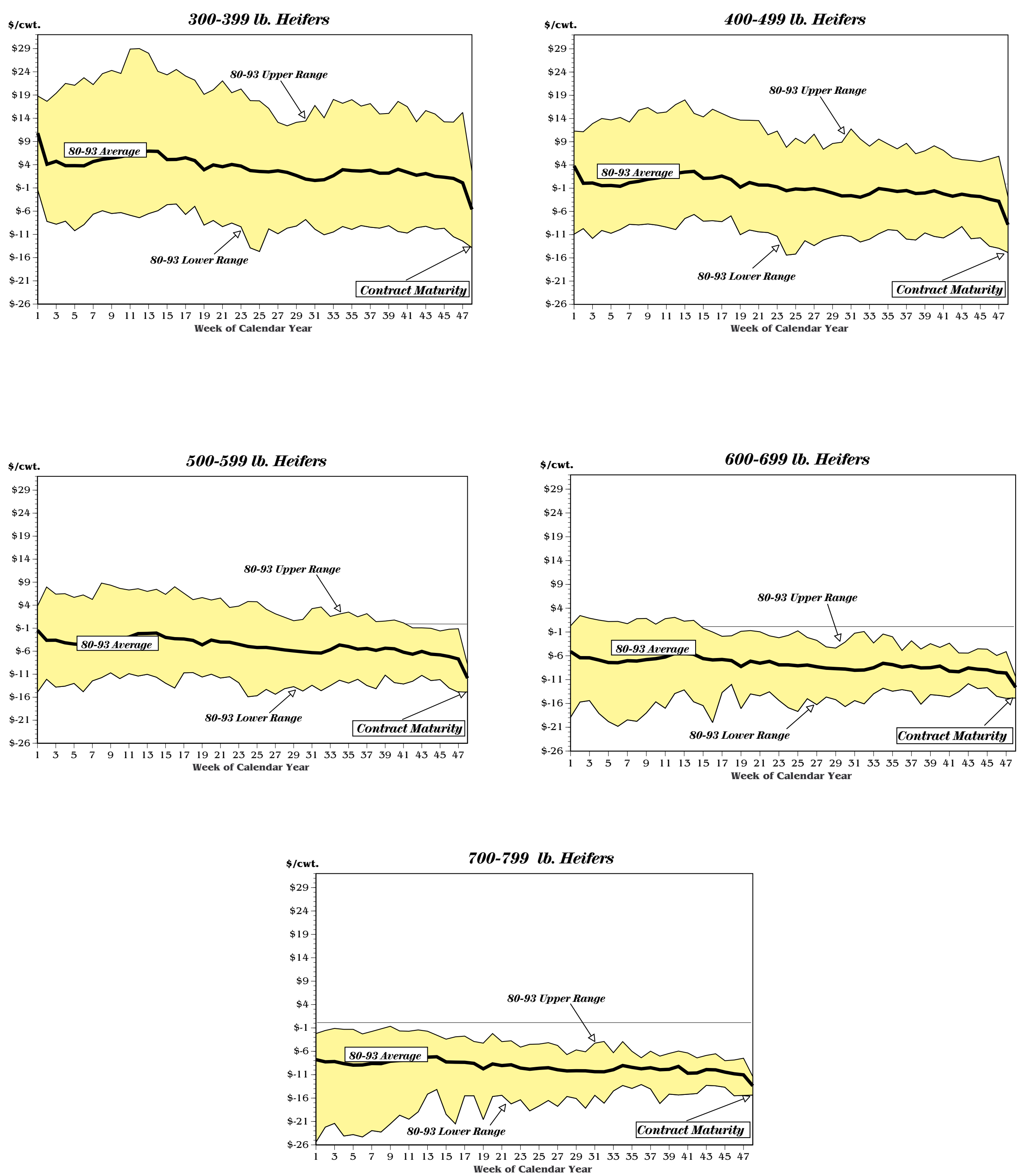


Figure 1 (continue)



Data Sources: Chicago Merchantile Exchange and Cattle-Fax.

Figure 2. May Basis (Cash-Futures) Range and Average, 1980-93.

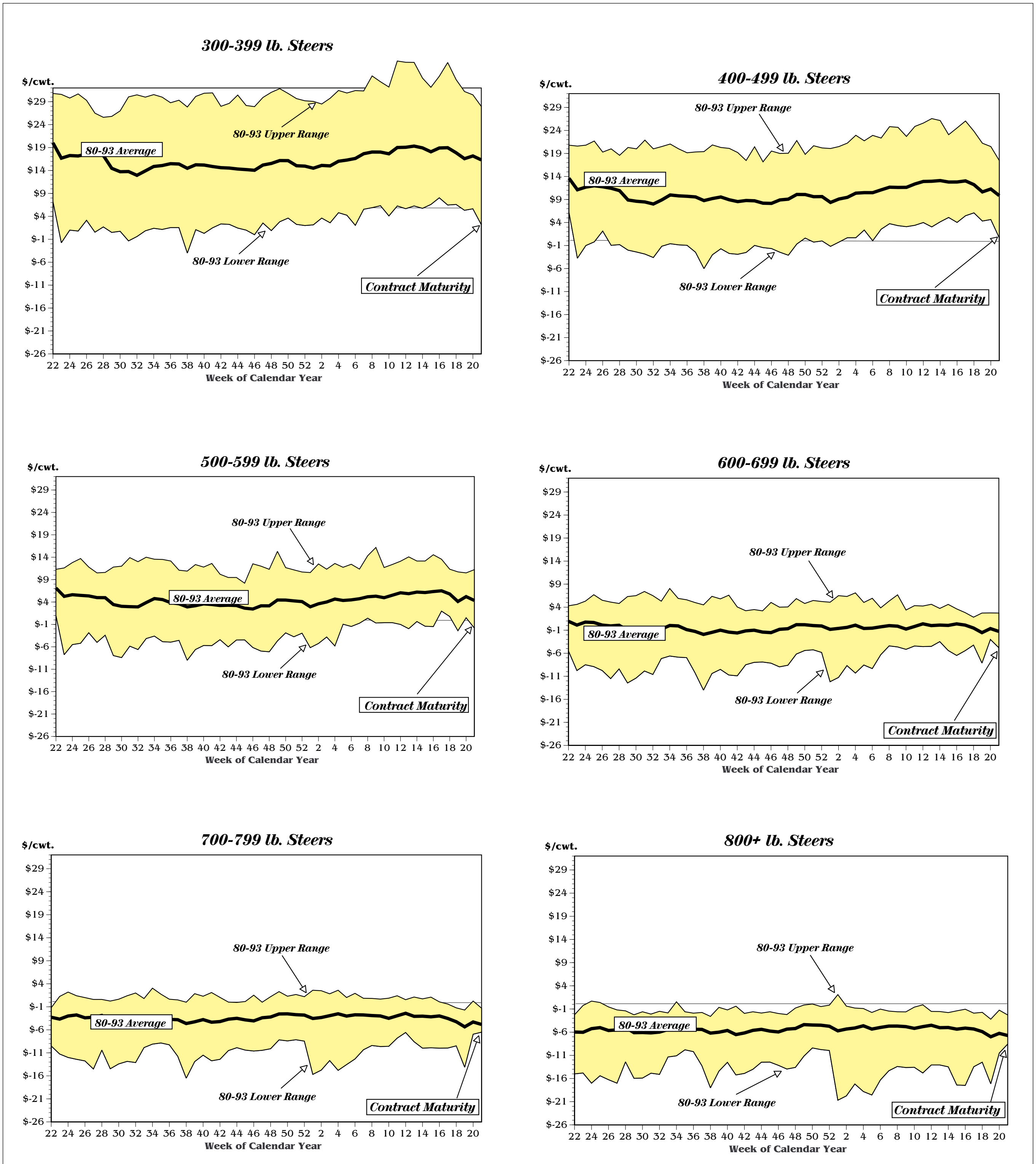
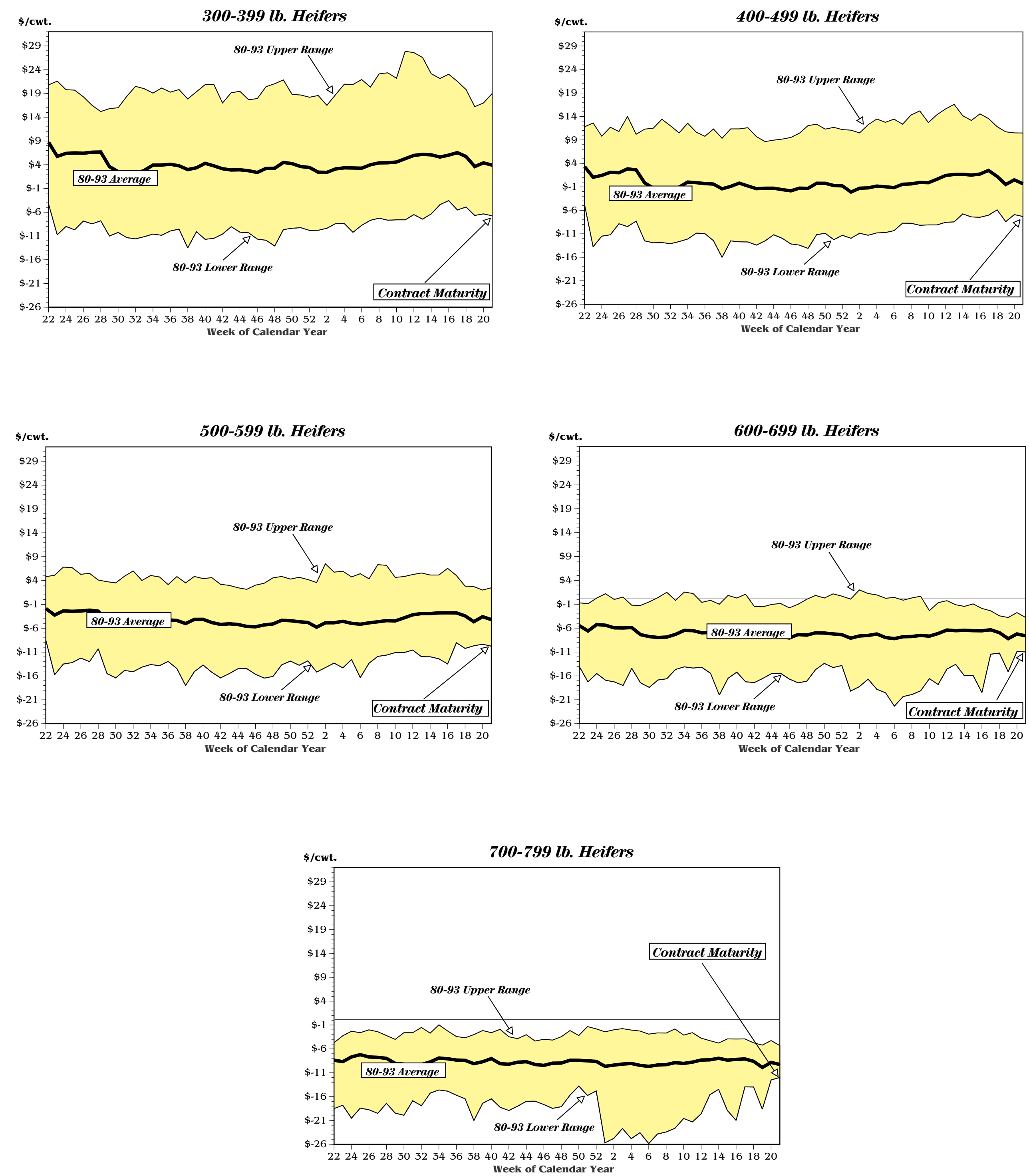


Figure 2 (continue)



Data Sources: Chicago Merchantile Exchange and Cattle-Fax.

the futures market primarily reflects, has been quite narrow. Average basis values shown between 1980 and 1993 for the calendar week of the year you plan to sell your steers or heifer give a reasonable estimate for calculating an expected net price.

For example, in mid-November (week 46) the average basis for 400-499 lb. steers is $6.75/cwt. If in March the November feeder cattle futures is trading at $80.00 cwt., a net price of $86.75/cwt. would be a reasonable price estimate for hedging with futures. November futures would be sold at $80.00 in March. Then, feeder steers weighing 400-499 lbs. would be sold in mid-November locally at the same time the November futures contract is bought back. If the cash price is $6.75 above the futures as anticipated, a net price of $86.75 (less a small commission fee and some interest accrued or expensed from margin calls) is realized by the rancher. If the cash price were only $2.00 above the future in November, then the net price received would decline by $4.75. The difference between the cash and futures market or basis is the key factor rather than the overall price level. Gains (losses) in the futures market are offset by declines (advances) in the cash market for all livestock hedged with a futures contract, if the basis remains constant.

Many other market tools and strategies are available than the few briefly described. Combinations of cash and hedging with futures can attain similar outcomes to the bear, and bull spreads described. The range and number of strategies available is only limited by the understanding and creativity of every marketer.

Margin calls may be required for hedging with futures or writing a call option. One reason the purchase of a put strategy has appeal is that no margin monies are ever required. But premium costs can add up with a put strategy. It is important that your banker or source of financing understands your hedging strategy if margin calls are a possibility. A hedging strategy can turn sour for the rancher if adequate cash is not available to meet margin expenses. Also, the hedging legitimacy of writing a call option and receiving a premium may be under question by the IRS. This may require the consultation of a tax advisor and futures broker since each individual situation can vary.

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Table 1. Pros and Cons of Marketing Methods

Method	Advantages	Disadvantages
Cash Marketing	* Full benefit of price advances.	* Only sell when delivery is possible. * Full risk of price declines in market. * Basis risk.
Electronic Marketing	* Lower costs of shipping, inspecting and buying cattle. * Standardized terms, more buyers—increased price efficiency.	* Infrequent sales. * Discounts likely for small lots.
Private Treaty	* Terms can be tailored to specific situation. * Can develop a long-standing reputation and business relationship.	* Few buyers may be interested in making a bid. * Integrity of buyer can be question-able regarding settlement price.
Local Auction	* Auction insures legitimacy of buyers. * Frequent sales.	* Transportation, shipping, and selling costs high.
Special Auction	* Target buyers for a particular sales.	* Special sale may be a “dud”- may be unsatisfied with sale price.
Cooperative Arrangements	* If cooperative is successful, returns will go back to member patrons. * Cooperation may increase number of buyers.	* May be difficult to get all ranchers to agree on business decisions. * Obtaining equity for forming a cooperative can be difficult.
Forward Contracting	* Can be tailored to specific situation and needs. * No basis risk.	* No upside price potential.
Hedging with Futures	* Widely traded competitive market. * Hedging costs minimal.	* No upside price potential unless basis change is favorable to target basis level. * Basis risk. * Margin monies required.
Put Option Hedge	* Allows for significant upside price potential. * No margin expenses.	* Premium costs can be significant for your minimum price targeted. * Trading sometimes thin. * Basis risk.
Bull Spread	* Premium costs minimal. * Allows for limited upside price gains. * “Wide spreads” generally plausible.	* Trading sometimes thin. * Basis risk. * Margin monies required.
Bear Spread	* Premium costs reduced. * Allows for limited gains in a bearish market.	* Trading generally very thin. * Magnitude of “spreads” limited. * Basis risk. * Margin monies required.

FROM:

Arizona Ranchers' Management Guide
Russell Gum, George Ruyle, and Richard Rice, Editors.
Arizona Cooperative Extension

HEDGING POTENTIAL IN CALIFORNIA CATTLE MARKETS

Steven Blank [1] *and Dawn Thilmany* [2]

Introduction

The potential of any futures market to serve as an effective hedge against price risk depends on the relationship between that market's futures price and the local cash price relevant to an individual hedger (Blank et al., p. 217). However, cash prices of commodities vary over time, space, and product form (Bressler and King), therefore each futures market's potential as an effective risk management tool will vary for hedgers pursuing different objectives and involved in different temporal, spatial and product markets.

The goal of this paper is to demonstrate the relationship between an individual hedger's objectives and the potential for successful hedging in various markets and to analyze these relationships for California cattle markets. The results derived from a simple model are used in an empirical analysis of the hedging potential in the case of California cattle markets. These results are intended to help readers understand the influence of price behavior over space, time and product form on the effectiveness of using a futures market as a hedging tool. The results also offer guidance to hedgers in the specific cattle markets evaluated.

The Objective of Hedging and Hedging Potential

For decades, it was assumed that the objective of hedging has to reduce price risk. However, if hedgers are viewed as investors, the motive for all market activities is to earn a return. Risk associated with an investment is considered by risk averse investors to be a by- product of market activity, not the object. The incentive for any action is the expected return, whereas risk is a disincentive. With this perspective it is unrealistic to assess business decisions using risk as the only criterion. This view of all investors being profit maximizers[1] does not preclude hedgers from acting like risk minimizers at some points in time. For example, if stable prices are expected, all hedgers behave as risk minimizers during that period even though they are still maximizing utility.

Since profit is defined as a function of cash and futures prices, factors which influence hedging objectives and hedging potential include a hedger's risk aversion, confidence in a forecast of expected prices, correlation between cash and futures prices, the nature of basis, and the ratio of basis variance to cash price variance. This analysis focuses on the correlation between cash and futures prices, the nature of basis and the Variance Ratio (see Blank and Thilmany). Together these three statistical measures illustrate how effective hedging is as a tool to accomplish either of a hedger's potential objectives.

Hedging Potential Across Time, Space, and Product Form

Differentiation of products can be based on elements of a product's form, geographical location, or the time it is available to the market (Bressler and

[1] Profit maximizers are substituted for utility maximizers here, with the understanding that risk considerations enter into their business decisions.

King). The California cattle industry is especially interesting because cattle are less storable and more expensive to transport than most commodities. Commodities which are storable and relatively inexpensive to transport, such as corn, have a basis[2] which can be reliably estimated using the cost of storage and transportation. However, delivery on cattle futures contracts is not economically feasible for California producers and, consequently, basis will not necessarily converge to any specific value at a futures contract's maturity date.

Commodity prices are related across time by storage costs, but cattle is not truly "storable." Some production flexibility allows producers to market their cattle in more than one time period, so prices are expected to be somewhat related across seasons. However, the change in basis across seasons (i.e., April vs. October contract maturities) may differ.

There is potentially a separate spatial equilibrium between California markets (where intra-market transportation may be feasible) and more distant markets. As a separate spatial market, the California industry will share some widespread shocks with other, U.S. markets, but there are factors that affect California only. Although prices in a local area may be related to prices in regional markets, the price in a local market depends on local supply and demand and the costs of transportation into or out of the local market (Bressler and King).

A market may also be viewed as extending through alternative and successive forms of a product with a consistent structure of prices interrelated through processing costs (Bressler and King). For this reason, feeder and slaughter animal contracts will have related, but not perfectly correlated cash and futures prices. Also, there are likely to be unique market conditions for alternate product forms such as steers versus heifers.

[2] "Basis" is defined as the difference between futures and cash prices of a product.

Empirical Analysis

The theoretical analysis discussed in the previous sections and derived in Blank and Thilmany will be illustrated by presenting empirical estimates for three measures of hedging potential for the California cattle industry. There are basically three regions with significant cattle production in California: the Southern San Joaquin Valley, the Northern San Joaquin Valley, and the Sacramento Valley.[3] This study will use market prices from Visalia, Stockton, and Cottonwood as the available cash price for producers in each of these regions, respectively, although some inter-regional transportation may occur.

The product specifications of each contract and delivery point used are listed and defined in Table 1. Futures prices from the Chicago Mercantile Exchange (CME) and monthly average spot prices (USDA) from each of the regional markets between January, 1987 and August, 1991 are included in the sample. To illustrate temporal price differences, Table 1 includes the mean futures price and the mean basis for both the April and October contracts for all cattle products and locations. In general, these statistics show two primary results: the October futures price is, on average, consistently below the April futures price and, the October mean basis is consistently less than the April mean basis for these California markets.

[3] These regions include the mountains on both sides of the valley. For example, the Sacramento Valley includes cattle sold in the Sierras to the east and the Coastal Range to the west.

TABLE 1-CONTRACT DEFINITIONS AND SUMMARY STATISTICS

Seasonal Contract	April Contract		October Contract	
Contract, Product and Delivery Location	**Mean Futures Price**	**Mean Basis***	**Mean Futures Price**	**Mean Basis***
Cottonwood Slaughter Bulls, Utility	$72.54	$13.16	$69.57	$10.19
Cottonwood Slaughter Cows, Utility	$72.54	$25.05	$69.57	$21.88
Cottonwood Feeder Steers #1, 600-700 lbs.	$79.65	-$3.92	$78.87	-$4.71
Cottonwood Feeder Heifers #1, 500-600 lbs.	$79.65	$1.92	$78.87	$1.14
Stockton Slaughter Steers, 1100-1300 lbs.	$72.54	$0.12	$69.57	-$2.85
Stockton Slaughter Heifers, 100-1200 lbs.	$72.54	$1.87	$69.57	-$1.10
Stockton Feeder Steers #1, 600-700 lbs.	$79.65	-$2.28	$78.87	-$3.06
Stockton Feeder Heifers #1, 500-600 lbs.	$79.65	-$1.47	$78.87	-$2.25
Visalia Slaughter Steers #2 & #3, 1100-1300 lbs.	$72.54	$0.03	$69.57	-$3.00
Visalia Slaughter Heifers #2 & #3, 1000-1200 lbs.	$72.54	$1.57	$69.57	-$1.40
Visalia Feeder Steers #1, 600-700 lbs.	$79.65	$0.27	$78.87	-$0.39
Visalia Feeder Heifers #1, 500-600 lbs.	$79.65	$0.62	$78.87	-$0.12

Sample: Monthly data from January 1987 to August 1991.
*Where basis is defined as the difference between the futures and cash price.

The nearby futures contract price series was used to estimate the long-run (five-year average) price correlations and Variance Ratios (VRs are defined as basis variance divided by cash price variance; see Blank and Thilmany). The price correlations were less than one in the majority of the cases. The estimated Variance Ratios were greater than one in 42 of the 96 cases, (and significantly greater in six cases).

The systematic nature of basis can be measured several ways, based on various theories of basis. The primary criteria of this study was to estimate whether basis has systematic or seasonal patterns that producers can predict. In this analysis, an equation to estimate basis was developed for each location that included lagged values of basis and a time trend, as well as other information available to producers (see Blank and Thilmany).

Statistical estimation of the cattle price data was performed and four tests were used to measure whether a contract exhibited systematic basis. Using the statistical results (see Blank and Thilmany), the hedging potential for various combinations of market attributes was broadly categorized. Exhibit 1 summarizes the likely hedging objective and potential for the twenty-four combinations of product form, hedging season and cash market location.

Applications of Results

The empirical results of this study have useful applications for the California cattle market. There are many similarities in potential hedging objectives across location, time and product form, as demonstrated by the large number of cases where the best potential objective for hedging is utility maximization (see Exhibit 1). Yet, it is interesting to note that there are distinct differences in the potential for various hedging strategies throughout the three

Exhibit 1 - Potential Hedging Objectives Among Space, Time and Product Form Combinations

Contract Combination	Potential Objective	Supporting Evidence
Cottonwood Slaughter Bulls,		
April Contract	Utility Maximization	High VR, systematic basis
October Contract	Limited potential for utility max	High VR, High correlation, systematic basis
Cottonwood Slaughter Cows,		
April Contract	Utility maximization	High VR, systematic basis
October Contract	Utility maximization	High VR, systematic basis
Cottonwood Feeder Steers,		
April Contract	Risk minimization	Low VR, High correlation, non-systematic basis
October Contract	Utility maximization	High VR, systematic basis
Cottonwood Feeder Heifers,		
April Contract	Both objectives possible, but risk minimization may dominate	Low VR, High correlation, systematic basis
October Contract	Utility maximization	High VR, Low correlation, systematic basis
Stockton Slaughter Steers,		
April Contract	Utility maximization, but only limited potential	High VR, Low correlation, non-systematic basis
October Contract	Utility maximization	High VR, Low correlation, systematic basis
Stockton Slaughter Heifers,		
April Contract	Limited potential for hedging	High VR, non-systematic basis
October Contract	Utility maximization	High VR, Low correlation, systematic basis
Stockton Feeder Steers,		
April Contract	Utility maximization	High VR, systematic basis
October Contract	Utility maximization	High VR, Low correlation, systematic basis
Stockton Feeder Heifers,		
April Contract	Utility maximization, but only limited potential	High VR, High correlation, systematic basis
October Contract	Utility maximization	High VR, Low correlation systematic basis
Visalia Slaughter Steers,		
April Contract	Limited potential for hedging	High VR, non-systematic basis
October Contract	Utility maximization	High VR, Low correlation systematic basis
Visalia Slaughter Heifers,		
April Contract	Utility maximization, but only limited potential	High VR, Low correlation non-systematic basis
October Contract	Utility maximization	High VR, Low correlation systematic basis
Visalia Feeder Steers,		
April Contract	Utility maximization	High VR, Low correlation systematic basis
October Contract	Limited potential for hedging	High VR, High correlation
Visalia Feeder Heifers,		
April Contract	Risk minimization, but only limited potential	Low VR, High correlation non-systematic basis
October Contract	Both objectives are possible	Low VR, systematic basis

regional markets included in this study, as well as among product forms and seasons.

Cottonwood

The Cottonwood region illustrates how independent a local market's prices can be from futures prices determined at a distant, centralized market. This independence is realistic since Cotton-wood is the most remote of the three California delivery points and because this local market deviates from the futures contract with respect to product form. In the case of slaughter cattle, Cottonwood trades utility beef from slaughter cows and bulls instead of higher grade beef from steers and heifers. This deviation also may account for the weak relationship between local cash and futures prices.

Among the different product forms (feeder vs. slaughter) and delivery dates (October vs. April) there are few differences in the potential for different hedging objectives by players in the cattle futures market. With the exception of the April contract for Feeder Steers and Feeder Heifers, potential hedging objectives focus on utility maximization. As evident by the high variance ratio and systematic nature of the basis in the majority of contracts, seasonal basis patterns dominate the relationship between cash and futures prices. In this case, hedging would not guarantee a fixed price at the local market, so utility maximization, rather than risk minimization, is the only potential objective.

It is interesting that the two exceptions to the norm in the Cottonwood market occur in the April feeder markets. The market conditions surrounding these two contracts allow for hedgers to effectively minimize their risk. Theoretically, the potential to minimize risk using the April contract for both feeder markets is primarily based on the low variance ratio, which shows that the hedger’s basis is less volatile than the cash market.

In terms of product form, it is possible to retain feeder cattle until they reach slaughter weight, unlike slaughter cattle that will only slightly increase (or possibly decrease) in value if left in the feedlot. The option to process feeder cattle into a different product form (slaughter cattle) makes another cash market available in the future, if local cash prices are not favorable. This is especially true in the case of April contracts as many cattle producers only have resources to feed out during the summer season when grazing land is available.

Cottonwood offers good potential for hedgers in general. The opportunities for utility maximizing hedgers are strong in all but three cases evaluated here. Two of the exceptions are the April Feeder Heifer and Steer contracts which demonstrate good potential for risk averse hedgers. The other anomaly, the October Slaughter Bull contract, is the only case with limited potential for any hedging objective.

<u>Stockton</u>

Stockton is similar to Cottonwood in that the prevailing potential objective for hedgers is utility maximization. However, the Stockton market offers no potential for the producers who use hedging as a risk minimization tool, and offers only limited potential for utility maximization in several specific contracts. The majority of the contracts demonstrate low correlation, as well as high variance ratios between cash and futures prices. These market conditions make it possible for hedgers to maximize profit, but not to effectively minimize risk, meaning that relatively sophisticated hedging strategies are needed.

Further, the April Slaughter cattle contracts and April Feeder Heifer contracts display limited potential for either hedging objective. The most clear case is the April Slaughter Heifer contract where the market conditions make it difficult for a hedger to benefit from using the futures market. The April Feeder Heifer and April Slaughter Steer contracts have limited potential for utility maximization by hedgers for two separate reasons. April Feeder Heifer cash and futures prices have a strong and predictable relationship. However, the basis is more variable than the relatively stable cash price which indicates little potential for profiting from hedging and the chance of increasing the hedger’s risk. The April Slaughter Steer futures and cash prices have a weak and unpredictable relationship which allow for little profit maximizing or risk minimizing potential.

Stockton offers good opportunities for utility maximization in some cases, but there are several markets where limited potential for either objective exist. In sum, hedging in these markets may not be advisable except for the most experienced of traders. Price risk may be better managed using forward contracts, if available.

Visalia

The Visalia markets have the most diversity with respect to the availability and type of objective available to hedgers. There appears to be some similarities among seasonal contracts and product forms. The April Slaughter contracts have potential for profit maximization, whereas April Feeder contracts have potential for risk minimization. The October Slaughter contracts present opportunities for profit maximization, whereas October Feeder Heifers may be effective for both objectives and Feeder Steers have limited opportunities for either objective.

Similar to the Cottonwood market, the April Feeder contracts both offer an effective means for hedgers to minimize risk. The strong, yet unpredictable, relationship between cash and futures prices, as well as the relatively low variability of basis, makes risk minimization possible. The market conditions which may affect the relationship between cash and futures prices are explained above in the Cottonwood section.

Similar to the Stockton case, the Visalia October Slaughter contracts offer hedgers the ability to maximize profits. On the other hand, the April Slaughter contracts and the October Feeder Steer contracts have only limited potential for either objective because of weak, unpredictable relationships between futures and cash prices. The most general case is the October Feeder Heifer contract where both hedging objectives may be viable because local cash price changes are seasonally correlated with changes in the futures market.

In general, Visalia has a diverse set of opportunities for hedgers. Similar to Cottonwood, April Feeder contracts offer risk minimizing hedgers good potential and October Slaughter contracts present hedging possibilities to utility maximizing hedgers. The October Feeder Heifer is unique in that it is the only case which offers good potential to both risk minimizing and utility maximizing hedgers. The remaining cases are not reliable markets for hedgers to participate in as they offer little potential for either objective.

There are also some similarities across hedging seasons. Hedging in October is best for traders pursuing the broader objective, utility maximization, because the chance of hedging failures is lower.

Across locations, Cottonwood has the best potential for successful hedging, while Stockton offers little potential for risk minimization, and Visalia has volatile potential. The totals for the four product forms clearly indicate that feeder markets offer more hedging potential than do markets for slaughter animals. Risk minimization may be pursued successfully in either feeder animal market while California slaughter animal markets offer no apparent potential for risk minimization and significant chances of hedging failure.

Conclusions

The California cattle industry provides a unique opportunity to examine the potential for hedging by producers for whom delivery to the futures market is not practical. Although there is evidence of correlation between futures and local cash market prices, this relationship varies across time, space, and product form. The variable nature of the futures-cash price movements reduces the potential for successful hedging for California cattle producers pursuing price risk minimization. While potential for utility maximization (which requires sophisticated hedging strategies) is widely offered by the markets analyzed, the more restrictive objective of risk minimization can be pursued successfully much less often.

These results may provide insight to the issue of why producers have been reluctant to use the futures market for hedging. If risk minimization is the objective of hedgers who are aware that achieving it is questionable in these markets, then it is reasonable for them to avoid hedging. Ultimately, the results of this study imply that increased hedging activity will occur more rapidly if producers are educated as to how a broader definition of hedging, that involved in utility maximization, can be incorporated into their business decision making.

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FROM:

California Ranchers' Management Guide
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LIVESTOCK HEDGING USING FUTURES OR OPTIONS

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Livestock Futures and Options

Commodity options and futures are two of the tools producers can use to reduce the price risks they face in agricultural markets. Whereas futures markets are familiar to many livestock producers, options require some explanation. This paper will introduce options trading by describing the advantages and disadvantages of this marketing tool compared to those of hedging with futures. First, futures trading is described briefly. Then, options on futures are discussed and their use as a hedging tool is illustrated. Finally, the processes of hedging with futures and options are compared.

Hedging With Futures

Hedging normally refers to holding positions in both cash and futures markets simultaneously. The goal of a hedger is partly to reduce the risk of holding a cash inventory by "locking in" the price to be received or paid. For a livestock producer, hedging usually involves locking in the value of animals to be sold in the cash market some time in the future by selling futures contracts in the present. The hedging process is illustrated later in this paper in an example.

Trading futures contracts is simple with the assistance of a broker. To place a hedge, a livestock producer must only make one telephone call to the broker handling his account. The quantity of cattle, delivery date and location are standardized on each futures contract, thus making trading easy. The producer tells the broker how many pounds of live beef is to be sold and the month in which they are to be delivered and the broker relays that information on to the futures exchanges in the form of a trade order. Live cattle futures contracts, for example, are available with delivery dates in February, April, June, August, October, and December of each year. Each contract covers a standardized quantity of 40,000 pounds and specifies quality requirements. Standardized delivery locations are specified also, however, none of those locations are in California, thus hedgers here must close their futures market positions by making an equal and offsetting trade. For example, if a producer established a hedge by selling a December 1996 live cattle futures contract, he must *buy* a December 1996 live cattle contract to close his futures hedge position. The hedge's net effect would be to add to (or subtract from) the cash market receipts, making the final value of the inventory approximately equal to what it was at the time the hedge was placed, thus reducing the risk of decreases in that inventory value.

What is an Option?

An option is a contract that gives the buyer the right, but not the obligation, to buy or to sell a futures contract at a specific time period. The right to sell at a fixed price is a "put" option and the right to buy at a fixed price is a "call" option. The price at which the underlying futures contract may be bought or sold is the "exercise" or "strike price".

Although most option positions are closed when the buyer makes an offsetting trade, option contracts can be *exercised*. For example, assume that the right to sell one February live-cattle futures contract at 80 cents/lb is available from an option seller for 5 cents/lb. Such an option would be a put option (the right to sell) with an 80-cent *strike price* and a premium of $2,000 (5 cents/lb times 40,000 lbs). A cattleman who purchased such a put option could exercise the right to sell at 80 cents any time up to the expiration date.

Assume February live-cattle futures are 72 cents/lb during December and the rancher exercises the put option. The broker is so instructed and the commodity exchange assigns the rancher one short (sell) position in February live-cattle futures at the strike price. To complete the transaction, the rancher immediately buys back the futures contract at the current market price of 72 cents, making an 8-cent/lb gross profit (3-cent net profit after subtracting the 5-cent price of the option).

On the other hand, if February live-cattle futures rise above 80 cents/lb at marketing time, the rancher will not exercise the option since the market price is higher than the option exercise price. In this situation, the rancher lets the option expire. In either situation, the seller of the option keeps the premium.

Similarly, a cattle buyer could pay $2,000 for a call option—the right to *buy* February live-cattle futures at a price of 80 cents/lb at any time between the purchase and expiration date of the option. The buyer would let the option expire if cash prices stayed below the strike price until February because cattle could be purchased cheaper in the cash market. However, if cattle futures prices are more than 80 cents/lb at the time of the desired purchase, the buyer would exercise the option to purchase cattle futures at 80 cents/lb, thus saving the difference between the available cash price and the lower option price (minus the premium).

Comparing Options and Futures

The two illustrations above point out the major differences between options and futures contracts.

- A *put* option establishes a minimum selling price but does not eliminate the opportunity to receive higher market prices.
- A *call* option establishes a maximum buying price but does not eliminate the opportunity to pay lower market prices.
- A *futures* contract sets a relatively fixed net cash price since futures market gains or losses are approximately offset by cash market losses or gains.

Options, therefore, permit producers to establish desired selling prices without sacrificing their potential to benefit if market prices increase after the put option is purchased. If prices rise, the option is not exercised and the user loses only the premium. If prices fall, the user can exercise the put option and obtain a price higher than what the market is offering. Thus, with a put option, a user eliminates most downside market risk while retaining the opportunity to benefit from higher prices.

With a call option, a user eliminates price risk above the exercise price while retaining the opportunity to buy at lower market prices. Therefore, options provide ranchers and other users with insurance against undesirable price changes while allowing them to benefit from favorable price changes.

The degree to which ranchers and other agribusiness people will use options depends largely upon the cost of the option (the premium). As in any other “insurance policy,” agricultural commodity options offer a possible benefit at a definite cost. If potential users do not feel the value of the possible benefit exceeds the cost, they will not buy the insurance.

Mechanics of Options Trading

Options trading is permitted only at exchanges approved by the Commodity Futures Trading Commission (CFTC). As in the futures market, trading in options is conducted in a pit by open outcry and hand signals. Trading is observed and regulated by the exchanges and the CFTC. All trades are reported to and cleared by a clearing corporation, which makes sure each option contract has a buyer and a seller at the same price and that all margin requirements are met. This process guarantees performance on all contracts.

For options *buyers*, the premium payment is the largest amount that can be lost, regardless of the price movement of the underlying futures contract. Hence, buyers of commodity options do not receive margin calls. The option *seller* (also called the *writer*) must deposit a margin and may receive margin calls because he or she has the potential liability to provide a futures contract to the option buyer should the buyer elect to exercise the option.

This margin procedure assures the buyer that the seller will always have sufficient funds on deposit with the clearing corporation to pay the difference between the option strike price and current market price should the buyer exercise the option. If the option price never increases, the option writer will receive no margin calls and the option will expire worthless. If the option expires “out of the money,” the buyer will lose the premium and the option writer will keep it as payment for providing the buyer with price insurance.

In addition to the premium, option buyers and sellers pay small commissions to their brokers. There is great variability in the level and manner in which commissions are charged: some brokers charge a separate commission for each purchase and sale; they may establish commissions as a fixed rate or a percentage of the price with a minimum fee; some may assess an additional charge when an option is exercised.

American options can be bought and sold on any business day. Therefore, an option holder can always trade out of (offset) an options position before the option expires. Due to this feature, an option buyer does not need to exercise the option in order to realize a profit. The trader can simply liquidate the option position by making an offsetting trade, without having to become involved in trading the underlying futures contract. The ability to trade in and out of options on a daily basis means that users can buy and sell price insurance as they deem it desirable.

The decision to exercise an option lies with the buyer. If, for example, a cattle rancher decides to exercise a put option rather than to offset the position in the options market, the following should happen. For a put, the clearing corporation assigns the buyer a “short” (sell) position in the futures market at the strike price. Simultaneously, the writer of the option is assigned a “long” (buy) position in the futures market using that day’s futures settlement price. At this point, the option contract has been terminated and both parties are free to trade their futures positions as they see fit.

Hedging Examples: Options vs. Futures

The following example illustrates how option pricing strategies work and how their results compare with those of hedging with futures. For ease of exposition, the put option contract is exercised rather than sold at the time of cash market delivery. In practice, most options will be sold rather than exercised, thus yielding larger returns.

Selling Futures Contracts

In December a feedlot operator takes delivery of a lot of feeder cattle to go on feed until April, at which time the total weight of the animals is expected to be 40,000 pounds. The cattleman, expecting the cash price to be 75 cents/lb in April, can sell one April live-cattle futures contract at 75 cents/lb to lock in that cash price.[1]

If futures and cash prices fall to 65 cents/lb between December and April, the futures gain of 10 cents/lb will compensate for the lower cash price received, resulting in a net price received of 75 cents/lb. The same net price would have been received if cash and futures prices had both risen 10 cents/lb over the same period. In this latter case, a futures loss of 10 cents/lb would have reduced the cash price of 85 cents/lb to give the same net price. Subtracting an estimated $50 for commission on the futures contract leaves a total net revenue of $29,950 for the sale of the cattle.

Buying Put Options

Now assume the cattleman buys one April put option with a strike price of 75 cents/lb instead of hedging with futures. Assume that the price of this option is 5 cents/lb for a premium of $2,000. With a 0 (zero) basis, the minimum cash price assured to the cattleman is 75 cents/lb. However, if prices increase, the cattleman can let the option expire and sell at the higher cash market price (85-75=10 cents/lb = $4,000 gross increase, minus the premium and commissions, leaves a net return of $31,950). If prices fall at least 5 cents/lb, the option would be exercised, giving the minimum net return of $27,900, no matter how far prices fall.

As this comparison shows, three factors will influence the relative attractiveness of options over futures: (1) the size of the premium, (2) the probabilities of a price rise or decline, and (3) the magnitude of price changes over time. The minimum return in the example is lower for options than it is for futures by an amount equaling the premium and commission. This will be true generally. Therefore, the desirability of options strategies depends greatly on premium levels.

Also, the net returns from a futures hedge will always be greater than those from options strategies if the price falls during the trading period. This means that the higher the probability of price decline, the more desirable are futures and the less desirable are options. Finally, the buyer will consider the magnitudes of potential price increases and decreases. If over a number of years the magnitude of price increases is substantially larger than the price declines, then option strategies will be more profitable than futures strategies.

Even if the average returns are lower for the option strategy in a particular case, some livestock producers may prefer it because it involves no margin calls, while futures strategies may involve margin calls. The possibility of margin calls requires that hedgers have a credit reserve or an arrangement with a lender for financing margin calls. Some livestock producers may feel that the

[1] This assumes that the cash and futures market prices will come together at the time of the futures contract's maturity — that there is a "basis" (defined as the difference between futures and cash prices) of zero. In most locations, such as California, this is not likely to happen; there is usually some transportation cost between the local market and the nearest delivery point for the futures contract, as reflected in a positive basis.

potential costs involved in meeting margin calls more than offset the larger returns from futures.

One final note: The example assumes that the option contract is held until it is exercised or expires worthless. In fact, the original options position can be offset on any business day until the expiration date, thus recapturing part of the premium cost.

The decision to offset an options position will depend on expectations concerning the price level of the underlying futures contract. The added flexibility of being able to trade options any time means that users may be able to have price protection when they need it without losing the entire premium, hence reducing the cost of the option strategy.

Advantages and Disadvantages: Options vs. Futures

In summary, the basic advantages and disadvantages of options vs. futures are:

Buying Put Options

Advantages:

- Permits establishing a minimum selling price while retaining the opportunity to benefit from higher cash prices.
- Option buyers does not receive margin calls.
- Maximum loss is equivalent to original premium cost.

Disadvantages:

- Option premiums may be relatively expensive.
- In most years, the option will expire worthless.

Selling Call Options

Advantages:

- Cash market returns can be increased by the amount of the premium received.

Disadvantages:

- The call option seller does not have price insurance against falling prices.
- Maximum return is equivalent to the option premium. Losses can be virtually unlimited if prices go up.
- Options sellers receive margin calls if premiums increase after the option is written (sold).

Selling Futures

Advantages:

- Establishes a selling price within a narrow range bounded by basis change.
- Commissions are relatively inexpensive compared to premium for options.

Disadvantages:

- Eliminates the opportunity to participate in higher cash market prices.
- Requires a margin deposit, and margin calls may occur if prices move higher.

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USING OPTIONS TO CONTROL LIVESTOCK FEED COSTS

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Feeding livestock is a risky business. To deal with the various types of risks faced, livestock feeders should make use of all available risk management tools. One valuable tool which can reduce the risk from volatile input prices is hedging with commodity options. This paper describes how feed costs can be controlled by using options to both raise average profits and reduce input price risk.

Feed costs are second only to feeder animal costs in terms of operating expenses incurred by a livestock feeder. Therefore, a feeder should pay close attention to feed prices when making production decisions. For example, the National Cattlemen's Association's Cattle-Fax produced Table 1 to show the impact of corn prices on the break-even purchase price for feeder cattle. According to Cattle-Fax, with cattle on feed for about four months feedlot operators expect to finish three lots of cattle each year. Such a constant feeding operation requires a constant flow of feed grain, regardless of feed prices. Table 1 shows that with corn at $2.50 per bushel and a $74/cwt price expected for finished cattle, feeders can break even paying $82.80/cwt for feeder calves. However, if corn goes to $3/bu before operators contract for that batch of feed, the break-even point moves out to $78.68. In other words, operators that have paid $82.80 for feeder cattle would lose almost $4/cwt if corn prices rose $.50 without being hedged.

Table 1. Break-even Purchase Price

Assumptions

In weight	**750**			**Conversion rate**	**8.5**
Out weight	**1,150**	**Average daily gain**	**3.0**	**Interest rate**	**11.5**

Corn price (dollars per bu.)	**1.50**	**1.75**	**2.00**	**2.25**	**2.50**	**2.75**	**3.00**	**3.25**	**3.50**
Finished price	**Break-even feeder purchase price (750 lbs.)**								
64.00	**76.48**	**74.42**	**72.35**	**70.29**	**68.23**	**66.17**	**64.11**	**62.05**	**59.98**
66.00	**79.39**	**77.33**	**75.27**	**73.21**	**71.14**	**69.08**	**67.02**	**64.96**	**62.90**
68.00	**82.30**	**80.24**	**78.18**	**76.12**	**74.06**	**72.00**	**69.94**	**67.87**	**65.81**
70.00	**85.22**	**83.16**	**81.10**	**79.03**	**76.97**	**74.91**	**72.85**	**70.79**	**68.73**
72.00	**88.13**	**86.07**	**84.01**	**81.95**	**79.89**	**77.82**	**75.76**	**73.70**	**71.64**
74.00	**91.05**	**88.98**	**86.92**	**84.86**	**82.80**	**80.74**	**78.68**	**76.62**	**74.55**
76.00	**93.96**	**91.90**	**89.84**	**87.78**	**85.71**	**83.65**	**81.59**	**79.53**	**77.47**
78.00	**96.87**	**94.81**	**92.75**	**90.69**	**88.63**	**86.57**	**84.50**	**82.44**	**80.38**
80.00	**99.79**	**97.78**	**95.66**	**93.60**	**91.54**	**89.48**	**87.42**	**85.36**	**83.30**
82.00	**102.70**	**100.64**	**98.58**	**96.52**	**94.46**	**92.39**	**90.33**	**88.27**	**86.21**

Source: Cattle-Fax

Producers can “lock in” their feed price using either forward or futures contracts, but that may not be the most profitable course of action. Hedging with options enables cattlemen to lock in feed costs to protect against market price increases, but with flexibility which may allow feeders to pay lower prices if the market price decreases. An example of the weaknesses of forward and futures pricing is presented below, followed by an illustration of how options hedging avoids these weaknesses.

Forward and Futures Contract Inflexibility

Hedging using either forward cash or futures contracts locks in a feed price, but gives the hedger no flexibility to take advantage of lower market prices which might be available at a later date. Consider the case of a cattleman who thinks that the current price of corn, trading at $2.50/bu, could go up to $3/bu by the time he needs to lay in additional supplies.

He could lock in the $2.50 market price using a forward cash contract. This guarantees his feed cost, no matter what feed prices do in the future. However, if prices fell after the forward contract was signed the cattleman would still be obligated to pay the contract price of $2.50.

If the cattleman used a futures hedge he would lock in the current $2.50 price, plus or minus any change in basis.[1] The hedge would be placed by buying a corn futures contract with a delivery date on or after the date he actually intended to take delivery of cash grain. If he was right and both cash and futures prices go to $3 before the hedge is liquidated, he would have a $.50/bu profit on his futures position to compensate for the higher cash price which is paid; the net price paid is still the $2.50 his hedge locked in ($3 - .50 = $2.50). He would capture the futures profit by liquidating the futures position by making an equal and opposite transaction in the futures market. In this case it would be to sell a futures contract identical to the one he purchased when placing the hedge. The hedge would be closed on about the same day the cash feed price is set. If the cattleman was wrong and prices fell after the hedge was placed the net price does not change (assuming no basis change). If cash and futures prices fell to $2/bu the hedger would be able to buy cash corn for $2, but he would have a $.50/bu loss on his futures position which raises the total cost of the hedged corn to the price locked in: $2.50 (= $2 + .50). In this situation, the inflexibility of the futures hedge and forward contract led to a higher net price than would have been paid by the cattleman if he had hedged using options.

Options Hedging

If the same cattleman had placed a hedge using options, he would have benefitted from any price decreases which occurred while the hedge was in place, yet he would have received the same protection against price increases as that provided by futures hedging. The simplest option strategy would be to buy a call option on corn prices. A “call option” gives the option buyer the right, but not the obligation, to buy the commodity at a specified *exercise price* any time before the option expires. An example of hedging with calls follows.

If the cattleman believes that the current corn market price of $2.50/bu could rise, he could hedge by buying a call option with an exercise price of $2.50. For that option the hedger will have to pay a *premium* of, say $.10 in

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[1] “Basis” is simply the difference between futures and local cash prices for the same product. Even though the two prices will move in the same direction over time, they will not always move in the same amounts, thus basis will change.

this case.[2] If market prices never change during the time period in which the option can be exercised the hedger would not "exercise his option", thus it would expire worthless just like other insurance policies. However, if corn price increase during the option's life, the hedger would exercise the call. For example, if market prices rise to $3/bu the hedger would profit by $.50. Exercising the call in this case enables the hedger to purchase a corn futures contract at the exercise price of $2.50/bu, and he could instantly sell it in the futures market at the going market price of $3, netting the difference as a profit to compensate for the rise in cash corn prices paid. The net price paid for corn would be $2.60: $3 (from the cash market) minus the $.50 options profit, plus the $.10 premium paid to get the option, or the $2.50 he intended to lock in with the hedge plus the option premium paid.

If corn prices fell during the life of an option, the flexibility of options hedging becomes clear. Options give the buyer the right, but not the obligation, to make a transaction at the exercise price. For a cattleman using calls to hedge against feed price increases, no options would be exercised in a falling price market. If corn prices fell to $2/bu, for example, the hedger would pay $2 for cash corn plus the premium, $.10 in this case. Thus, the cattleman would pay $.40/bu less for his feed if he hedged using options rather than forward cash or futures contracts in this falling price market. To gain this potential benefit, the hedger did have to pay an extra cost, the option's premium. However, in volatile markets, such as this example, the cost proved to be a good investment.

[2] The "premium" is the amount paid by an option buyer to get the option. This amount is determined by market and can go up or down over the short run. As the option approaches its expiration date, the premium will decrease because part of its value is determined by the amount of "time" before it expires; the more "time" before an option expires, the more "time value" it has in its premium. At the date an option expires it obviously has no "time" left, so its time value decreases to zero. At that point, an option's premium will equal its "intrinsic value", which is the value of the option if it were exercised at that point in time. A call option will have intrinsic value only if the current market price is above the option's exercise price. If an option has no intrinsic value, it will be worthless at the time it expires. If it does have some intrinsic value, the option buyer will exercise the option to capture the intrinsic value at that time.

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BEEF COW SHARE LEASE ARRANGEMENTS

James Oltjen,[1] Daniel Drake [2] and Mark Nelson[3]

Leasing arrangements between ranch operators and cattle owners are being used more in livestock production today than ever before. Leasing has long been used to acquire control of land, but now it is being used with livestock. It is used for a number of reasons—it allows one with little capital to lease cows and, perhaps, land as well; it allows for intergenerational transfers of the cow herd. Cow leasing is not new, but there is relatively less historical precedent compared to other agricultural leases. What is fair is still a common question.

This publication discusses the practice of leasing a cow herd. The owner of the cow herd is referred to as the owner and the party who leases the cow herd is referred to as the operator.

Purpose of Leasing Arrangements

Ranching requires control of large amounts of capital if the operator is to have adequate net income for a comfortable living. It is difficult, if not impossible, for ranch operators to acquire adequate capital without borrowing.

Leasing livestock is a form of acquiring control of additional capital. However, rather than borrowing this capital from a bank or lending institution, the operator borrows from another individual or firm. The operator acquires the use of a cow herd and shares the costs and returns of the cow herd operation with the owner. Borrowing may still be required for short term operating expenses.

Advantages of Leasing Arrangements

1. Allows the operator to acquire the use of resources without making a direct monetary investment in the assets.

2. Allows the risk and profit associated with livestock production to be shared.

3. Can provide a more efficient use of resources (land, labor and capital).

4. Can allow the owner to spread the sale of a cow herd, and avoid potentially large capital gains.

5. Can allow the owner to convert taxable income from “self-employment earnings” to “non-participation income.”

Disadvantages of Leasing Arrangements

1. Both owner and operator give up some individual control and income earning potential.

2. Takes more time, effort and records.

3. Could be difficult to prove that the owner is not materially participating.

“Cow Herd” Versus “Cow” Leases

The first step in developing a lease between two individuals is to decide whether the lease is for a cow or a cow herd. For the purposes of this paper, let's define a "cow" lease as one where no one furnishes replacements. The lease, then is viewed as a single cow lease, when the cow is culled, the owner receives the income. When the entire herd is sold, the lease is over. This type of lease works well for producers who wish to get out of business, yet spread the sale of the cow herd over a period of years. It also provides for ownership transfer between generations.

A "cow herd" lease is viewed as an on-going business arrangement whereby the owner is responsible for providing replacements. The replacements may be purchased from outside the lease arrangement, or can be raised within the leased cow herd by the operator but subtracted from the owners "share." In either case, the owner would receive all cull income.

What Is a Fair Leasing Agreement?

In developing a lease, owners and operators want an arrangement that is fair to both parties. As a rule, leasing arrangements are considered fair if the parties involved each receive approximately the same percent of income as the percent of costs they contribute. Bargaining may have an important influence on the value placed on contributions.

Forms can be used to determine the basic contributions of both owner and operator. These are especially helpful when working out a leasing arrangement for the first time. In such cases there may be no past record of expenses involved in production.

It is best if an owner and operator can work together in determining their respective contributions. They might work independently at first; then they will be better prepared to resolve any differences.

Costs To Be Considered

There are two types of costs to consider when determining the amount that each party contributes towards an operation. These are fixed and variable costs.

Fixed costs are incurred due to owning property, and are often referred to as ownership costs. Usually these costs are called the DIRTI five - depreciation, interest, repairs, taxes, and insurance. It is assumed that these costs are incurred regardless of operating levels and returns.

Variable costs are incurred in day-to-day operations. In a livestock operation, variable costs include feed, labor, veterinary, drugs, trucking, and marketing, as well as miscellaneous costs. These costs are sometimes called operating costs.

In most leasing agreements, the owner is responsible for fixed costs of the livestock and perhaps for some variable costs. The operator is generally responsible for most of the variable costs, and may also furnish some fixed costs. In a cash lease, the operator may pay the owner cash rent equal to the owner's fixed costs.

Other Factors To Consider

Other factors besides fixed and variable costs also need to be considered when preparing a livestock leasing agreement. In the case of a cow herd, some other factors include:

1. Who provides/pays the breeding bill?

2. Contingencies (e.g. drought, death loss): how will they be handled?

3. Who makes which management decisions (e.g. culling, sale time)?

4. The lease itself: length, renewability, termination?

5. How is income divided?

6. How will price be set if one party purchases the other's share?

Determining Sharing Arrangements

Three things need to be determined for an equitable leasing arrangement. These need to be done by the operator and owner working together:

1. Determine the costs to be considered.

2. Determine the contributions of each party.

3. Determine the percent of costs contributed by each party.

When these three factors are determined, the operator and owner should share in income in the same proportion as they contribute to the operation.

Evaluate the leasing agreement occasionally to assure an equitable arrangement over time. Fluctuating prices and management changes can cause the proportion of the contributions to shift over time.

Costs for a Cow Herd

A worksheet (Table 1) can be used to estimate the various costs involved in the operation of a cow herd. The amount each party contributes can be credited to the party making the contribution. A short explanation of each cost item may help in arriving at an equitable figure.

When historical costs are well documented, proposed new contributions by each party may be set based on historical costs. In such cases, validation of the proportions with current records is important.

Consider these estimates (Example 1) valid only under the costs, production level, and prices specified. Individuals or groups using the information provided should substitute costs, production levels, and prices valid for the locality, management level to be adopted, and marketing circumstances for the location and time period involved.

Variable Expenses

<u>Feed</u>

1. Pasture is a feed cost. If the pasture is owned by the party providing it, the pasture cost could be a reasonable rate of return (2 to 6 percent) based on its value, or it could be the amount for which it could be rented to someone else. If the pasture is rented by the party providing it, then his contribution is the actual cash rent.

2. Supplemental pasture in the form of crop or pasture residue or other grazing is a contribution towards feed costs and credit should be given to the party who provides this feed.

3 & 4. Hays are considered as feed costs and should be valued at market prices.

5. If grain is used in the operation, value at market price.

6. Protein, mineral, and vitamins are valued at market price. These items should be furnished by the same party

who provides hay and forage so there will be no conflict concerning rations.

Other Expenses

7 - 11. Other expenses should include the costs of the cow herd. For example, the cost of operating capital for the operator may be a significant expense. Sources of information include tax returns and detailed financial analysis (e.g. SPA, FINPACK).

12. Labor is a contribution of the party who provides it. If labor is hired, its cost is the actual cost to the party who pays for it. If labor is furnished by one or both parties, then labor should be valued at the current cost of labor as though it had to be hired. Labor required per cow per year will vary with the size of the herd. For herds of less than 30 cows, 10 to 15 hours per cow per year may be required. Large herds will require 5 to 6 hours per cow per year. Use actual costs, if available.

13. Management of a cow herd should be the responsibility of both parties. The owner of the cow should decide which cows to cull and the operator should be responsible for the day-to-day decisions involved in managing the cow herd to produce optimum returns. Placing a dollar figure on the value of good management is difficult, but no other factor is more critical when determining overall cow herd profit. Helpful guides include 5 to 8 percent of gross income or 1 to 2 percent of total capital managed.

Fixed Expenses

Cows and Bulls

14. Interest on cows as an investment contribution of the owner. The interest rate used should be the approximate interest rate that could be earned if money were invested in other alternatives. If interest rates are 5 percent and the average value of a cow is $600, then the annual contribution of the owner is 5 percent of $600 for 12 months or $30. Cow value for one-year leases is her market value minus capital gains taxes; for longer term leases it is balance sheet value (a conservative base value or cost less depreciation).

15. Depreciation on cows is a contribution of the owner because he is responsible for providing replacements. It is the difference between the value of the cow when she is placed in the herd and her salvage value when she is removed from the herd. To arrive at annual depreciation, divide this figure by the number of years the cow is expected to remain in the herd. If a cow going into the herd is valued at $600 and you expect her to be worth $350 when she is removed from the herd in 7 years, then annual depreciation is $600 minus $350 divided by 7 or $35.71 per cow. Depreciation is also a contribution of the owner in the typical “cow” lease arrangement, because the cow is usually worth more at the beginning of the lease than she will be when culled.

16. Insurance on livestock will usually be about .1 to .25 percent of the value of the breeding herd. Bull value is estimated by dividing its cost by the number of cows serviced, e.g. $2,500 ÷ 25 cows/bull = $100.

17. Death loss of cows should be considered a contribution of the owner. Death loss is usually computed at 1 to 2 percent of the value of the breeding herd. There should be contingencies written in the lease for cases where actual death losses are greater than the percent used in the lease worksheet.

18 & 19. Annual interest and depreciation on bulls are determined the same as for cows (items 14 & 15) except bull value is estimated by dividing bull cost by the number of cows serviced. This determines the amount to charge against each cow.

<u>Buildings and Equipment</u>

20 & 21. Interest and depreciation on buildings and equipment used in the operation is a contribution of the party who owns the buildings and equipment. Again, figure the interest on the value of the buildings and equipment according to an interest rate that approximates investment returns. Depreciation is the decrease in the value of the property in a year's time.

22. Taxes and insurance on buildings and equipment is the cost for taxes and insurance incurred against property used for livestock during the year. This will amount to 1 to 1.5 percent of the current value of buildings and .5 to 1 percent of the current value of livestock equipment.

Determining Contribution of Each Party

After it has been determined which costs each party contributes, list these amounts in the appropriate column on the worksheet. The totals of the owner and operator columns will show the total contribution of costs for each party.

These totals might make both parties concerned as to the profitability of the cow herd operation. This is the risk that each party assumes. If returns per cow exceed the value of all contributions, then each party will get full value of all contributions. If contributions are greater than the returns, then each party will not receive full value of his contributions. However, this does not mean that each party does not benefit from the operation. There are benefits such as capital gain advantages, way of life, and pride of ownership realized by the owner. There may also be advantages in the use of otherwise unsalable feed and in the use of off-season labor for the operator.

Determining Percent Contributed by Each Party

As illustrated in Example 1, a simple way to calculate the percent contributed by each party is to separate the total contributions into the amount contributed by each party and then divide by the total contribution.

In Example 1, the owner receives 22.07% of the calf crop and all of the cull income from sale of cows (7 year life, 100 cows ÷ 7 years = 14.29 cows/ year) and bulls (6 year life, 100 cows ÷

25 cows/bull = 4 bulls, 4 bulls ÷ 6 years = .6667 bulls/year). If 100 cows had been exposed to a bull and a 85% calf crop was weaned, the owner would receive:

85 calves (550 lb. @ $.90/lb.) x .2207	**9,285**
14.29 cull cows (@ $350)	**5,000**
.6667 cull bulls (@700)	**467**
	$14,752

In addition it is important to note, the owner would be responsible for replacing the 14.29 culled cows, the 1 dead cow (100 cows @ 1% death loss), the .6667 culled bulls, and the .04 dead bulls (4 bulls @ 1% death loss).

The operator would receive 77.93% of the calf crop:

85 calves (550 lb. @ $.90/lb.) x .7793	**$32,790**

Profit or Loss?

In this example, the operator's costs are $31,930 ($319.30 x 100 cows), resulting in a profit of $860 ($32,790 - $31,930).

The owner's calculated costs from Example 1 are $9,041 ($90.41 x 100 cows), but his total estimated expenses include replacing the cull animals since he is providing the cow herd. These expenses are $14,508 which include replacing the salvage value of what was sold ($5,467). His out of pocket expenses are:

15.29 replacement cows @ $600	**9,171**
.7067 bulls @ $2,500	**1,767**
Total other costs of $35.70 X 100 cows	**3,570**
	$14,508

The $35.70 per cow cost is $30 interest on cows + $5 interest on bulls + $.70 insurance. The owner's net result is a profit of $244 ($14,752 - $14,508). Another way to consider or check profit is to exclude cull and death income and expenses. Then the owner would have an income of $9,285 and expense of $9,041 for a net gain of $244.

Thus, each party receives the same proportion of net returns as they contribute in costs. Total returns are $42,075 (85 calves x 550 lb @ $.90/lb); total costs are $40,971 ($409.71/cow x 100 cows). Total net returns are thus $1,104 ($42,075 - $40,971). The operator nets $860, or 77.93% of $1,104; the owner nets $244, or 22.07% of $1,104.

Accounting Procedures for Raising Replacements Within the Cow Herd

When the owner is furnishing replacements to replenish the cow herd, and they are selected and raised from the calf crop, the value and cost to raise these replacements must be subtracted from the owner's share. In Example 1, the owner's share of income could be amended to include the value of the replacements:

Income	
85 calves (550 lb. @ $.90/lb.) x .2207	**9,285**
14.29 cull cows (@ $350)	**5,000**
.6667 cull bulls (@700)	**467**
	$14,752
Costs	
15.29 replacement heifers (550 lb. @ $.90/lb.)	**7,566**
Growing phase cost estimate, pay to operator	**2,136**
.7067 bulls @ $2,500	**1,767**
Total other costs of $35.70 X 100 cows	**3,570**
	$15,039
Amended Income	**(-$287)**

The costs to grow the replacement heifers from weaning age to 15 months for breeding is estimated by using a monthly charge (based on the annual cost per cow adjusted to 3/4 of an animal unit) times the number of months from weaning to breeding age (3/4 X 15.29 females X $319.30 annual cost / 12 months X 7 months). In the example, heifers are weaned at 8 months of age and grown for 7 months before reaching breeding age at 15 months. Specific growing period costs should be used when available.

If additional replacements are saved for later culling, their costs and cull income would be assigned to the owner.

In the above example, from a strictly out-of-pocket cash basis, raising replacements is clearly less profitable compared to purchase of breeding age females. The additional cost is $1,136 ($7,566 + $2,741 - $9,171). However, long-term genetic gains, improved animal health, and pride of ownership are possible offsetting benefits, which may also improve income from future calf and cull sales.

In the event the owner purchases replacements of under-breeding age, growing costs from purchase until attainment of breeding age should be assigned as in the example above.

Conclusions

The methods described in this publication are not the only ones available, but these are accepted as fair for the assumptions stated. Other lease options available include cash leases, fixed percent of calf crop, and lease with the option to buy. In all cases, records are important to both establish a lease, as well as to evaluate it through time. Current estimates and projections are needed to adjust the lease as described above, and historical analyses allow one to factor risk and temper any changes. Communication and negotiation between the two parties is important for keeping this form of lease equitable.

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Example 1. Beef "Cow" Lease or "Cow Herd" Lease with replacements purchased outside the arrangement ($/cow).

	Total Contribution	Owner's Share	Operator's Share
Variable Expenses			
FEED:	$ / cow		
1. Pasture	82		82
2. Crop residue pasture	16		16
3. Hay: ________	90		90
4. Hay: ________			
5. Grain			
6. Protein, minerals and vitamins	5		5
OTHER EXPENSES:	$ / cow		
7. Veterinary and drugs	7		7
8. Fuel, oil and utilities	11		11
9. Repairs and supplies	9		9
10. Marketing and trucking	6		6
11. Miscellaneous: operating capital	4		4
12. Labor 7 hrs @ $6.00 /hour	42		42
13. Management 475.42 gross income/cow @ 5 %	23.77		23.77
Fixed Expenses			
COWS AND BULLS:	$ / cow		
14. Interest on cows 600 @ 5 %	30	30	
15. Depreciation on cows (600 - 350) / 7 years	35.71	35.71	
16. Insurance on herd (600 + 100) @ .1 %	.70	.70	
17. Death loss (600 + 100) @ 1 %	7	7	
18. Interest on bulls 100 @ 5 %	5	5	
19. Depreciation on bulls (2,500 - 700)/ 6 years/ 25 cows	12	12	
BUILDINGS AND EQUIPMENT:			
20. Interest on buildings and equipment - value 230 /cow @ 5 %	11.5		11.5
21. Depreciation on bldgs. and equip. ($/cow)	10		10
22. Taxes & insurance, bldgs. and equip. 120 @ 1.25 % + 70 @ 0.75 %	2.03		2.03
TOTAL CONTRIBUTIONS (sum of lines 1-22)	409.71	90.41	319.30
PERCENT OF TOTAL CONTRIBUTIONS		22.07 %	78.93 %

Table 1. Fill in values in the worksheet to evaluate possible arrangements ($/cow).

	Total Contribution	Owner's Share	Operator's Share
<u>**Variable Expenses**</u>			
FEED:	$ / cow		
1. Pasture	______	______	______
2. Crop residue pasture	______	______	______
3. Hay: ______________	______	______	______
4. Hay: ______________	______	______	______
5. Grain	______	______	______
6. Protein, minerals and vitamins	______	______	______
OTHER EXPENSES:	$ / cow		
7. Veterinary and drugs	______	______	______
8. Fuel, oil and utilities	______	______	______
9. Repairs and supplies	______	______	______
10. Marketing and trucking	______	______	______
11. Miscellaneous: <u>operating capital</u>	______	______	______
12. Labor _____ hrs @ $______ /hour	______	______	______
13. Management _______ gross income/cow @ ____ %	______	______	______
<u>**Fixed Expenses**</u>			
COWS AND BULLS:	$ / cow		
14. Interest on cows _____ @ ____ %	______	______	______
15. Depreciation on cows (_____ - _____) / _____ years	______	______	______
16. Insurance on herd (_____ + _____) @ ____ %	______	______	______
17. Death loss (_____ + _____) @ ____ %	______	______	______
18. Interest on bulls _____ @ ____ %	______	______	______
19. Depreciation on bulls (_____ - ____)/____ years/ ____ cows	______	______	______
BUILDINGS AND EQUIPMENT:			
20. Interest on buildings and equipment - value _______ /cow @ ______%	______	______	______
21. Depreciation on bldgs. and equip. ($/cow)	______	______	______
22. Taxes & insurance, bldgs. and equip. ______ @ ____ % + ______ @ ______%	______	______	______
TOTAL CONTRIBUTIONS (sum of lines 1-22)	______	______	______
PERCENT OF TOTAL CONTRIBUTIONS		______ %	______ %

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Steven Blank and James Oltjen, Editors.
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VALUE OF PREGNANCY TESTING

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An earlier article in this Ranchers' Guide investigated optimal culling decisions for range cows given cow age, pregnancy status, and market prices (i.e., Optimal Economic Range Cow Culling Decisions: Biological and Market Factors Combined by Tronstad and Gum). The analysis found conditions where it was optimal to keep a sound cow even if the cow was open. This result indicates that pregnancy testing doesn't always have economic merit. The economic value of pregnancy testing is quantified in this article for different biological and market conditions.

Biological, market, and cost information on which these pregnancy test and culling alternatives are evaluated include: cow age, recent history of calf fertility, replacement cost of bred heifers, calf prices, cull cow values, and the cost differential (feed and/or performance cost) between spring and fall calving. Biological productivity estimates were taken from a prior article in this Guide entitled, "Range Cow Culling: Herd Performance." Market price relationships estimated in the prior article of "Market Impacts on Culling Decisions" were updated to reflect more recent prices and to categorize prices in narrower intervals. The cost differential between spring and fall calving is considered since the analysis has allowed for spring and fall calving. Biannual calving was found to be an important factor for culling decisions since a cow has the potential to be productive six months earlier than under a strict annual calving system.

Management Alternatives

Range cow culling and replacement decisions are driven by future cow productivity, feed costs, and the market value of replacements, calves, and slaughter cows. As the spread between market prices changes through time the value of pregnancy testing and optimal culling decisions also change. To simultaneously evaluate the dynamics of physical productivity, market prices, and production costs a computer model is used to evaluate the culling decision. The model incorporates statistical price relationships while evaluating the long-term economic implications of decision alternatives. Decision alternatives evaluated are:

1. Whether to keep or cull a cow without a pregnancy test? Economics may conclude that older cows should be replaced or younger cows should be kept, irrespective of pregnancy status. If young cows are open, should they be bred immediately or at a later period?

2. If pregnancy testing has economic justification, what should be done with cows that are open? Should they be culled and replaced with a bred heifer now or at a later time in the future? Do market factors justify maintaining, expanding, or contracting herd size?

Table 1. Fertility Rates for Cows with Sale Calf at Side.

Cow Age	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5
					%						
Pregnant	86.20	85.73	85.13	84.41	83.57	82.61	81.54	80.34	79.02	77.59	76.03
Open	13.80	14.27	14.87	15.59	16.43	17.39	18.46	19.66	20.98	22.41	23.97

Table 2. Fertility Rates for Cows with No Calf at Side.

Cow Age	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5
					%						
Pregnant	74.03	74.03	74.03	74.03	74.03	74.03	74.03	74.03	74.03	74.03	74.03
Open	25.97	25.97	25.97	25.97	25.97	25.97	25.97	25.97	25.97	25.97	25.97

Comparing Alternatives

In order to assess the value of pregnancy testing, the economic returns from making decisions with pregnancy test information is compared to returns generated without pregnancy test information. Without pregnancy test information, the likelihood that a cow is open or pregnant is made solely on the basis of cow age and recent calving history. These estimates were made from data collected on the San Carlos Apache Experimental Research Registered Herd, located at Arsenic Tubs, AZ. The odds that a cow was pregnant or open with a sale calf at side were found to be influenced by cow age (see Table 1). If a cow had no calf at her side because she was previously open or lost her calf, cow age was not found to be a factor that influenced whether the cow would be open or pregnant (see Table 2).

In calculating the value of pregnancy testing, the economic value associated with applying the same culling decision to all cows of a given age and calf status was first obtained. Say the decision under consideration is to keep and allow for immediate breeding of all cows 7.5 years of age that have a sale calf at their side. Given the information in Tables 1 and 2, 83.57% are expected to be pregnant and 16.43% open. The economic value of making a keep decision is made by multiplying the value of keeping a pregnant cow by 83.57% and adding the value of keeping an open cow by 16.43%. Four non-pregnancy test alternatives for a given cow age and calf status are compared: (a) keep all and allow for immediate breeding, (b) replacing all with a bred heifer, (c) keep all cows but don't allow for breeding any open cows until 6 months from now, and (d) cull all cows and don't replace with a bred heifer this period. The highest value from the four non-pregnancy testing alternatives is the best decision one can make without any information regarding pregnancy status. This value is compared to the best decision possible with pregnancy testing. Two economically viable options under pregnancy testing are; (a) keep all pregnant cows and replace open cows with a bred heifer, or (b) keep all pregnant cows and cull the open cows without replacing them with a bred heifer. The optimal decision is the highest value attained from evaluating all options. The model assumes a cost of $2 per head for pregnancy testing.

Table 3. Long-term Probability Price Levels Estimated for May.

Replacement	Calf Prices ($/cwt.)						
Prices ($/head)	< 64	64-72	72-80	80-88	88-96	96-104	> 104
< 465	0.0507	0.0345	0.0248	0.0138	0.0065	0.0025	0.0008
465 - 555	0.0234	0.0324	0.0358	0.0267	0.0158	0.0076	0.0035
555 - 645	0.0148	0.0276	0.0406	0.0403	0.0300	0.0176	0.0109
645 - 735	0.0070	0.0168	0.0313	0.0400	0.0383	0.0283	0.0234
735 - 825	0.0024	0.0074	0.0172	0.0277	0.0338	0.0319	0.0370
825 - 915	0.0006	0.0023	0.0066	0.0132	0.0201	0.0243	0.0428
> 915	0.0001	0.0005	0.0019	0.0050	0.0096	0.0151	0.0547

Table 4. Long-term Probability Price Levels Estimated for November.

Replacement	Calf Prices ($/cwt.)						
Prices ($/head)	< 64	64-72	72-80	80-88	88-96	96-104	> 104
< 465	0.0863	0.0227	0.0139	0.0069	0.0026	0.0007	0.0001
465 - 555	0.0592	0.0325	0.0259	0.0164	0.0080	0.0027	0.0007
555 - 645	0.0451	0.0381	0.0389	0.0307	0.0186	0.0079	0.0026
645 - 735	0.0250	0.0298	0.0390	0.0392	0.0298	0.0159	0.0066
735 - 825	0.0103	0.0164	0.0270	0.0348	0.0340	0.0228	0.0124
825 - 915	0.0030	0.0063	0.0127	0.0206	0.0266	0.0235	0.0171
> 915	0.0006	0.0018	0.0047	0.0096	0.0164	0.0219	0.0318

The value of pregnancy testing is determined by subtracting the best uniform culling decision from the highest of the two pregnancy test alternatives. The value of pregnancy testing varies depending on market prices, cow age, calving season (spring or fall), the cost differential between spring and fall calving, and recent cow fertility. Whether a cow has a sale calf at her side or no calf at side is the information used for recent cow fertility. Cows that were sound with a newborn calf at side were automatically kept in the herd and thus not pregnancy tested.

Market Prices

Market prices for replacements (2.5 year old bred heifers), calves, and slaughter values are considered in the analysis. Table 3 gives long-term price probabilities of replacement and calf prices for May based on biannual prices from 1971 through 1991. These probabilities are for a range of prices rather than for an exact price. For example, historical prices indicate that for any year in May the odds that calf prices are between $80 to $88 per cwt. while replacement prices are between $555 to $645 per head is 4.03 percent. However, as shown in Table 4 for the month of November, the odds of this price combination are lower at 3.07%. Historical prices show sale calves to be lower for November than in May. On average, $6.66/cwt. lower in the fall than spring using long-term price probabilities.

Prices have been observed to follow predictable patterns from one period to the next for shorter time intervals. These patterns are highly dependent on the level of current

Table 5. Six Month Transition Probabilities Given November Calf Price<$64 per cwt. and Replacement Price Between $555-$645 per Head.

Replacement Prices in May ($/head)	May Calf Prices ($/cwt.) < 64	64-72	72-80	80-88	88-96	96-104	> 104
< 465	0.1272	0.0221	0.0053	0.0006	0.0000	0.0000	0.0000
465 - 555	0.1120	0.0615	0.0266	0.0054	0.0005	0.0000	0.0000
555 - 645	0.0776	0.0887	0.0651	0.0227	0.0037	0.0003	0.0000
645 - 735	0.0264	0.0580	0.0721	0.0426	0.0119	0.0016	0.0001
735 - 825	0.0042	0.0171	0.0362	0.0363	0.0172	0.0039	0.0004
825 - 915	0.0003	0.0023	0.0082	0.0140	0.0113	0.0043	0.0008
> 915	0.0000	0.0001	0.0009	0.0026	0.0038	0.0027	0.0012

prices. Table 5 illustrates how price levels in November influence where prices will be in the following May. Given a November calf price less than $64 per cwt. and replacement costs between $555 - $645 per head, the odds of going to the price category described above (calf prices of $80 to $88 per cwt. and replacement prices between $555 to $645) is only 2.27 percent rather than the long-term odds of 4.03 percent. The odds are lower because current calf prices are low. The value of pregnancy testing is based most heavily on current price levels since the impact of distant prices is reduced by a discount rate. Future returns are discounted at a real discount rate of 6 percent. Because current prices play the biggest role in determining the value of pregnancy testing, the value of pregnancy testing and optimal culling decisions are not very sensitive up to a 4 point increase or decrease in the discount rate.

Costs of Production

Costs directly influence the bottom line of profitability and the differential in feed costs for a replacement versus an older cow impacts the culling decision. Added feed costs of a first calving replacement heifer need to be evaluated against the performance of an older cow with lower feed costs. The model uses a feed cost of $100 per head every six months except for replacements during their first year. An additional feed cost of $25 per head every six months was added for replacements in the period that they gave birth and the following nursing period.

Costs of production are allowed to vary for spring versus fall calving. In general, spring calving is the norm since most areas can better match their forage availability with nutritional demands associated with a spring calving season. Lower calf prices in the fall than spring reflect this seasonal phenomena. In total, 11 different cost differentials of $0.0, $10, $20, $30, $40, $55, $75, $100, $130, $165, and $205 were evaluated. A cost differential of $30 implies that it costs $30 more to calve a cow in the fall than the spring. The highest cost differential implies a spring only calving system. The cost differential can be associated with more feed requirements, more labor, lower fertility, and/or lower calf weights.

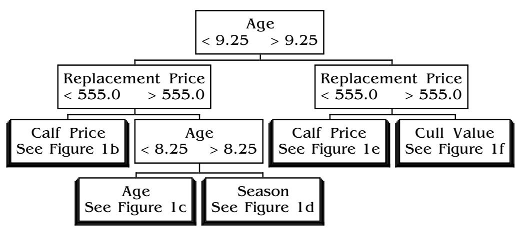
Culling Decisions and Value of Pregnancy Testing

The number of possible price combinations (49, 7•7), age (20), calf or no calf at side (2), spring or fall (2), and cost differentials (11) considered for evaluating culling decisions number 43,120 possibilities. Because this number is unduly large, these decisions have been categorized into a decision tree framework. Figures 1a through 1f describe the 43,120 different possibilities into 110 categories or terminal nodes. The six possible culling decisions are defined as: 1) K - keep and breed immediately, 2) R - replace with a bred heifer, 3) K6 - keep and breed in 6 months, 4) RN - cull and don't replace, 5) PR - pregnancy test cows, keep pregnant cows and replace open cows with a bred heifer, and 6) PN - pregnancy test cows, keep pregnant cows and don't replace open cows that are culled at this time.

Condensing 43,120 decisions into 110 general categories comes with a cost since most of the nodes are not classed 100% correctly. In technical terms they have some "node impurity." In order to assess how much node impurity exists, average one period cost of mistake

Figure 1. Culling Rule Recommendations of Decision Tree by Terminal Nodes.

Figure 1a.



Legend

K - Keep and breed immediately
R - Replace with a bred heifer
K6 - Keep and breed in 6 months
RN - Cull and don't replace
PR - Pregnancy test cows replace open cows with a bred heifer
PN - Pregnancy test cows, don't replace open cows that are culled.

Figure 1b.

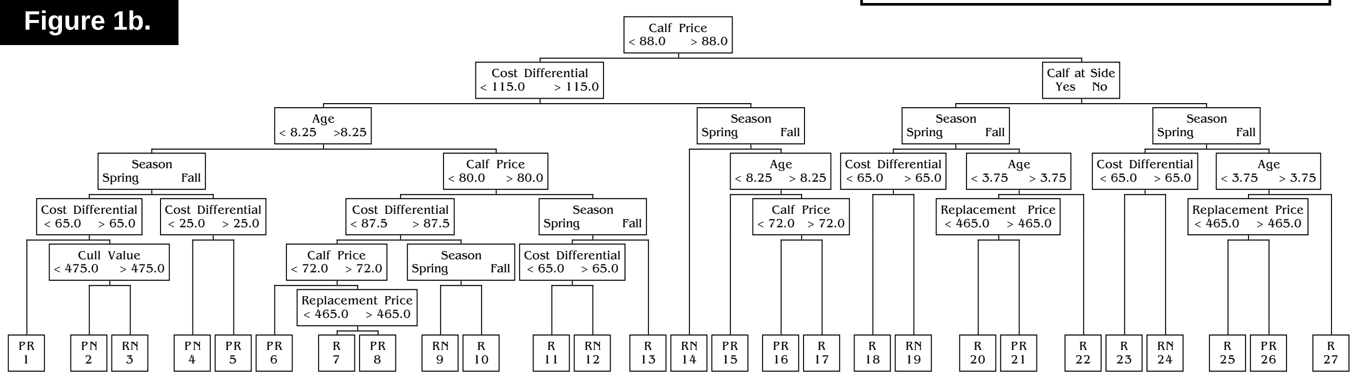


Figure 1c.

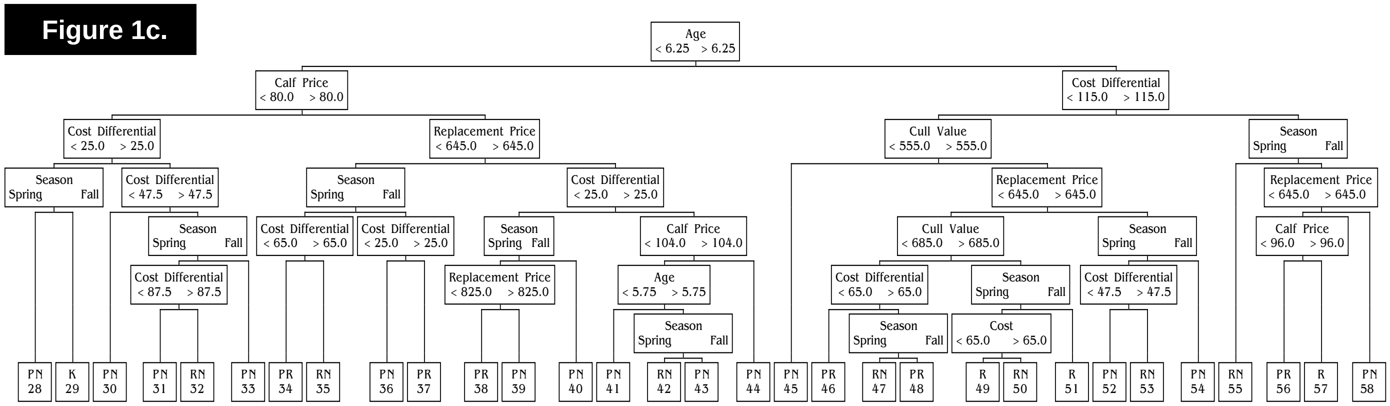
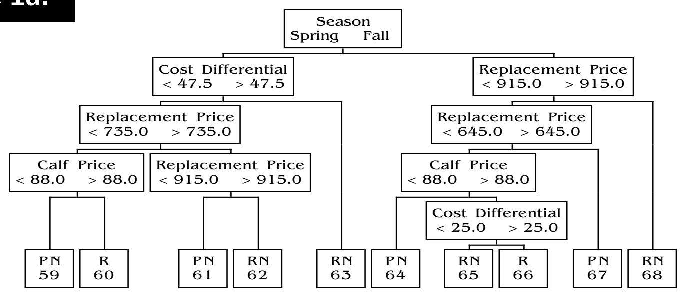


Figure 1 (cont.)

Figure 1d.



Legend

K - Keep and breed immediately

R - Replace with a bred heifer

K6 - Keep and breed in 6 months

RN - Cull and don't replace

PR - Pregnancy test cows replace open cows with a bred heifer

PN - Pregnancy test cows, don't replace open cows that are culled.

Figure 1e.

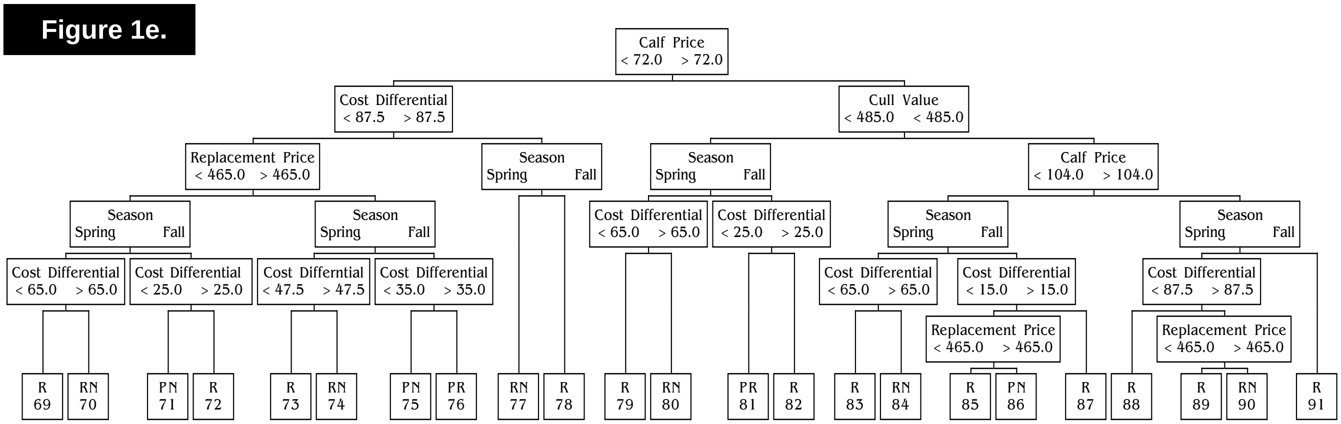
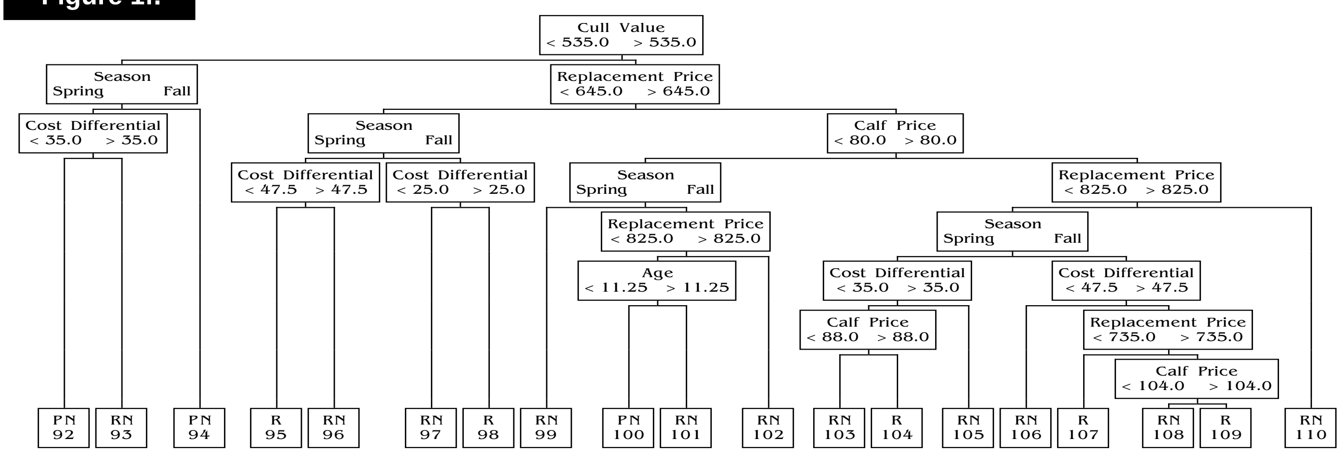


Figure 1f.



values are given in Table 6. One period cost of mistake values are determined by comparing a non-optimal decision one period followed by optimal culling decisions to a continuous stream of optimal culling decisions. All splits and categories were selected on the basis of minimizing average one period cost of mistakes for each category. For example, the first split at the top of Figure 1a was selected on the basis of splitting all decisions into two categories or nodes so that the average cost of mistake for all decisions is minimized. All variables and levels were numerically searched. Cow age of 9.25 years is the variable and level identified that splits all 43,120 culling decisions into two groups so that the average cost of mistake is minimized. Subsequent splits were

Table 6. Value of Pregnancy Testing, Present Value, and Cost of Mistake Values for Terminal Nodes in Figure 1.

Term-inal Node Number	Recommended CART Decision	Average Value of Preg Testing by Node	Average Present Value by Node	Average Cost of Mistake Values For Different Decisions* K Decision 1	R Decision 2	K6 Decision 3	RN Decision 4	PR Decision 5	PN Decision 6
1	PR	$31.8	$1965.2	-$35.9	-$46.5	-$46.0	-$135.3	-$4.2	-$22.4
2	PN	$6.4	$1403.2	-$9.1	-$106.9	-$23.2	-$21.6	-$20.2	-$2.7
3	RN	-$10.3	$1447.4	-$33.8	-$79.2	-$42.6	-$3.5	-$29.5	-$13.8
4	PN	$2.5	$1897.1	-$5.0	-$75.1	-$9.1	-$53.3	-$7.0	-$2.5
5	PR	$23.5	$1645.2	-$34.6	-$49.8	-$26.3	-$131.9	-$2.8	-$19.7
6	PR	$23.9	$1723.8	-$31.8	-$33.0	-$30.6	-$66.7	-$6.7	-$14.1
7	R	-$20.1	$1834.5	-$68.0	-$8.4	-$65.9	-$92.0	-$28.5	-$46.9
8	PR	$8.8	$1779.1	-$44.0	-$20.8	-$42.1	-$51.5	-$12.0	-$18.8
9	RN	-$21.9	$1335.0	-$47.2	-$112.6	-$49.7	-$0.1	-$46.8	-$22.0
10	R	-$2.9	$1439.8	-$64.6	-$9.0	-$42.5	-$110.0	-$11.9	-$34.2
11	R	-$46.3	$1958.6	-$105.0	$0.0	-$107.6	-$117.4	-$46.3	-$72.2
12	RN	-$42.2	$1440.8	-$76.6	-$55.8	-$77.6	$0.0	-$54.6	-$42.2
13	R	-$13.1	$1886.5	-$58.6	-$9.8	-$49.5	-$79.9	-$22.9	-$38.4
14	RN	-$33.0	$1446.8	-$48.2	-$127.0	-$58.5	-$0.4	-$59.8	-$33.4
15	PR	$30.1	$1573.2	-$67.8	-$48.1	-$33.4	-$162.6	-$3.3	-$26.9
16	PR	$8.3	$1319.2	-$69.0	-$13.6	-$32.2	-$101.6	-$5.3	-$24.7
17	R	-$34.9	$1565.9	-$113.3	$0.0	-$76.5	-$141.0	-$34.9	-$66.0
18	R	-$48.4	$2361.8	-$97.6	-$2.1	-$100.4	-$163.4	-$50.4	-$75.7
19	RN	-$57.1	$1822.9	-$83.4	-$37.5	-$86.0	-$4.1	-$66.5	-$61.2
20	R	-$31.7	$2179.6	-$71.3	-$0.6	-$62.0	-$157.0	-$32.4	-$53.8
21	PR	$13.8	$2100.2	-$37.5	-$18.7	-$29.1	-$120.5	-$4.8	-$18.8
22	R	-$39.7	$2246.3	-$84.9	-$2.9	-$73.1	-$132.0	-$42.6	-$63.2
23	R	-$43.1	$1849.7	-$123.9	-$1.7	-$128.8	-$163.1	-$44.9	-$86.8
24	RN	-$50.6	$1310.8	-$92.0	-$37.5	-$96.8	-$4.1	-$63.3	-$54.7
25	R	-$27.5	$1688.5	-$103.6	-$0.5	-$85.9	-$156.9	-$28.0	-$68.6
26	PR	$11.6	$1609.1	-$68.2	-$16.0	-$52.3	-$117.8	-$4.4	-$30.8
27	R	-$35.5	$1733.6	-$107.8	-$2.5	-$88.7	-$131.7	-$38.1	-$71.6
28	PN	$17.1	$1804.7	-$18.1	-$226.4	-$28.7	-$125.2	-$21.5	-$1.1
29	K	-$1.5	$1734.2	-$1.9	-$263.1	-$16.9	-$76.4	-$41.2	-$3.5
30	PN	$11.2	$1517.4	-$11.4	-$244.8	-$21.9	-$91.0	-$31.3	-$0.2
31	PN	$13.1	$1407.6	-$15.0	-$275.6	-$32.1	-$35.2	-$50.6	-$2.0
32	RN	-$41.8	$1401.4	-$55.7	-$349.8	-$72.9	-$0.9	-$113.3	-$42.7
33	PN	$13.3	$1436.4	-$36.5	-$243.6	-$13.7	-$107.4	-$28.0	-$0.4
34	PR	$39.8	$2233.1	-$41.9	-$42.0	-$51.5	-$118.6	-$2.1	-$17.6
35	RN	-$38.4	$1742.8	-$62.1	-$126.2	-$74.3	-$1.7	-$65.3	-$40.1
36	PN	$11.5	$2126.2	-$12.1	-$67.6	-$16.0	-$29.4	-$8.4	-$0.6
37	PR	$31.2	$1872.8	-$50.5	-$47.4	-$32.4	-$125.9	-$1.2	-$17.0
38	PR	$34.3	$2177.0	-$35.7	-$94.4	-$44.7	-$127.6	-$1.3	-$8.1
39	PN	$32.3	$2132.2	-$32.3	-$187.4	-$41.7	-$98.1	-$18.1	-$0.1
40	PN	$9.2	$2090.2	-$9.6	-$180.0	-$20.2	-$51.8	-$26.2	-$0.3
41	PN	$27.3	$1791.2	-$40.7	-$214.6	-$41.5	-$70.4	-$42.4	-$13.4
42	RN	-$21.2	$1789.8	-$66.8	-$227.8	-$76.4	-$12.5	-$78.3	-$33.7
43	PN	$18.6	$1766.5	-$39.2	-$140.7	-$19.9	-$67.7	-$16.3	-$1.2
44	PN	$33.3	$1888.1	-$51.6	-$145.6	-$49.5	-$55.9	-$34.3	-$16.2
45	PN	$17.5	$1731.4	-$19.1	-$130.2	-$18.6	-$55.5	-$17.0	-$1.1
46	PR	$22.2	$2113.5	-$38.1	-$28.1	-$38.5	-$51.4	-$5.9	-$10.9
47	RN	-$24.9	$1641.6	-$57.3	-$116.2	-$63.0	$0.0	-$49.7	-$24.9
48	PR	$4.2	$1702.3	-$59.8	-$10.9	-$41.1	-$99.9	-$6.6	-$25.6
49	R	-$37.5	$2240.1	-$101.8	$0.0	-$103.3	-$104.8	-$37.5	-$59.9
50	RN	-$48.5	$1749.8	-$90.4	-$65.5	-$91.9	$0.0	-$62.5	-$48.5
51	R	-$22.6	$2131.0	-$71.5	-$7.8	-$62.9	-$55.1	-$30.4	-$40.5
52	PN	$30.6	$2179.3	-$44.4	-$128.4	-$47.9	-$34.8	-$24.1	-$4.1

* See Figure 1 for a description of decisions.

Table 6. (cont.)

Term-inal Node Number	Recommended CART Decision	Average Value of Preg Testing by Node	Average Present Value by Node	Average Cost of Mistake Values For Different Decisions* K Decision 1	R Decision 2	K6 Decision 3	RN Decision 4	PR Decision 5	PN Decision 6
53	RN	-$26.8	$1743.3	-$66.6	-$237.3	-$71.8	-$1.1	-$78.3	-$27.9
54	PN	$20.4	$2095.4	-$29.3	-$158.3	-$22.4	-$24.3	-$30.6	-$2.0
55	RN	-$79.1	$1749.2	-$115.6	-$305.1	-$121.0	$0.0	-$144.2	-$79.1
56	PR	$19.0	$1602.2	-$56.0	-$52.9	-$20.5	-$84.8	-$1.5	-$8.3
57	R	-$29.5	$1805.3	-$111.2	$0.0	-$75.7	-$121.8	-$29.5	-$55.5
58	PN	$19.7	$1748.6	-$57.3	-$142.3	-$21.8	-$38.5	-$24.2	-$2.1
59	PN	$33.2	$1844.9	-$37.1	-$53.0	-$40.5	-$42.3	-$6.3	-$3.9
60	R	-$32.1	$2231.5	-$96.3	-$0.7	-$97.5	-$83.2	-$32.8	-$51.0
61	PN	$7.3	$2111.4	-$50.4	-$102.2	-$51.9	-$12.8	-$25.2	-$5.5
62	RN	-$20.7	$2054.7	-$72.5	-$194.9	-$73.2	-$0.6	-$64.2	-$21.3
63	RN	-$65.4	$1766.9	-$108.8	-$256.5	-$111.0	-$0.3	-$122.3	-$65.7
64	PN	$13.7	$1818.4	-$32.8	-$57.7	-$16.7	-$40.5	-$6.8	-$3.0
65	RN	$8.4	$2121.5	-$33.1	-$33.0	-$30.9	-$1.3	-$16.7	-$9.7
66	R	-$36.5	$1868.1	-$99.7	-$0.3	-$77.6	-$89.1	-$36.7	-$56.3
67	PN	$11.9	$2085.9	-$42.0	-$108.4	-$25.8	-$16.6	-$25.0	-$4.7
68	RN	-$15.1	$2022.3	-$58.2	-$222.9	-$41.9	$0.0	-$64.3	-$15.1
69	R	-$34.1	$1712.3	-$81.3	-$0.2	-$84.0	-$101.9	-$34.3	-$58.0
70	RN	-$14.4	$1228.7	-$40.0	-$46.9	-$40.6	-$0.2	-$25.5	-$14.6
71	PN	$9.4	$1653.5	-$12.3	-$47.1	-$10.0	-$33.7	-$3.8	-$0.6
72	R	-$21.5	$1386.3	-$64.1	-$1.8	-$52.5	-$86.4	-$23.4	-$43.1
73	R	-$6.9	$1657.3	-$52.9	-$4.8	-$55.6	-$61.6	-$11.7	-$24.9
74	RN	-$18.2	$1235.2	-$48.3	-$69.9	-$49.4	-$0.6	-$34.9	-$18.8
75	PN	$13.6	$1625.2	-$16.9	-$66.1	-$13.6	-$20.6	-$10.6	$0.0
76	PR	$1.3	$1295.4	-$42.0	-$7.3	-$28.8	-$46.9	-$6.0	-$15.2
77	RN	-$29.4	$1229.0	-$56.9	-$138.6	-$57.7	$0.0	-$61.8	-$29.4
78	R	-$20.4	$1308.5	-$90.1	-$2.6	-$55.1	-$90.7	-$23.1	-$43.6
79	R	-$74.2	$1876.8	-$136.1	$0.0	-$138.0	-$127.3	-$74.2	-$104.1
80	RN	-$45.1	$1359.0	-$78.9	-$69.4	-$79.1	$0.0	-$61.4	-$45.1
81	PR	$14.8	$1831.7	-$20.1	-$21.5	-$17.8	-$24.0	-$3.0	-$3.5
82	R	-$62.7	$1592.5	-$131.1	$0.0	-$107.5	-$129.9	-$62.7	-$93.3
83	R	-$85.5	$2208.3	-$155.3	-$0.4	-$156.4	-$129.7	-$85.9	-$116.0
84	RN	-$64.8	$1670.1	-$105.7	-$68.5	-$105.9	-$0.7	-$81.3	-$65.5
85	R	-$18.0	$2111.8	-$47.2	-$2.4	-$46.0	-$43.4	-$20.3	-$29.9
86	PN	$3.6	$2039.8	-$23.5	-$28.6	-$22.3	-$6.6	-$8.1	-$3.0
87	R	-$67.2	$1934.5	-$136.7	-$0.8	-$115.6	-$127.9	-$68.0	-$97.5
88	R	-$127.6	$2335.6	-$209.8	-$0.6	-$210.0	-$157.7	-$128.1	-$164.8
89	R	-$85.9	$1779.6	-$132.2	$0.0	-$132.2	-$15.0	-$85.9	-$89.4
90	RN	-$88.4	$1745.4	-$136.0	-$48.7	-$136.0	$0.0	-$99.7	-$88.4
91	R	-$102.3	$2220.3	-$178.9	$0.0	-$161.3	-$142.5	-$102.3	-$135.5
92	PN	$20.9	$1642.0	-$38.9	-$41.1	-$40.9	-$26.9	-$9.3	-$6.0
93	RN	-$35.9	$1285.3	-$70.3	-$195.7	-$71.6	-$0.8	-$82.3	-$36.7
94	PN	$11.9	$1669.3	-$37.8	-$83.5	-$20.3	-$13.7	-$18.2	-$1.8
95	R	-$56.2	$2213.0	-$121.5	-$0.6	-$122.5	-$82.4	-$56.8	-$75.9
96	RN	-$74.1	$1748.5	-$121.2	-$116.6	-$121.5	-$0.8	-$101.9	-$75.0
97	RN	-$11.3	$2104.1	-$39.3	-$42.1	-$36.9	-$1.2	-$22.0	-$12.5
98	R	-$47.1	$1850.7	-$113.5	-$1.4	-$90.2	-$75.2	-$48.5	-$65.8
99	RN	-$51.3	$1685.6	-$96.7	-$268.2	-$97.5	-$1.0	-$114.6	-$52.3
100	PN	$5.2	$1661.1	-$38.2	-$121.1	-$21.1	-$6.4	-$27.5	-$1.2
101	RN	-$8.9	$1609.3	-$52.4	-$106.8	-$34.3	$0.0	-$34.6	-$8.9
102	RN	-$16.2	$1654.1	-$60.2	-$253.5	-$42.8	-$0.1	-$75.5	-$16.3
103	RN	-$11.0	$1777.6	-$66.1	-$29.0	-$66.9	-$7.1	-$23.2	-$18.1
104	R	-$38.5	$2151.9	-$104.4	-$3.5	-$104.7	-$44.6	-$42.0	-$51.6
105	RN	-$76.3	$1778.2	-$129.1	-$157.6	-$129.5	-$1.2	-$113.9	-$77.4
106	RN	-$19.8	$2068.1	-$54.3	-$63.3	-$49.7	-$1.3	-$35.6	-$21.1
107	R	$30.5	$1726.6	-$97.6	-$1.8	-$69.3	-$43.0	-$32.2	-$41.8
108	RN	-$8.0	$1578.3	-$65.8	-$31.5	-$37.5	-$1.8	-$16.7	-$9.7
109	R	-$35.0	$1669.7	-$102.6	$0.0	-$74.3	-$16.6	-$35.0	-$38.9
110	RN	-$55.6	$2034.4	-$110.8	-$176.4	-$102.1	$0.0	-$96.8	-$55.7

* See Figure 1 for a description of decisions.

made below each category until the average cost of mistake for a node was less than $5 or a split could not be found such that the number of cases in the smaller branch was at least 10 percent of the number of cases to be split at this point in the tree.

Terminal node 1 gives a culling recommendation of pregnancy test and replace open cows with a bred heifer. This category describes cows that are less than 8.25 years in age, replacement prices less than $555/head, calf prices less than $88/cwt., spring decision period, and a cost differential for spring calving that is $65/head less than fall calving. The amount of node impurity associated with this decision is identified by looking at the cost of mistake value for the recommended decision. This value is $4.17 (cost of mistake value for PR), about $17 less than the next best decision of pregnancy test and not replacing open cows (PN). Under the conditions described, the decision of cull all and don't replace (RN) is the worst decision one could make. The average cost of mistake for RN is $135.30, significantly more than all the other possible decisions. Terminal node 17 has an average cost of mistake of $0.00 for the decision R since none of the decisions are incorrectly classified.

Table 6 also gives the present value for an animal unit that is classed into each terminal node (20 year planning horizon). The category with the highest present value is node 18, at $2,362. This node represents the following; a cow less than 9.25 years of age with a sale calf at side, spring season, an operation where the cost of fall calving is not $65/head more than spring calving, calf price is greater than $88/cwt. and replacement prices less than $555/head. This cow and calf are not worth $2,362 but expected future returns from this starting point and subsequent optimal replacement decisions for a 20 year planning horizon yield a present value of $2,362 (6% real discount rate utilized).

The value of pregnancy testing for one period is determined by subtracting the lowest cost of mistake value for pregnancy testing (i.e., PR, or PN) from the lowest uniform culling decision (i.e., K, R, K6, or RN) cost of mistake. For example, for node 1 the lowest uniform cost of mistake value is K at $35.93. The lowest pregnancy test cost of mistake is PR at $4.17. Subtracting $4.17 from $35.93 yields a value of pregnancy testing of $31.76. Node 11 has a value of pregnancy testing equal to -$46.28. The value of pregnancy testing can go much lower than -$2/head or the assumed cost of pregnancy testing each cow. This is because cows that test open are always culled from the herd even if market prices and age indicate that these cows should be maintained in the herd. And pregnant cows are always maintained in the herd, even if market prices and biological factors are conducive to replacing these cows with a bred heifer or culling them and not replacing them in the current period. The lower limit of -$2/head would only occur if cows that tested open or pregnant were kept or culled according to optimal culling decisions.

Figure 2 compares the long run economic merits that accrue to (i.e., present

Figure 2. Present Value of Selected Culling Strategies.

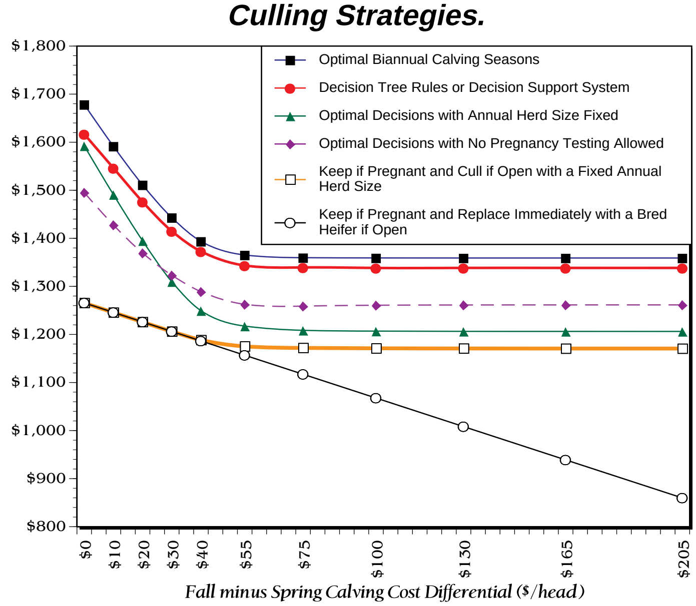
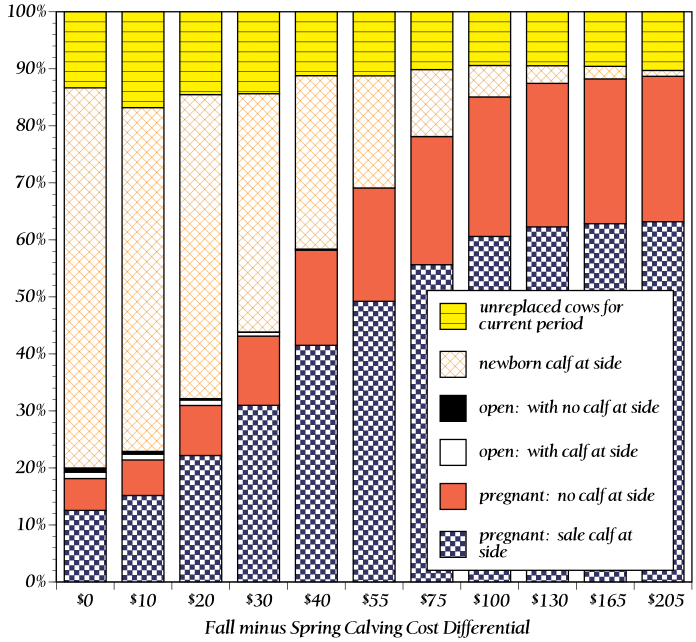


Figure 3. Long Term Status of Herd in the Fall for Different Calving Cost Differentials.



value of a 20 year planning horizon) six different culling strategies. The strategies considered are: 1) optimal culling decisions with pregnancy testing allowed and herd size variable, 2) decision tree rule presented in Figure 1 that simplifies the 43,120 decisions from the dynamic programming model (decisions used to obtain 1), 3) optimal culling decisions with a fixed annual herd size, 4) optimal culling decisions made with herd size variable and no pregnancy test information, 5) keep if pregnant and cull if open culling decisions with a fixed annual herd size, and 6) keep if pregnant and replace open cows immediately with a bred heifer. The present value of a slot in the herd is at a maximum of $1,678 if the cost differential between spring and fall calving is $0.0 and optimal culling decisions are made with a variable herd size and pregnancy testing is allowed. The present value falls quite rapidly as the cost differential increases to $55 and then levels off to a value of $1,359 with a spring only calving season. A biannual calving season has an expected net worth of $319 ($1,678-$1,359) more than a spring only calving season when the cost of spring and fall calving are equal. Two items contribute to this increase in profitability. First, sale calf prices have been historically higher in the spring than fall. As described in Figure 3, on average around 70% of the herd should have a newborn calf at side in the fall. These calves will be sold in the spring at a relatively higher price than if they were sold in the fall. Second, open cows can be brought back into production six months earlier (by allowing the cow to switch calving seasons) than with a spring only calving system. As described in Figure 3, a small percentage of open cows are maintained in the herd when the cost differential of fall minus spring calving is less than $40 or when biannual calving seasons are viable. Figure 3 indicates that about half of the calves should be born in the spring and the other half in the fall if the cost of fall calving is $30 to $40 greater than spring calving.

The decision tree culling rules shown in Figure 1 capture anywhere from 96.4% of the optimal returns with a $0.0/head calving cost differential to 98.5% with a calving cost differential above $40/head. The third management alternative evaluated is a biannual calving season with a fixed herd size. As shown in Figure 3, around 10% of the slots in a herd are not replaced immediately in the current period. This means that on average price conditions are often not conducive for immediately bringing a replacement into the herd. The impact of not allowing herd size to vary can be seen by comparing the present value of optimal decisions with herd size variable (strategy 1) and annual herd size fixed (strategy 3). The fixed herd size is 5% less profitable over the long run than optimal culling decisions with a $0.0/head calving cost differential and decreases to over 13% less cumulative profit with a calving cost differential greater than $75/head. Size is fixed in an annual sense because replacements are not forced to take the place of a cow that may die or be determined physically unfit in the spring. That is, replacements are not forced into the herd to calve in the fall when the cost of fall calving is not economically viable.

Table 6 describes the value of pregnancy testing for one season. Figure 2 quantifies the long run value of pregnancy testing by comparing the optimal returns generated when pregnancy testing is allowed (strategy 1) to those when pregnancy testing is not allowed (strategy 4). The fourth management strategy considered allows for biannual calving and a variable herd size, but optimal culling decisions are made on the basis of not having the ability to obtain any pregnancy test information. The long run value of pregnancy testing is estimated at $183 when the differential is $0.0/head. This value falls to $105 with a $40/head calving cost differential and levels off at around $98 with a cost differential above $100/head. Although pregnancy testing is not always profitable, having the technology to obtain pregnancy status information at $2/head allows for increasing long term ranch profitability from 7% to 11%.

The fifth management strategy keeps all cows that are pregnant and culls all open cows. Open cows must be replaced within a year since annual herd size is fixed. As seen in Figure 2, this strategy yields $413 less expected wealth with a $0 cost differential than optimal biannual calving seasons. As the calving cost differential increases above $55, expected wealth is $188 or about 13% less than optimal biannual calving seasons. Clearly, pregnancy testing alone is not the answer to increasing ranch profitability. In fact the more traditional management strategy of pregnancy testing all cows and culling all open cows (strategy 5) results in anywhere from 8% to 18% less profit than optimal culling decisions made without any pregnancy test information. The last management strategy considered forces open cows to be replaced with a bred heifer immediately. Plus cows that test pregnant must be maintained in the herd. Cows that die or are determined to be unfit in the spring, must be replaced with a bred heifer even if the cost of fall calving is $100/head greater than spring calving. This strategy illustrates the impact that bringing cows into the herd to calve in the fall has when the cost of fall calving escalates. As the cost of fall calving exceeds spring calving costs by over $55, profits plummet in almost direct proportion to the increase in the cost of fall calving.

Age Distribution

Figures 4 and 5 give the anticipated age distribution in the fall under optimal biannual culling decisions (strategy 1). Panel b gives a cumulative age distribution from the percentages in panel a.

Figure 4. Long Term Age Distribution in the Fall with a $0 Cost Differential.

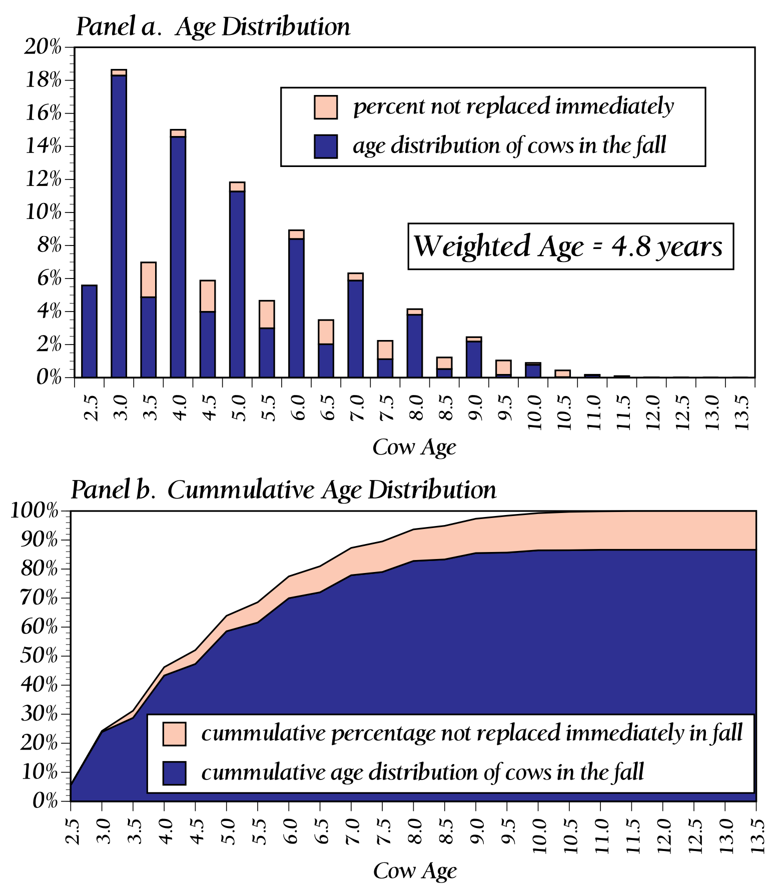
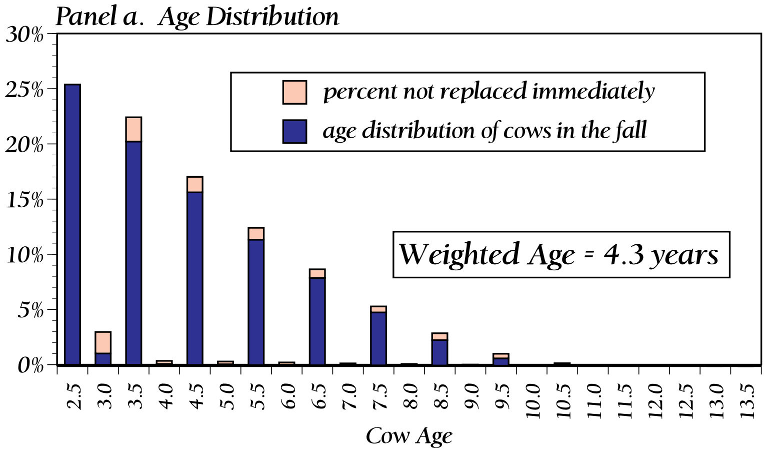
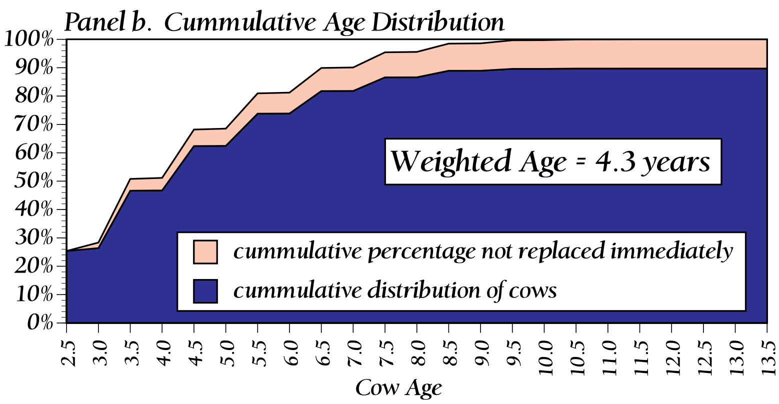


Figure 5. Long Term Age Distribution in the Fall with a $250 Cost Differential.





The cost of spring and fall calving are equal in Figure 4, whereas the cost of fall calving exceeds spring calving costs by $205 in Figure 5. Cow age is slightly higher for the $0 than $205 calving cost differential. In the fall, an average cow age of 4.8 years is expected with a $0 cost differential, one-half a year more than when fall calving costs exceed spring calving by $205. Cow age is determined after replacement decisions have been made. With essentially a spring only calving season, about 25% of the herd is expected to be composed of 2.5 year old bred heifers after culling decisions have been made. This greatly contributes to a relatively young cow age.

A $205 calving cost differential implies that essentially all bred heifers will enter the herd in the fall to coincide with a spring calving cycle. Whereas with a $0 cost differential, bred heifers are more likely to enter the herd in the spring so that sale calves can be sold at a relatively higher spring market the subsequent spring. During the spring season, the average age for a $0 and $205 cost differential is 4.5 and 4.6, respectively. When averaging age across seasons, $0 and $205 cost differentials have a combined fall-spring average age of 4.65 and 4.45 years, respectively. Biannual calving with no cost penalty for fall calving increases the optimal age of the herd by about 1/5 of a year. All cows are culled by 12 years of age with a $0 calving cost differential. When the calving cost differential increases to $205, essentially all cows are culled before they reach 11 years of age.

The analysis assumes that the cost of bringing a bred heifer replacement on the ranch is the market price plus $10/head for veterinary costs and $10/head for trucking costs. Feed and/or management costs were increased by $50/head over older cows for bred heifers during their first year of ownership. A 4% shrink, 1.5% sale commission and $.01/lb. in trucking costs were deducted from the revenues obtained from selling cull cows. Any increase in these transaction costs of replacing culled cows with replacements would increase the long term age of the herd. Also, replacement prices may be relatively high for some remote local areas. If this were true, this would also increase the long term age distribution of the herd. However, results suggest that a relatively young and thrifty herd is the most economically viable management strategy.

Conclusions

A good culling strategy has the potential to increase your long run ranch profitability to the tune of 7 to 10 percent over many of the simple strategies used in the past. The following questions are critical to ask about your culling strategy:

1. Should I preg test. If so which cows?
2. Should I maintain a constant herd size?
3. Should I calve in the spring, fall or both?

These are not simple questions. The results presented for our biological data suggest that in general you should preg test, not maintain a constant herd size, and depending on your cost differential between fall and spring calving, calve part of your herd in spring and fall. The specific recommendations change as market conditions change. This reaction to market conditions is in one of the keys to increasing profits by using our culling strategy system.

To simplify the development of culling recommendations for situations similar to our baseline herd we have set up a World Wide Web (WWW) site with an interactive version of our decision tree that will give you culling recommendations for specific market conditions. Check it out at http://ag.arizona.edu/AREC/cull/culling.html.

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FROM:

Arizona Ranchers' Management Guide
Russell Gum, George Ruyle, and Richard Rice, Editors.
Arizona Cooperative Extension

IS A BED AND BREAKFAST RANCHING?

Russell Tronstad[1]

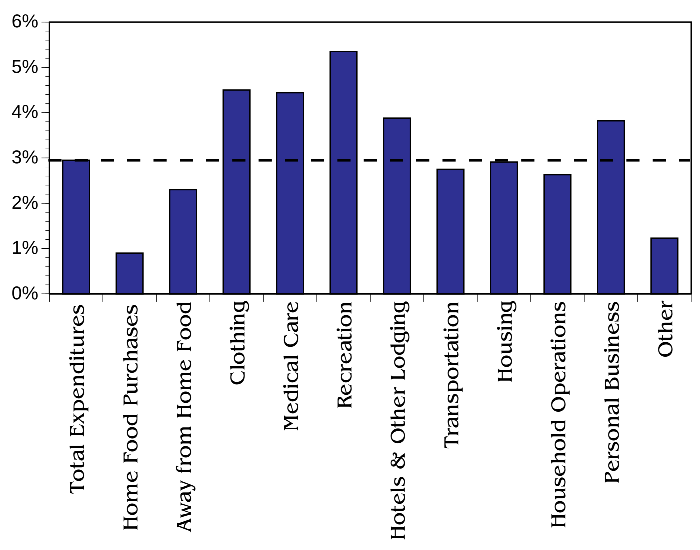
Situation

Ranchers have heard for years that the demand for beef has been slipping due to perceived health concerns and increased competition from other meat products. With cattle numbers increasing and prices looking bearish many ranchers may be wondering if they are in the right business. In general, food products haven't faired as well at fetching consumers' dollars as other industries.

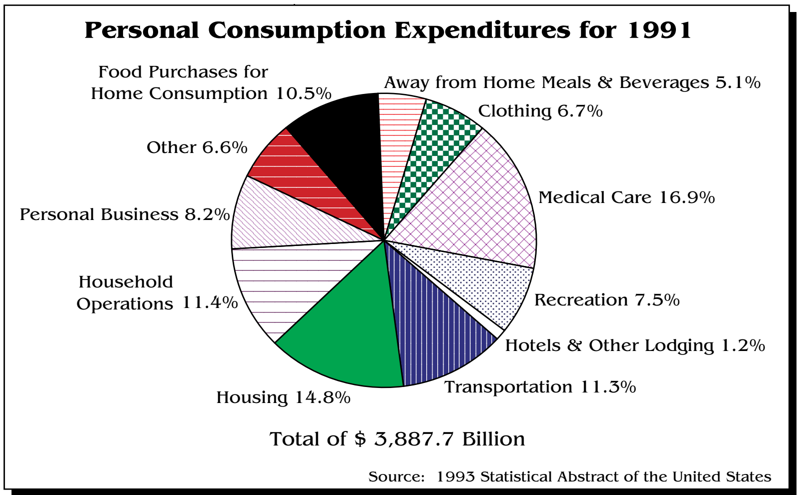
As shown in the accompanying bar chart, consumer expenditures of food purchases for home consumption have increased at an annual rate of less than 1% since 1970 after adjusting for inflation. Even restaurant food and beverage purchases have not kept up with average expenditure increases. Annual consumer purchases of all goods have increased slightly under 3%. Not surprisingly, the medical care industry has been a big growth industry by increasing 4.3% annually and accounting for 16.9% of all consumer expenditures in 1991, as shown in the pie chart on the following page. But an industry that has grown more rapidly than health care is recreation. After adjusting for inflation, Americans have increased their expenditures on recreation activities and goods more than 5.3% annually since 1970. Other expenditure groups above average are clothing, hotel and other lodging purchases, and personal business expenses. Some of the items and activities included in recreation are expenditures on books, magazines, video and audio products, amusement park fees, flowers, lottery purchases, pets and pet care services, golf fees, boats, pleasure aircraft, and many other recreational services.

Many ranchers have recognized that recreation is a growth industry and they been complimenting their existing operation by offering ranch tours, big game hunting, horse back riding, cattle drives, and Bed & Breakfasts (B&B) with various amenities. Other ranchers have indicated that getting people on their ranches is the best way to educate the public. Public education may be key to the survival of many ranches that have public land grazing rights. If people can see first-hand how they run their operation and depend on the land for their living they will see that ranchers are not out to exploit the land. Public land manage-

1970 to 1991 Average Annual Percentage Change of Expenditures in Constant Dollars



Source: 1993 Statistical Abstract of the United States



ment issues will continue to be debated over what is the most appropriate stocking rate and fee for grazing public lands.

Strategies

Some ranchers have been able to educate the public first-hand on how they operate their ranch while capitalizing on some of the recreational demands that tourists are demanding. For example, Peggy Monzingo of Benson, Arizona started up a ranch B&B a few years ago in order to educate the public on environmental and public land issues. “Ranchers need to do their part in educating the public first-hand and correctly since so many are misinformed,” says Peggy. She has a love for the land and a concern for how encroaching urbanization and public policies can disrupt an ecosystem. These factors ultimately impact both the aesthetic appeal and economic viability of the land. The B&B has given her an opportunity to educate individuals one-on-one in the field, meet many interesting people, and receive some “positive cash flow” for the first time in her life. Positive cash flow is non-existent in the checkbook ledger of most ranchers.

Wyoming has an established ranch B&B industry with over 60 registered in the 1994 Wyoming Homestay & Outdoor Adventures (WHOA) guide. Wyoming has set their own regulations and definitions for a ranch B&B. A ranch B&B is defined as “a private home which is used to provided temporary accommodations for a charge to the public with not more than four lodging units or not more than a daily average of eight persons per night during a thirty day period and in which no more than two family style meals are provided per 24 hour period. A minimum of 160 acres is needed to qualify for a ranch recreation enterprise. These operations are definitely not “dude ranches,” and virtually all are businesses that earn most of their living through livestock or crops. Although B&B rates are seasonal, the most common price charged falls between $50-$75 per night.

As with any business, you must decide what audience you want to attract and tailor your business for that group. Identifying the natural resources on your ranch and the people skills you possess will help determine what audience you want to target. If you are located near a large urban population you can probably attract many families that want to get-away and relax for the weekend. Note that most people are looking for space and the more emptiness you have to offer, the better. Remember that you are selling an experience that goes beyond sleeping quarters and meals. If you have a trout stream that runs through your property you might tailor your operation for fishing. But again remember that you are probably selling an experience that allows a father and son to fish in solitude rather than just selling fish. National parks and monuments, and other tourist attractions nearby can be an asset for you in attracting customers to a ranch B&B. B&Bs allow travelers the opportunity to experience a new flavor of vacationing that deviates from what they may be accustomed to. While today’s travelers may want to taste a bit of the roughing and romance that goes with some experiences like ranch chores and branding, most want a private bath, soft bed, and hot shower every morning.

Having something unique to offer is a definite plus for selling a recreational experience.   J. Irwin Young of Alamosa, Colorado decided to concentrate on raising tilapia fillets in the geothermal waters of southern Colorado in 1987. He didn't like the idea of throwing all the bones and other fish remains away so he got the idea that he would use this as feed for alligators. But once people found out that alligators were alive in the Rocky Mountains it wasn't long before they were spending more time giving tours than raising fish. That's when J. Irwin decided they needed to start charging for their farm tours. Last year they had over 30,000 tourists and charged $2.00 per person for tourists to view their alligators and fish ponds.

Implications

Ranch B&Bs are continuing to grow as an industry as consumers lure to the appeal of open space and new adventures. Recreation expenditures continue to show that recreation is a high growth industry. Although "ranch recreation" is definitely not in the personality genes of all ranchers, ranch recreation should not be ignored as being a viable tool for enhancing ranch income, improving cash flow, educating the public, and meeting interesting people. Testing the waters by starting small and using existing facilities is a good strategy. Word of mouth from satisfied customers is commonly the most effective advertisement for "recreation experiences." Many people find B&Bs by calling the chamber of commerce before they go to visit an area. The typical ranch B&B consumer is interested in what you grow, how it grows, and why your operation grows it. This consumer differs remarkably from the traveler that pulls into a Motel 6 off the freeway at 10:00 o'clock at night and is ready to hit the road again at 6:00 a.m. Competition is often an element of concern for ranch B&Bs. But two neighboring ranches starting a B&B at the same time may be more complimentary than competitive. Overflow customers can be forwarded to the neighboring ranch rather than to the nearest town. As mentioned above, the beauty and desirability of your area is often best spread by word of mouth. Recreation ranches benefit from more first-hand exposure by being in the same general area than if they are in two different locations.

Liability insurance is a concern of all individuals involved with ranch recreation. First, make sure that you identify dangerous situations on your operation and eliminate these conditions where possible. If a dangerous condition cannot be eliminated then restrict the accessibility of this area. Make sure that your employees are alert and trained to identify situations that are potentially dangerous. After informing individuals through a checklist of the risks inherent in an activity they are contemplating, have individuals acknowledge in writing that they were informed of these risks. Finally, liability insurance has no good substitute and should be included in your costs of providing "recreational experiences." Insurance carriers may limit the activities that you can provide and still maintain coverage with them.

Opening your ranch to the public is definitely not for everybody. How much you enjoy people and are able to deal with a group of "greenies" on your property is the first resource needed to be successful at ranch recreation. As Jeff Powell of Wyoming notes, "you may not have to be friendly to your cows all the time but with visitors you have to or they won't come back." Jeff Powell and Susan Rottman of Laramie, Wyoming have established RLS International (307-635-5746), a business that specializes in giving seminars and workshops on "recreational ranching." They discuss various aspects from marketing, advertising, and liability insurance to planning menus. Some ranching communities in the Western States have brought in this kind of expertise to access and help develop their recreation potential.

Another source for ranch recreation information is the Handbook entitled "Direct Farm Marketing and Tourism," by Arizona Cooperative Extension and Arizona Department of Agriculture. To obtain a copy send a check for $25.00 payable to Arizona Department of Agriculture/DFMT to:

Office of Commodity Development
and Promotion
P.O. Box 234
Phoenix, AZ 85001

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OVERVIEW OF RANCH FINANCIAL ANALYSIS SPREADSHEET

Russell Tronstad[1] and Trent Teegerstrom[2]

INTRODUCTION

This article provides an overview of a spreadsheet template developed to help cow-calf producers in Arizona analyze the profitability of common ranch management decisions. Important requirements for a ranch analysis tool are the ability to easily conduct economic analyses of management decisions and to narrow in on the strengths and weaknesses of a ranching operation. These requirements are satisfied in the spreadsheet template presented through a compilation of several worksheets linked together. For example, cash expenditures and revenues are linked with biological livestock inputs, such as cow fertility and sale weights, so that biological impacts are incorporated into the economic evaluation of a management practice, such as supplemental feeding.

USING THE TEMPLATE

The following seventeen different worksheets are placed together in the same spreadsheet template file to help analyze ranch profitability.

1) Actual Cash Flow — Allows the user to input monthly cash receipts and expenditures into several categories. Information entered on the actual cash flow spreadsheet occurs at the end of each month throughout the yearly business cycle of the ranch. Actual cash flow values can be used to evaluate historical cash performance per exposed cow or be used as a guide for future cash flow needs.

2) Projected Cash Flow — Cash expenses and revenues are monthly projections rather than actual expenditures and revenues as in the actual cash flow worksheet. The projected cash flow should be completed before the start of the year so that it can show when and where irregular transactions occur throughout the year or identify if total expenditures are increasing at an unanticipated rate.

3) Net Cash Position — Graphical view by month of actual and projected cash positions of the ranch. This worksheet can be used to see how close projections are to actual cash flow values.

4) Biological Cow Data — Worksheet includes total cow numbers by age along with accompanying conception rates, calving percentages, death losses, and percentage of cows culled because they are unfit. Livestock numbers are linked to the planning worksheet of production, health, feed, and grazing.

5) Production Planning Sheet — The herd production planning sheet is basic to developing total revenue and expense figures for the ranch. Livestock categories of steer and heifer calves (spring and fall born), steer and heifer yearlings, cows by age, bulls by age, and horses by working condition are provided. Planned livestock purchases are placed in column E for every livestock category. Heifer calves planned for use as replacements are entered in column F. Death losses for calves between birth and weaning, yearlings, bulls, and horses are entered in column H. Sale weights and prices received (columns L and M, respectively), plus beginning (column C) and ending (column N) year cash values are also entered in this worksheet. From these inputs, the total change in livestock inventories for the year is easily calculated.

6) Fixed Costs Planning Sheet — Vehicle and equipment purchases, fencing, building improvements, grazing

Figure 1. Control Sheet Headings and Decision Control Cell

ranch analysis 98

	A–C	D	E	F	G	H	I
1–3	ACTUAL CASH FLOW Pg. 1 Prices & Number of Head	Year End Year to Date	Modified Projections	New Total With $ Change	Projected Year End	Dec. Control =1,Activates Planning Sheets	New Total With Planning Sheet
4	# of Spring Calves (Steers)	196		196	199	1	164
5	Spring Calf Price ($ Per Head)	$318.75				1	$333.75
6	# of Spring Calves (Heifers)	161				1	129
7	Spring Calf Prices ($ Hd.)	$280.00				1	$294.00
8	# of Fall Calves (Steers)	10				1	9
9	Fall Calf Price ($ Per Head)	$328.63				1	$348.00
10	# of Fall Calves (Heifers)	11				1	9
11	Fall Calf Prices ($ Hd.)	$287.64				1	$300.00
12	# of Yearling Steers					1	
13	Steer Price ($ Hd.)					1	$390.00
14	# of Yearling Heifers					1	
15	Heifer Price ($ Hd.)					1	$455.00
16	# of Cull Cows	23		23	11	1	24
17	Cull Cow Price ($ Hd.)	$535.87		$535.87	$536.36	1	$534.53
18	# of Cull Bulls	5		5	6	1	5
19	Cull Bull Prices ($ Hd.)	$980.00		$980.00	$950.00	1	$980.00
20	**Operating Receipts**						
21	Spring Calves (Steers)	$62,475.00		$62,475.00	$63,680.00		$54,842.58
22	Spring Calves (Heifers)	$45,080.00		$45,080.00	$46,110.00		$38,020.77
23	Fall Calves (Steers)	$3,286.25		$3,286.25	$4,420.00		$3,005.29
24	Fall Calves (Heifers)	$3,164.00		$3,164.00	$3,720.00		$2,587.77
25	Yearling Steers						
26	Yearling Heifers						
27	Monthly Totals	$114,005.25		$114,005.25	$117,930.00		$98,456.42
28	**Capital Receipts**						
29	Cull Cows			$12,325.00	$5,900.00		$12,828.75
30	Cull Bulls			$4,900.00	$5,700.00		$4,900.00
31	Other Livestock			3		1	3
32	Horses Pric			$600.00		1	$1,400.00
33				$1,800.00			$4,200.00
34	Equipment					1	
35	Monthly Totals	$19,025.00		$19,025.00	$11,600.00		$21,928.75
36	Total Combined Income	$133,030.25		$133,030.25	$129,530.00		$120,385.17

Decision Control cell (type 1 in cell H4) for activating planning sheets.

Tabs below indicate that the worksheet of "Control Sheet" is selected.

FIXED COSTS PLANNING SHEET | CONTROL SHEET | COST & RETURNS | TOTAL DIAGNOSTIC TREE

resources, and other related non-livestock asset costs are entered in this worksheet. This sheet calculates annual payments and depreciation (straightline) utilizing purchase price, estimated useful life, salvage value, down payment, interest rate, and loan term (years) values. Other values entered include the beginning and ending year cash value of the asset. Cash values are used to determine changes in owner's equity.

7) Control Sheet — This sheet is a control sheet for determining whether cash flow values (actual shown in column G or modified as entered in column E of Figure 1) or values associated with all planning sheets feed into the diagnostic worksheets. A value of 1 entered in cell H4 activates values from all planning sheets associated with livestock inventories and fixed asset information to be transferred to the ranch diagnostic and financial sheets.

Note that a value of 1 is placed next to all items in column H that trigger a value to be called from the planning sheet. Values from planning sheets link to column I of the Control Sheet so that year-to-date cash values, projected cash values, and projected totals from the planning sheet can be seen side-by-side. A value other than 1, say 0 in cell H4, will reflect just cash transaction values in the ranch diagnostic and financial sheets. See Figure 3 for a graphical snapshot of how all the sheets link together and note that the Control Sheet is a flow control sheet. Note that throughout all of the worksheets, user input can be provided whenever a cell is shaded inside a line-box—otherwise values are automatically calculated from prior input.

8) Cost & Returns — This report gives a legend summary of total and per unit cash receipts and expenditures by major category. Returns after cash outlays, returns after inventory changes, and returns to unpaid labor, management, and risk are provided. Break-even steer prices ($/cwt.) for each cwt. of steer calf sold are also provided at each level. Note that only gross income less the cash outlay calculations are valid unless cell H4 in the Control Sheet equals 1 or “planning sheets” are in use.

9) Total Diagnostic Tree — Total cash and accrual profit values are decomposed into the general areas of gross sales (calves, yearlings, cows, bulls, and horses), cash production costs, cash overhead costs, depreciation, adjusted cash value of fixed assets, and livestock adjusted inventory income. Note that the accrual profit value is relevant only if the planning sheets are utilized (i.e., cell H4 in the Control Sheet equals 1). This sheet can be used as a visual snapshot to identify critical areas of ranch management depending on how large the expenses and revenues by general category are for the ranch. A management change of building a new tank that increases the grazing capacity of the ranch by 5 AUYs can be easily analyzed from this sheet.

10) Diagnostic Tree Per Exposed Cow — This sheet takes the information from the total diagnostic tree worksheet and displays it on a per exposed cow basis. This sheet has great value for comparing expenditure and revenue performance across categories for different ranches. Management decisions such as creep feeding calves can be easily evaluated from this sheet, while focusing on the final cash and accrual profit per exposed cow. Creep feeding will directly increase labor and feed costs, but it will also impact weaning weights and sale prices. How all of these factors fit together can be easily evaluated by looking at the final cash and accrual profit values per exposed cow in this sheet.

11) Finance Measures — Common financial measures such as current assets and liabilities and owner’s equity are reported in this sheet. Financial ratios associated with liquidity and solvency are also presented.

12) Health Expense Planning Sheet — Veterinary expenses associated with pregnancy testing, bull testing, vaccinations, and implants can be itemized out in this sheet for all livestock given in the production planning sheet.

13) Feed Expense Planning Sheet — Cost of supplement, minerals, salt, and hay is calculated from the inputs of cost of the feed ($/ton), pounds of feeding per day, and the number of days on feed. Livestock numbers provided in the production planning sheet are also linked to calculate total feed costs.

14) Grazing Planning Sheet — This sheet is tailored for public grazing fees of Bureau of Land Management, U.S. Forest Service, and State land. Grazing fees for these agencies are generally different, so the number of grazing months for each class of livestock on these different lands, along with any Animal Unit Month (AUM) conversion is required to calculate total grazing costs. Private grazing months and costs should also be included, if applicable. Grazing costs associated with land that is owned comes from the fixed cost planning sheet.

15) Labor Expense Planning Sheet — Hired labor associated with a manager, a bookkeeper, or cowboys is easily input into the labor expenses of the ranch using this sheet. Benefits such as FICA, Workman’s Compensation, or other benefits can be easily calculated in this sheet to determine total labor costs.

16) Actual Cash Flow Charts — Several figures display total cash income and expenses, operating receipts, variable costs, and overhead costs by major category and month. These charts display values from the actual and projected cash flow worksheets.

Figure 2. Key Output Associated with Retained Ownership Worksheet

ranch analysis 98

Note that profit figures do not account for any Commission and Margin Expenses or other costs not listed here

	AH	AJ	AK	AM	AN	AP	AR	AT	AU
	Expected Sale Price ($/HD)	PROFIT INCLUDING PROF OBJ ($/HD)	PROFIT INCLUDING PROF OBJ (% ret)	PROFIT EXCLUDING PROF OBJ ($/HD)	PROFIT EXCLUDING PROF OBJ (% ret)	Price able to Purchase Feeders at Given the Profit Objective Desired ($/HD)	Price able to Purchase Feeders at Given the Profit Objective Desired ($/lb)	Purchase Date	Purchase Weight (lbs)
40	$710.32	$36.99	19.13%	$61.99	31.63%	$386.49	$0.96623	30-Aug-99	400
41	$727.40	$13.66	7.71%	$38.66	21.50%	$425.53	$0.85106	30-Aug-99	500
42	$777.94	$23.78	13.59%	$48.78	24.62%	$488.03	$0.81339	30-Aug-99	600
43	$793.42	($4.08)	-2.46%	$15.92	9.44%	$527.04	$0.75292	30-Aug-99	700
44	$828.12	($2.74)	-1.97%	$17.26	12.16%	$576.26	$0.72032	30-Aug-99	800
46	$685.36	$0.42	0.21%	$25.42	12.74%	$352.62	$0.88155	30-Sep-99	400
47	$727.40	$2.01	1.12%	$27.01	14.77%	$417.26	$0.83452	30-Sep-99	500
48	$777.94	$11.55	6.49%	$31.55	17.46%	$479.85	$0.79976	30-Sep-99	600
49	$812.09	$2.55	1.51%	$22.55	13.17%	$538.40	$0.76914	30-Sep-99	700
50	$828.12	($15.02)	-10.61%	$4.98	3.46%	$569.38	$0.71173	30-Sep-99	800
52	$685.36	($2.51)	-1.27%	$22.49	11.22%	$352.39	$0.88098	30-Oct-99	400
53	$701.84	($27.19)	-15.01%	($2.19)	-1.19%	$391.44	$0.78288	30-Oct-99	500
54	$750.60	($20.13)	-11.25%	($0.13)	-0.07%	$452.22	$0.75370	30-Oct-99	600
55	$812.09	($2.50)	-1.48%	$17.50	10.16%	$538.08	$0.76868	30-Oct-99	700
56	$847.60	($1.26)	-0.88%	$18.74	12.92%	$588.54	$0.73568	30-Oct-99	800
58	######	#######	#######	######	#######	#######	#######	30-Nov-99	400
59	$701.84	($27.59)	-15.23%	($2.59)	-1.41%	$391.41	$0.78282	30-Nov-99	500
60	$750.60	($20.61)	-11.51%	($0.61)	-0.34%	$452.19	$0.75365	30-Nov-99	600
61	$783.55	($31.60)	-18.64%	($11.60)	-6.73%	$509.50	$0.72786	30-Nov-99	700
62	$847.60	($1.89)	-1.33%	$18.11	12.47%	$588.51	$0.73563	30-Nov-99	800
64	######	#######	#######	######	#######	#######	#######	30-Dec-99	400
65	######	#######	#######	######	#######	#######	#######	30-Dec-99	500
66	######	#######	#######	######	#######	#######	#######	30-Dec-99	600
67	$783.55	($37.06)	-21.71%	($17.06)	-9.83%	$504.04	$0.72006	30-Dec-99	700
68	$817.82	($36.80)	-25.64%	($16.80)	-11.50%	$553.60	$0.69200	30-Dec-99	800

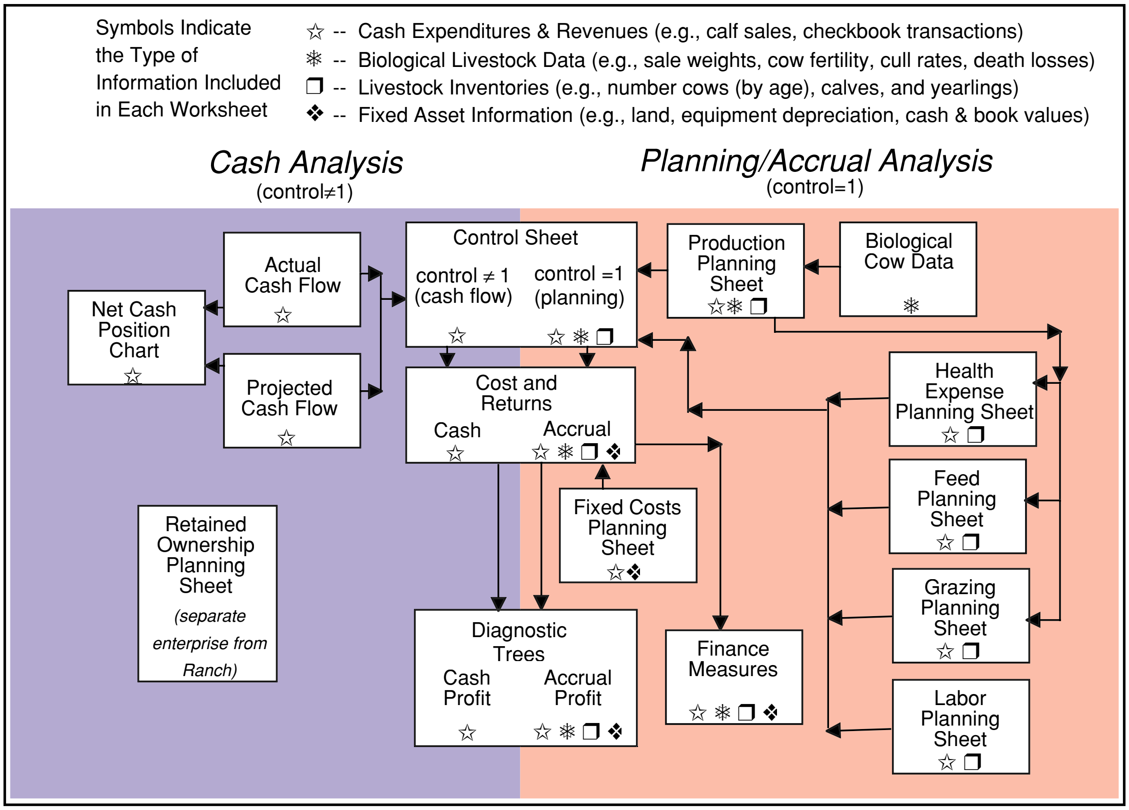
ACTUAL CASH FLOW CHARTS | RETAINED-OWN EVALUATION SHEET

17) Retained-Own Evaluation Sheet — Retained ownership is considered a separate enterprise from the ranch, so this worksheet is not linked to any of the other worksheets given above. This sheet provides the expected return from retained ownership, utilizing future market data available for when animals would be placed in the feedlot. Five different initial feeder weights (i.e., 400, 500, 600, 700, and 800 pounds) are evaluated side by side for five different "purchase dates" or days for entering the feedlot. Most current futures prices (all time horizons), along with expected basis values (cash minus futures) need to be entered. Figure 2 shows some of the key output values, such as: expected profit per head (columns AJ and AM) and annual adjusted percentage rate (columns AK and AN); feed (column AD) and total cost of gain (column AF); and break-even price for purchasing feeders (columns AP and AR). A total of 25 different purchase date and weight combinations are provided. Purchase date and weight combinations that are too far into the future for a feeder to be sold using the fed futures when purchased are displayed with "######".

Figure 3 displays how all the worksheets described above fit together. Four general categories of information are: 1) cash expenditures and revenues (e.g., calf sales, checkbook transactions); 2) biological livestock data (e.g., sale weights, cow fertility, cull rates, death losses); 3) livestock inventory values (e.g., head counts, cash values); and 4) fixed asset information (e.g., land, equipment depreciation, cash and book values). Figure 3 describes how these general categories of information flow from one worksheet to the next. Note that planning sheets must be in use (i.e., cell H4 in the Control Sheet equals 1) for any accrual values associated with livestock inventory or fixed asset information to feed forward into financial measures, costs and returns, and diagnostic tree worksheets.

The spreadsheet template is available from the authors for free, but you still need to input your baseline data. After

Figure 3. Flow Diagram of Excel Ranch Analysis Workbook



entering data from your ranch, you can evaluate your operation using the diagnostic trees and see where you should target changes in your management. Management decisions can be easily evaluated once you have entered your baseline data. For example, if you are considering supplemental feeding as a way of increasing calving rates, you could enter the proposed feeding schedule into the feed expense planning spreadsheet and change the calving rates in the biological cow data spreadsheet. A quick look at either the diagnostic tree per exposed cow or the cost and return worksheet would display the estimated impact on expected profits. Other potential management plans could be evaluated in a similar fashion.

Once a plan has been selected and implemented, it must be monitored. This includes physical aspects, such as calving rates, as well as economic aspects, such as expenses and market prices. When differences occur between the plan and reality, it is time to evaluate the reasons for the differences and possibly develop a revised management plan. At this point, the spreadsheet template presented can again be used as a tool to assist in the planning process.

CONCLUSIONS

Although spreadsheets are not structured to capture all the dynamics that can be associated with management decisions, they are relatively easy to follow and understand. Once a spreadsheet template is developed, it can easily be modified and tailored to a specific situation. Another advantage of using spreadsheets for planning is that you may get new ideas about management strategies by going through the planning process.

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FROM:

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Russell Tronstad, George Ruyle, and Jim Sprinkle, Editors.
Arizona Cooperative Extension

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ACTUAL & PROJECTED CASH FLOWS

Trent Teegerstrom[1]

INTRODUCTION

This article describes the actual and projected cash flow worksheets that are included in the ranch analysis spreadsheet template (see previous article).

Cash-flow analysis is an important step in taking control of any agricultural business. This is especially true in the ranching industry. In ranching, expenses happen on a daily basis, but the main income occurs only one or two times a year. The allocation of income to cover expected costs throughout the year will help ensure that all credit obligations are met. It is equally important not only to track current cash flows, but also to project at the start of the production year all expected income and expenditures. Once expected income and expenditures are recorded, comparisons can be made between projected and actual cash flows to help point out any discrepancies.

Actual cash flow allows the user to summarize all cash receipts (inflows) and expenditures (outflows) affecting the ranch during the yearly business cycle. Daily receipts and expenditures are organized into categories and entered on the actual cash flow worksheet for the end of each month. Actual cash flow values can then be used to evaluate historical cash performance of the business, as well as serve as a guide for future cash flow needs throughout the current business year.

The projected cash flow worksheet is a summary of monthly cash receipts and expenditures projected or expected for the upcoming year. The projected cash flow worksheet should be completed *before* the start of the year so that it shows when and where irregular transactions occur throughout the year and identifies if total expenditures are increasing at an unanticipated rate.

The projected cash flow worksheet in the spreadsheet template is linked to the actual cash flow worksheet and provides a monthly and year-end comparison between the two worksheets. Differences between monthly and projected transactions are reported below each of the totals and subtotals. A graphical presentation of the ending monthly cash balance is automatically shown on the net cash position worksheet.

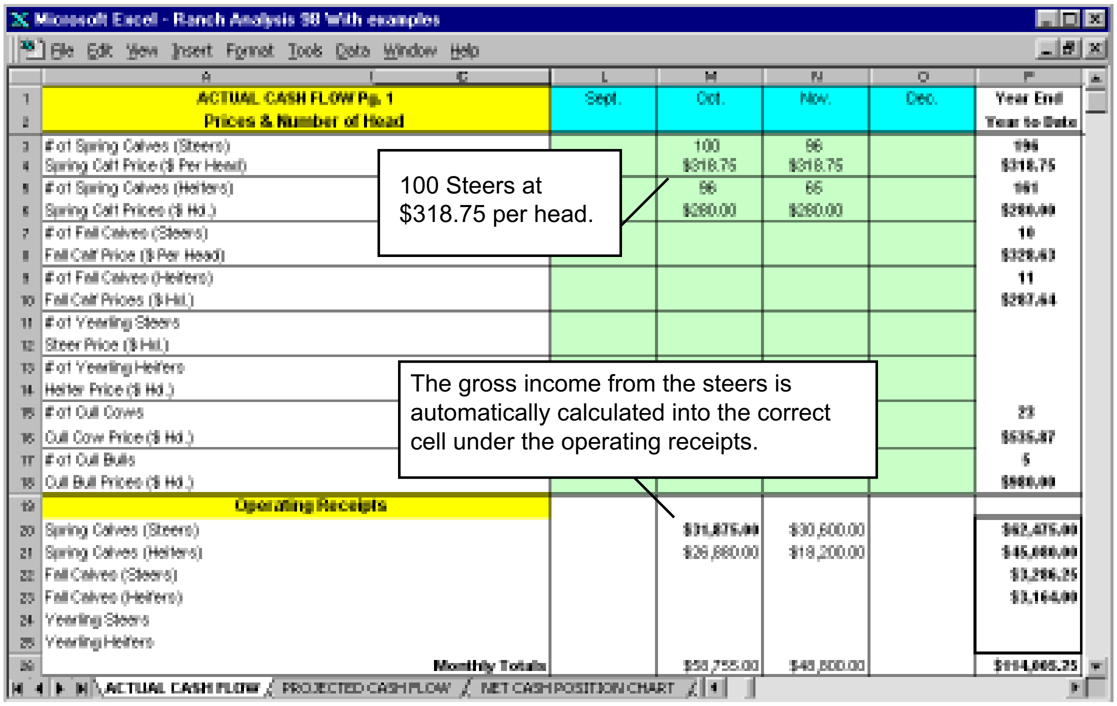
COMPONENTS OF THE WORKSHEETS

Both of the cash flow worksheets are broken up into twelve main areas by type of receipt and expenditure. Under each of the main receipt and expenditure areas are subcategories further defining each cash entry. Each of the twelve main areas is presented below with descriptions of what is contained within the areas and, where appropriate, examples of data entries are presented. Data should only be entered in the areas shaded in green on the worksheets. All other areas are calculated fields and fill in when the information is provided in the green shaded sections.

1) Price and Number of Head—This area is for recording the number of head sold and the price received per head for the different classes of animals sold: fall and spring calves, yearlings, cull cows, and cull bulls. Operating receipts and some of the capital receipts are calculated from this information and reported in the proper area of the worksheets.

Example 1 demonstrates the first two sections of the cash flow worksheet. In this example, a ranch sells 100 spring

Example 1. Operating Receipts



steer calves in October for $318.75 per head. On the worksheet, 100 steer calves is entered in cell M3 for the steers sold in October and then 318.75 is entered in cell M4 for the corresponding price per head.

2) Operating Receipts—Operating receipts are receipts generated from the yearly operation of the ranch, such as calf sales. These receipts are calculated from the information provided in the prices and number of head section. No entry of information is needed in this area.

In Example 1, the total amount received ($31,875.00) for the spring steer calves appears in cell M20.

3) Capital Receipts—Capital receipts are generated from the sale of a capital asset, such as breeding livestock, working horses, or equipment. These capital items are usually part of the business for more than one operating year. Capital receipts from the sale of cull cows and bulls are calculated from the prices and number of head area. However, total monthly receipts from the sale of horses and equipment need to be entered in the shaded sections.

4) Capital (Cash) *Expenditures*—Capital cash expenditures are expenditures on a capital asset such as breeding livestock, working horses, or equipment where no financing is required. Expenditures are recorded in the shaded area for the type and month in which the transaction occurred.

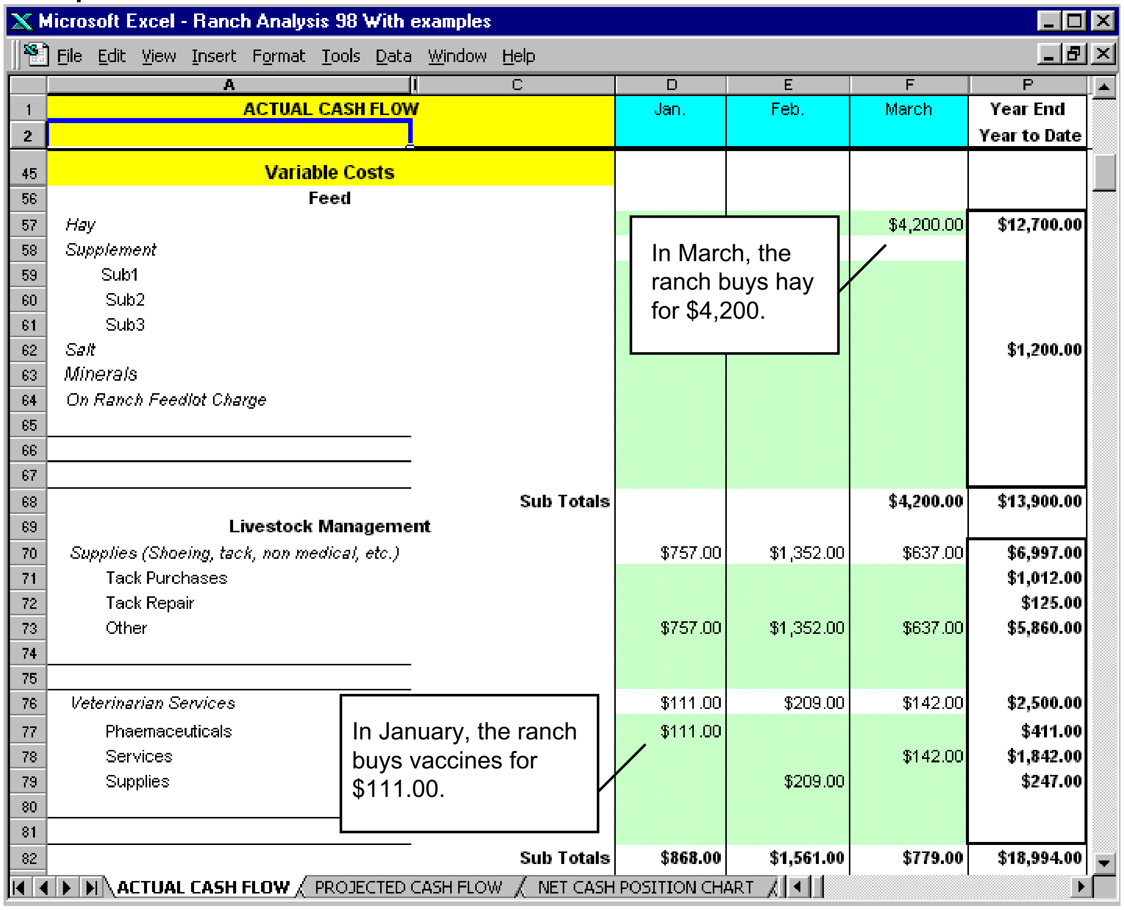
5) Variable Costs—Variable costs are those costs that vary with output for the production period under consideration. There are five subcategories contained under the variable cost heading:

Grazing fee costs include fees associated with grazing permits on BLM, USFS, state, and private lands.

Feed costs include hay, supplements, salt, minerals, and ranch feedlot charges.

Livestock management costs include supplies (tack, shoeing), and veterinarian services (medicine, services, supplies).

Example 2. Variable Costs



	A	C	D	E	F	P
1	ACTUAL CASH FLOW		Jan.	Feb.	March	Year End
2						Year to Date
45	Variable Costs					
56	Feed					
57	*Hay*				$4,200.00	$12,700.00
58	*Supplement*					
59	Sub1					
60	Sub2					
61	Sub3					
62	*Salt*					$1,200.00
63	*Minerals*					
64	*On Ranch Feedlot Charge*					
65						
66						
67						
68		Sub Totals			$4,200.00	$13,900.00
69	Livestock Management					
70	*Supplies (Shoeing, tack, non medical, etc.)*		$757.00	$1,352.00	$637.00	$6,997.00
71	Tack Purchases					$1,012.00
72	Tack Repair					$125.00
73	Other		$757.00	$1,352.00	$637.00	$5,860.00
74						
75						
76	*Veterinarian Services*		$111.00	$209.00	$142.00	$2,500.00
77	Phaemaceuticals		$111.00			$411.00
78	Services				$142.00	$1,842.00
79	Supplies			$209.00		$247.00
80						
81						
82		Sub Totals	$868.00	$1,561.00	$779.00	$18,994.00

Livestock transportation costs include contract trucking and other hauling costs associated with moving animals.

Marketing costs include commissions, inspection fees, checkoff, and any other costs associated with selling animals.

Example 2 shows the Variable Costs area of the worksheet. In this example, the ranch purchased a load of hay for $4,200 in March. In the feed costs section, 4200 is entered into cell F57. This adds $4,200 to variable costs under the subheading “hay” for March. In this same example, the ranch purchased $111.00 worth of vaccines for the herd in January. In the livestock management section, 111 is entered in cell D77. This adds $111.00 to variable costs under the subheading “pharmaceuticals” for January.

6) Overhead Costs—Overhead costs are those which do not vary with changes in output for the production period under consideration. There are five subcategories contained under the overhead cost heading:

Administration costs include dues and subscriptions, bank charges, advertising/promotion, donations, offices supplies, utilities, insurance, interest expenses, professional (legal & accounting), business travel, and income tax.

Labor costs include state & federal withholding, Medicare, Social Security, contract help, day help, wages, and benefits.

Equipment costs include parts, tires, fuel/oil, and repair/maintenance associated with equipment, such as a bulldozer used for dirt tank repair.

Example 3. Overhead Costs

Microsoft Excel - Ranch Analysis 98 With examples

File Edit View Insert Format Tools Data Window Help

	A / C	H	I	J	P
1	**ACTUAL CASH FLOW**	May	June	July	**Year End**
2					**Year to Date**
98	**Overhead Costs**				
100	**Administration**				
101	*Dues & Subscriptions*				
102	Sub1				
103	Sub2				
107	*Bank Charges*				
108	*Donations*				
109	*Office:*		$27.00	$162.00	$1,282.00
110	Office Supplies		$27.00	$162.00	**$1,282.00**
111	Postage				
112	Equipment Rental				
113	Internet service				
114	*Utilities*	$469.00	$437.00	$592.00	$5,511.00
115	Electricity	$131.00	$397.00	$318.00	**$3,710.00**
116	Telephone	$338.00	$40.00	$274.00	**$1,801.00**
117	Nat. Gas				
118	Propane				
119	Miscellaneous				
120	*Insurance*				
121	Ranch / Vehicle Premiums				
122	Medical				
123	Dental				
124	Vision				
125	*Interest expenses (From below)*				$2,650.40
126	*Professional (accounting/legal)*				
127	Legal Fees				
128	Accounting Fees				
129	Consultant Fees				
130	Miscellaneous				
131	*Business Travel, workshops, Etc.*				**$1,688.00**
132	*Income Tax*				
133					
134					
135					
136					
137	**Sub Totals**	**$469.00**	**$464.00**	**$754.00**	**$11,131.40**

ACTUAL CASH FLOW / PROJECTED CASH FLOW / NET CASH POSITION CHAF

Shows subtotal for month.

Ranch pays utility bill for June.
Electricity: $397.00
Telephone: $40.00

Auto/vehicle costs include parts, tires, fuel/oil, and repair/maintenance associated with vehicles used on the ranch.

Land costs include land taxes and repairs/maintenance. For example, the construction of a road on the ranch would be included under this category.

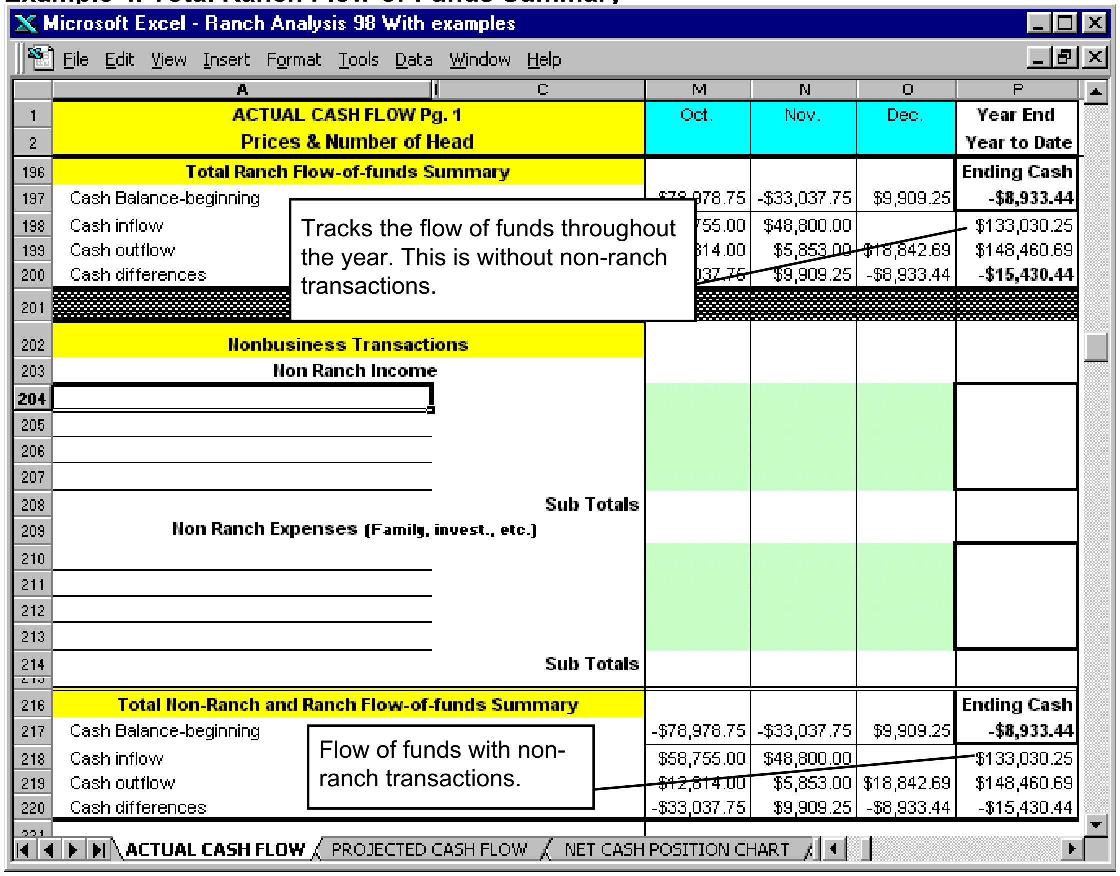
In Example 3, the ranch paid both the electricity bill for $397.00 and the telephone bill for $40.00 in June. In the worksheet, 397 is entered in cell I116 and 40 in entered in cell I117. These transactions are summed up next to the subcategory “Utilities” for June.

7) Debt/Credit Flows—All interest and principal payments are recorded, along with the acquisition of new funds for short, intermediate, and long term loans.

8) Total Ranch Flow of Funds Summary—The difference between all cash receipts (inflows) and expenses (outflows) excluding non-ranch effects are calculated for each month of the production year. This area shows if there is a negative cash balance or positive cash balance.

9) Non-business Transactions—All income generated outside of the ranch and all expenses outside of the ranch are recorded in this area. Income items

Example 4. Total Ranch Flow-of-Funds Summary



may include earnings from a town job, gifts, dividends, and interest. Expense items include food, clothing, home furnishings, and recreation.

10) Total Non-Ranch and Ranch Flow-of-Funds Summary—The differences between all cash inflows and outflows including non-ranch related items are calculated for each month of the production year. This area shows if there is a negative cash balance or positive cash balance (see Example 4).

CONCLUSIONS

While cash flow analysis is an important tool in managing today's ranches, care should be used when interpreting cash-flow analysis. Remember that a cash flow only looks at cash transactions when they are either paid or received, not when they are actually incurred (accrual accounting). Therefore, cash flow is only a measure of cash profits. To get at true profits, accrual accounting is needed to account for not only non-cash items, but also changes in inventories, accounts receivable, and accounts payable. It is a well-known fact that a business can be going broke and still generate a positive cash flow for several years. To overcome the cash flow shortcomings, the spreadsheet template contains many other worksheets to account for information not found on the actual and projected cash flow worksheets.

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FROM:

Arizona Ranchers' Management Guide
Russell Tronstad, George Ruyle, and Jim Sprinkle, Editors.
Arizona Cooperative Extension

MODIFIED CASH PROJECTIONS

Trent Teegerstrom[1], Russell Tronstad[2], and Jim Sprinkle[3]

INTRODUCTION

A cash flow budget is needed to assure that daily financial obligations of the ranch can be met just as an individual needs adequate cash reserves to cover daily account withdrawals. Because ranch expenditures and revenues are much more difficult to predict than typical wages or living expenses, a cash flow budget needs to be more thoroughly planned and developed. If available, historical cash flow values can be used as a basis to make cash flow projections. As the year progresses, actual expenses and revenues are likely to deviate from projections, resulting in a need to analyze how these deviations will affect the financial liquidity and economic performance of the ranch. Within the Control Sheet, cash flow projections can be easily modified in a separate column (Column F) so that financial implications can be easily evaluated. Modifications can be made on individual categories that are shaded in light blue. Consistent with the rest of the ranch analysis worksheet, cells that are not shaded are determined from formulas. It is important to note that when the modification column is activated, the projected year end totals are used, not the actual cash year end totals. The following is an example of how the effects of two unforeseen cash flow changes can be evaluated.

EXAMPLE

It is mid-May and you have just been informed that your 4WD ranch truck has had an engine seize up from a hole that was knocked in the oil pan by a ranch employee. A local mechanic quotes you a price of $2,500.00 to put a rebuilt replacement engine in the truck. To top things off, five steer and five heifer calves have been found dead and are believed to have been killed by a lion that recently moved on your ranch. You would like to assess how these items will affect your overall cash profit per cow for the year.

Steps for evaluating these cash flow changes:

1) Go to the Control Sheet and verify that the Decision Control column is not activated. That is, if a “1” appears in cell H4, type a “0” in this cell to deactivate the planning sheets (see Figure 1).

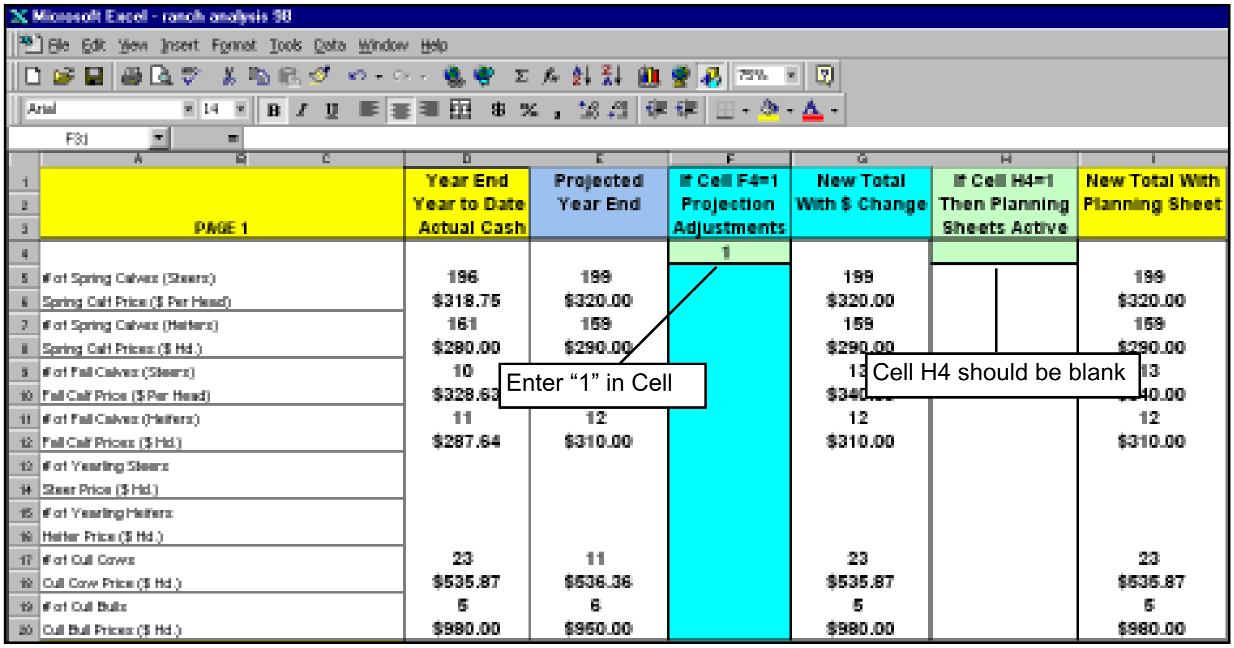
2) Then enter the number “1” in cell F4. This will activate the modified column and override the Actual Cash Flow totals with the Planning Sheet totals.

3) Next record the net cash profit per exposed cow as reported in cell B21 of the Diagnostic Tree Per Exposed Cow. You are now ready to make the changes to the projected cash flow.

4) Return to the Control Sheet and enter -5 in cells F5 and F7, as shown in Figure 2, for the five spring steer and heifer calves lost.

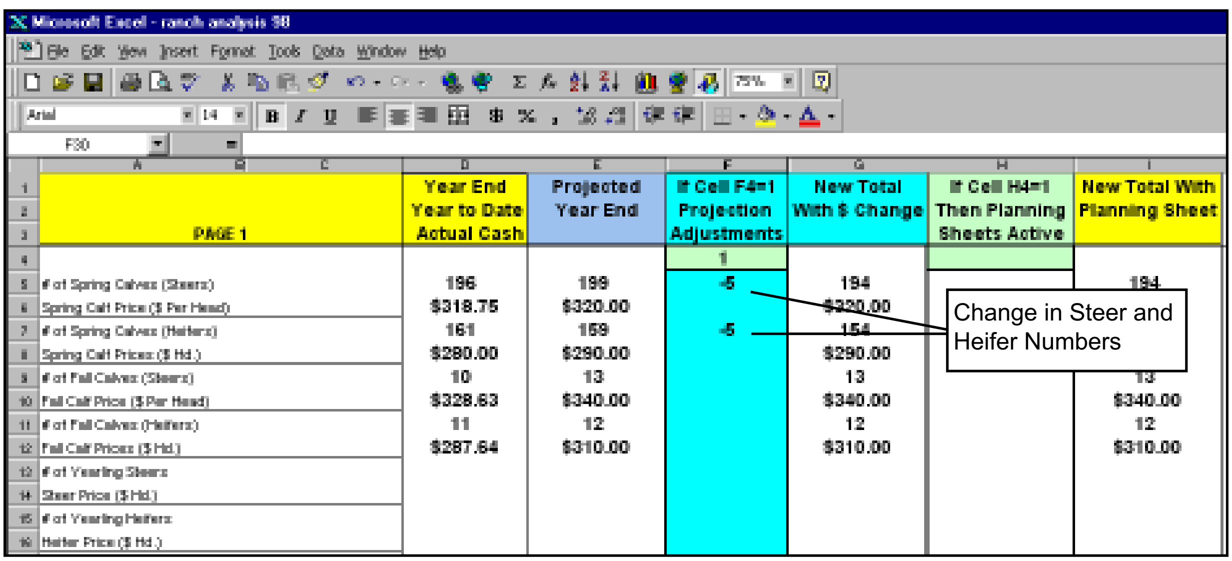
5) The next change needed is the additional cost of the truck engine replacement. Make sure you are still on the Control Sheet. Scroll down to the Overhead Cost section of the Control Sheet until you reach cell F127 and enter $2,500 (see Figure 3). This will be added to the current projected Repairs & Maintenance expenses of $3,282 for a final adjusted total of $5,783. If you would prefer to keep the engine replacement as a separate item, then you could enter the $2,500 in cell F128 (see Figure 4). However

Figure 1. Modified Cash Flow



Row	A	D: Year End Year to Date Actual Cash	E: Projected Year End	F: If Cell F4=1 Projection Adjustments	G: New Total With $ Change	H: If Cell H4=1 Then Planning Sheets Active	I: New Total With Planning Sheet
1–3	PAGE 1						
4				1			
5	# of Spring Calves (Steers)	196	199		199		199
6	Spring Calf Price ($ Per Head)	$318.75	$320.00		$320.00		$320.00
7	# of Spring Calves (Heifers)	161	159		159		159
8	Spring Calf Prices ($ Hd.)	$280.00	$290.00		$290.00		$290.00
9	# of Fall Calves (Steers)	10			13		13
10	Fall Calf Price ($ Per Head)	$328.63			$340		$340.00
11	# of Fall Calves (Heifers)	11	12		12		12
12	Fall Calf Prices ($ Hd.)	$287.64	$310.00		$310.00		$310.00
13	# of Yearling Steers						
14	Steer Price ($ Hd.)						
15	# of Yearling Heifers						
16	Heifer Price ($ Hd.)						
17	# of Cull Cows	23	11		23		23
18	Cull Cow Price ($ Hd.)	$535.87	$536.36		$535.87		$535.87
19	# of Cull Bulls	5	6		5		5
20	Cull Bull Prices ($ Hd.)	$980.00	$950.00		$980.00		$980.00

Figure 2. Calf Head Changes



Row	A	D: Year End Year to Date Actual Cash	E: Projected Year End	F: If Cell F4=1 Projection Adjustments	G: New Total With $ Change	H: If Cell H4=1 Then Planning Sheets Active	I: New Total With Planning Sheet
1–3	PAGE 1						
4				1			
5	# of Spring Calves (Steers)	196	199	-5	194		194
6	Spring Calf Price ($ Per Head)	$318.75	$320.00		$320.00		
7	# of Spring Calves (Heifers)	161	159	-5	154		
8	Spring Calf Prices ($ Hd.)	$280.00	$290.00		$290.00		
9	# of Fall Calves (Steers)	10	13		13		13
10	Fall Calf Price ($ Per Head)	$328.63	$340.00		$340.00		$340.00
11	# of Fall Calves (Heifers)	11	12		12		12
12	Fall Calf Prices ($ Hd.)	$287.64	$310.00		$310.00		$310.00
13	# of Yearling Steers						
14	Steer Price ($ Hd.)						
15	# of Yearling Heifers						
16	Heifer Price ($ Hd.)						

to properly track the expense, you will have to go to the Actual Cash Flow sheet and enter Truck Engine Replacement in cell A165. The new heading will then automatically show on both the Projected Cash Flow Sheet and the Control sheet.

6) Once you have finished adding in the truck engine replacement, return to the Diagnostic Tree Per Exposed Cow and record the net cash profit per exposed cow in cell A19. The new number is -$28.80 per exposed cow. So the net effect of the changes is an additional loss of -$4.88 (-$28.80 minus -$23.92) per exposed cow.

From the example above you can see that the ranch must generate an additional income of $4.88 per exposed cow if it is going to maintain the level of income projected at the start of the

Figure 3. Truck Repair

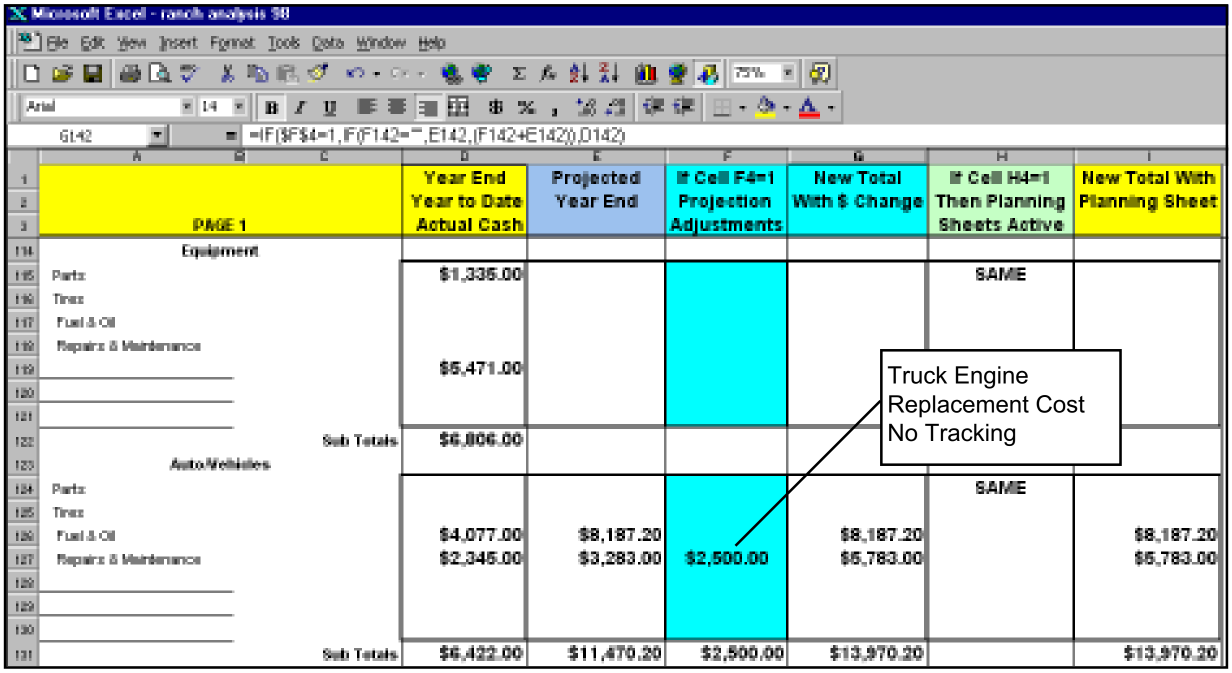
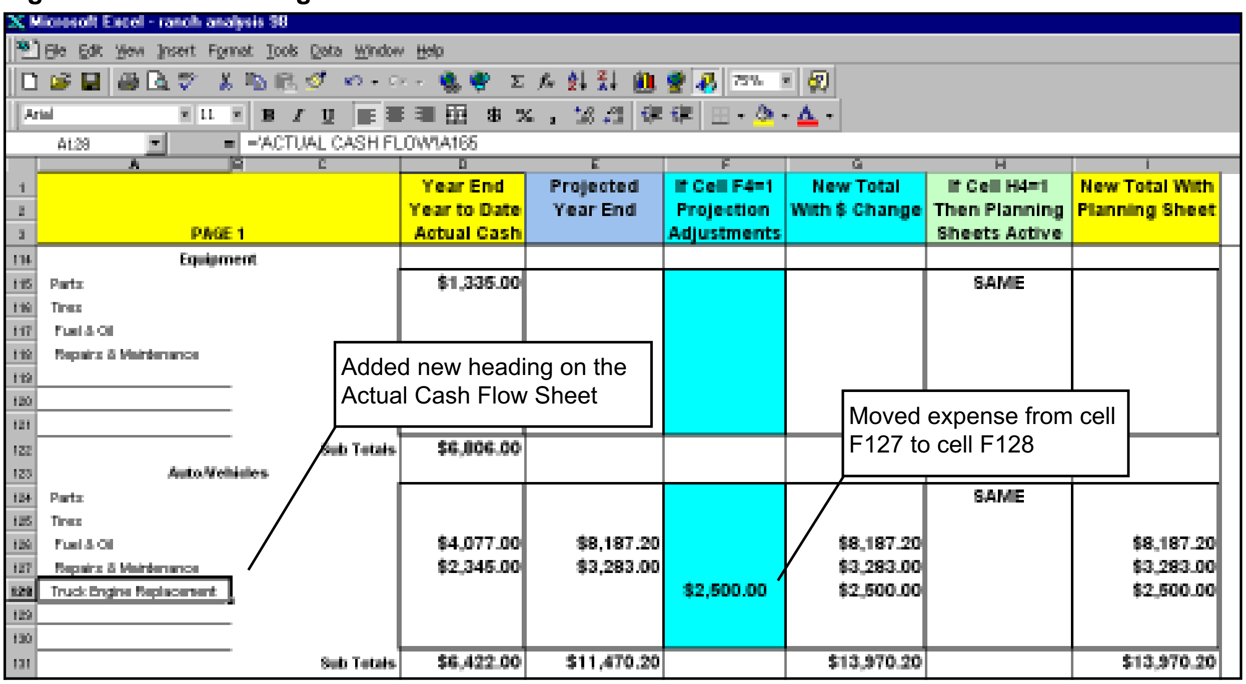


Figure 4. Truck Tracking



year. By determining this shortfall prior to the end of the fiscal year, you can possibly make adjustments to compensate for the shortall and increase the chances of ending the year with a positive cash flow.

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FROM:

Arizona Ranchers' Management Guide
Russell Tronstad, George Ruyle, and Jim Sprinkle, Editors.
Arizona Cooperative Extension

EVALUATING MANAGEMENT DECISIONS

Russell Tronstad[1], Jim Sprinkle[2], and Trent Teegerstrom[3]

INTRODUCTION

One of the main reasons for entering ranch information in a spreadsheet template is to easily evaluate management decisions. A few numbers related to different management decisions can be changed and the computer can instantly provide answers about economic consequences that would most likely take hours to do by hand. This article presents a couple examples on how the ranch financial analysis spreadsheet can be used to evaluate the economic returns of different management decisions. We illustrate how the computer can be used as a tool to answer "what if" questions. An evaluation of decisions before they are actually made allows producers to avoid costly mistakes and hopefully capitalize on the best economic decision. Although the computer can do computations efficiently, quantifying all components of a management decision can be difficult. This is particularly true when dynamics are involved or when a management decision made today impacts future productivity relationships. For these reasons, results from the ranch spreadsheet template need to be interpreted within the context of the management decision under consideration.

Economic returns are calculated for the ranch on a calendar year basis for total and per unit (i.e., exposed cow) returns. Both cash and accrual profits are calculated. An accrual profit measure that accounts for changes in livestock inventories and depreciation of fixed assets is reported in the spreadsheet template. If a management decision does not involve a change in herd composition or animal numbers, the profit per exposed cow should be focused on. An example of this analysis would be supplemental feed to improve weaning weights and possibly herd fertility. Total ranch profit should be analyzed if a management decision involves any change in herd composition or numbers. An example of this type of analysis would be running fewer cows to increase fertility and weaning weights.

In order to compare how much of an impact any management decision will have on ranch profitability, a "base line" of current ranch practices needs to be entered into the ranch financial analysis spreadsheet template. This "base line" of current or normal practices provides a reference point from which alternative management strategies can be evaluated. If one is solely concerned with cash profits, a comparison can be made between alternatives by appropriately modifying cash expenses and revenues in the *Control Sheet*. However, the planning sheets will generally be the easiest and most relevant tool for evaluating alternative management decisions. Expenses and revenues are built from biological relationships and per unit inputs in the planning sheets so that the impact of a change in grazing fee or health expense can be readily evaluated. An example of using the planning sheet for supplemental feeding follows. Please note that to enable the planning sheet, a value of 1 must be entered in cell H4 of the *Control Sheet* (see article entitled, *Overview of Ranch Financial Analysis Spreadsheet*).

SUPPLEMENTAL FEEDING EXAMPLE

The following example assumes that a "base line" has been established or all planning sheets have been filled out to reflect normal practices. Please note that "green shaded" areas of the worksheet indicate areas for the user to provide input, and numbers that are not shaded are determined from formulas that key off entered data. The following example uses data obtained from the University of Arizona, V bar V Ranch for the 1998 calendar year.

Supplemental Feeding Scenario: The proposed management change involves feeding 2 lbs. of protein supplement for 60 days to cows and 80 days to "bred heifers/2-year-olds." These bred heifers at the beginning of the calendar year turn 2 years old and have a calf before the end of the calendar year. Protein supplement will cost $180/ton and we expect to see an increase in weaning weights of 20 lbs. per calf.

Steps for evaluation of the proposed change**:**

1) Verify that the planning sheets are in use or that cell H4 of the *Control Sheet* equals 1. Then print the sheet of *Diagnostic Tree Per Exposed Cow* or write down the resulting cash and accrual profit values per exposed cow. For the V bar V "base line" example, -$42.37/exposed cow for cash profit (cell B21) and $44.76/exposed cow for accrual profit (cell B23) is calculated.

2) The cost of supplemental feed is entered in the *Feed Expense Planning Sheet*. Under the column heading Supplement (Column G), go to shaded cell G18 (bred heifers/2-year-olds) and enter 2 for 2 lbs. of supplement per day. Now enter 2 in cells G19 through G27. This will feed the entire herd 2 lbs. per day. Next, under Column H (Day), go to cell H18 and enter 80 to feed the bred heifers/2-year-olds for 80 days. Now enter 60 in cells H18 through H28 to feed supplement to the rest of the herd for 60 days. Finally, enter or check that 180 is entered in cell J5 to reflect the cost of supplement at $180/ton. This will calculate the cost of feed for each age group of cows and transfer totals to the rest of the spreadsheet template. Your before and after screens in the *Feed Planning Expense Sheet* should look as depicted in Figure 1.

3) Next, go to the *Herd Production Planning Sheet* and in the shaded cells (L8 through L12) under the column Sale Weight increase each of the sale weights by 20. This will increase the weaning weights for steers and heifers for both the spring born calves and the fall born calves. Figure 2 illustrates these changes to the *Herd Production Planning Sheet.*

4) Finally, go back to the *Diagnostic Tree Per Exposed Cow* and compare the new values in cells B21 and B23 with the original values you wrote down earlier. How have they changed?

As shown in Figure 3, cash and accrual profits both decreased by $1.66 (drop from -42.37 to -44.03 for cash and 44.76 to 43.10 for accrual) per equivalent exposed cow. Equivalent exposed cow is from the *Biological Cow Data* worksheet and accounts for cows exposed to the bull last year and any yearlings that were on the ranch. Because this supplemental feeding example did not affect livestock inventories or depreciation adjusted overheads, the change is the same for both cash and accrual profits.

This example could be further extended by inquiring about additional issues. For example, what is the economic impact if calf prices change due to the 20 lb. increase in calf weights? What is the impact on next year's profit level if the fertility for the herd improves? Although the spreadsheet template is not dynamic (i.e., one-year snapshot) in nature, the template can be used to gain insights into multi-period decisions such as herd fertility. First, determine the difference in economic return generated by the spreadsheet template from increasing fertility. Then multiply a discount rate (i.e., 1/[1 + interest rate]) to any increase in return from fertility improving. If market prices remain basically the same for the following year, this approximation is fairly accurate.

EXAMPLE THAT EVALUATES OPTIONS AFTER A RANGE FIRE

Range Fire Scenario: A fire recently swept through your USFS allotment, eliminating the ability to use a 7,000-acre pasture you had planned on grazing for 3 months. At the time of the fire, you had 489 cows and 37 bulls. Because of poor precipitation the previous year, other USFS allotments in the vicinity are currently stocked and unavailable for grazing. The USFS range conservation officer says you can use a 5,300-acre pasture on your allotment that was scheduled to be rested this year, but it will only accommodate 369 cows, 120 less than you have, and 37 bulls for the same 3-month period. You have recently culled some open cows and do not wish to sell any more cows at this time. Most of the cows are already bred. You have three different options you wish to evaluate: (1) Leasing Pasture for Extra Cows, (2) Early Weaning Calves, and (3) Drylot Cows on Ranch.

Steps for Leasing Pasture Option evaluation**:**

1a) A contact you have in Nevada has informed you that irrigated pasture is available for 3 months for 120 cows at a price of $15 per month for each cow/calf unit. You would not haul any bulls since cows should already be bred. You will take only cows that have a spring born calf as side to Nevada. Go to the *Grazing Expense Planning* sheet (see Figure 4), and enter the number of cows by age that you expect to take to Nevada (cells K16 to K24). Then enter 3 in cells L16 through L24 for 3 months of grazing. The pasture price of $15/month is entered in cell M4.

1b) The pasture is 500 miles away and trucking costs $2.00 per loaded mile for each semi-load of cattle. It will take 4 semi-loads going to Nevada (30 cows + calves per load) and 3 semi-loads coming back from Nevada (sell calves in Nevada; 40 cows per load return trip). Go to the *Herd Production Planning Sheet* (see Figure 5) under column Q (Paid/Contract Trucking Costs Without Selling) and enter 500 in cell Q8 for the total miles per trip, 7 in cell Q11 for total number of trips, and 2 in cell Q13 for the cost per mile. Total trucking expense of $7,000 is automatically calculated and shown in cell Q6. Calves shipped to Nevada are expected to weigh 20 lbs./head more than those kept on the ranch. This increases the average sale weight of all spring born calves by 7 lbs./head ([120/341] • 20 = 7.0). Increase the sale weight of calves by 7 lbs. in cells L8 and L9.

1c) Finally, go to the *Diagnostic Tree Per Exposed Cow* and record what the cash and accrual profit is for this leasing pasture option.

Cash Profit (Cell B21) ________

Accrual Profit (Cell B23) _______

As another alternative, you may wish to save the entire file with a different name that associates these numbers with the leased pasture option after the fire. This is especially helpful if you also want to study how the financial ratios and cost and return measures compare under different scenarios.

Early Weaning Calves Option. Since a nonlactating cow will eat only about 70% of a cow/calf unit, by early weaning calves you will be able to maintain all your cows on the 5,300 acre pasture for the next 3 months. The USFS range conservation officer is familiar with the concept of reduced forage intake for nonlactating cows and has allowed similar things to be done on other grazing allotments during drought. You will not have to truck cows to Nevada or rent additional pasture, but calves will weigh about 150 lbs. less when you sell them. Because the calves are 150 lbs. lighter and corn prices are relatively low, you also think that you can sell your calves for $20/cwt. more.

Steps for Early Weaning Calves:

2a) Reverse the steps and entries that were made above in the *Grazing Expense Planning* and *Herd Production Planning Sheets* for the leased pasture option so that "after screens" look like "before screens." If you saved the changes made in the leased pasture option under a new file, just open the original file without any of the leased pasture option changes. Before (i.e., base line) and after values in the *Herd Production Planning Sheet* for reducing calf weight by 150 lbs. and increasing the price per lb. received by $.20 are depicted in Figure 6.

2b) Go to the *Diagnostic Tree Per Exposed Cow* and record what the cash and accrual profit is for this early weaning option.

    Cash Profit (Cell B21) ________

    Accrual Profit (Cell B23) _______

    Figure 7 compares cash and accrual profit values in the *Diagnostic Tree Per Exposed Cow* for the leasing pasture and early weaning options. The leasing pasture option is $12.30 (difference of -59.84 and -72.14 for cash or 27.32 and 15.02 accrual profit) per unit more profitable than the early weaning option.

In addition to looking at changes in total profit, financial ratios, and cost and return measures, the spreadsheet template can be used to get an idea of what you could actually afford to pay for pasture. Simply go to the lease pasture scenario and increase cell M4 in the *Grazing Expense Planning Sheet* until profitability is the same from the leasing pasture or early weaning scenarios. The cost of pasture has to exceed $32.53/month before it is more profitable to do early weaning than lease pasture.

Drylot Option. Another option is to put the 120 additional lactating cows and their calves into a drylot and feed them purchased hay for 90 days rather than lease pasture or early wean calves. Hay can be shipped in for $95 per ton and each pair is expected to consume 25 lbs. per day for the 90-day feeding period. Weaning weights are expected to be the same as if they were shipped to Nevada and put on the leased pasture. But there will be some additional health costs for calves under the drylot option due to crowded conditions and dusty corrals. Health costs are expected to be $.80/head more for calves placed in the drylot.

Steps for Drylot Option:

3a) Reverse the steps and entries that were made above for the early calf weaning option. If you saved the changes made to a new file for the early weaning option, just open the original file without any of the early weaning option changes. In the *Feed Expense Planning Sheet*, feed consumption is calculated for all cows in an entire age group. Using a calculator, 25 lbs. per day for 120 cows for 90 days equals 135 tons ([25•120•90]/2000) of hay. Note that in the *Herd Production Planning Sheet*, 175 cows are in the category of "Unknown > 4." We can adjust the hay consumption to 17.14 lbs. per day (i.e., [120/175]•25) for all the cows in this category to get

135 tons total. That is, enter 17.14 in cell B27 and 90 in cell C27; cell D27 reveals that an additional 135 tons are being bought. The price of $95 per ton is given in cell E5. Figure 8 illustrates these before and after changes.

3b) Go to the *Health Expense Planning Sheet* (see Figure 9), and add additional medicine costs for calves by entering the vaccination label of “LA200” in cell N5. Next, enter the cost per head or .80 in cell O5. Enter 60 in both cells N8 and N9 to reflect the number of steer and heifer calves expected to be given this vaccine.

3c) In the *Herd Production Planning Sheet*, weaning weights need to be increased to the same level as the leased pasture option. Calves in the drylot are expected to weigh 20 lbs. per head more than calves on the range. This increases the average sale weight of all spring born calves by 7 lbs./head ([120/341]•20 = 7.0). Increase the sale weight of calves by 7 lbs. in cells L8 and L9. Also, check to see that trucking costs have been reduced to zero (i.e., cells Q9, Q11, and Q13 equal 0).

3d) Go to the *Diagnostic Tree Per Exposed Cow* and record what the cash and accrual profit is for this drylot option.

Cash Profit (Cell B21) ________

Accrual Profit (Cell B23) ________

As described in Figure 11, cash return from the drylot option is -60.85, or $1.01 less per exposed cow than the return associated with the leasing pasture option (-60.85 minus -59.84). The major expense for the hay feeding option is 135 tons of hay at $95 per ton, or $12,825. Major expenses for the leasing pasture option were $7,000 for trucking and $5,400 for pasture for a total of $12,400. Note that the spreadsheet tool can easily determine at what hay price it becomes more economical to drylot than ship to pasture. By changing cell E5 or the price of hay in the *Feed Expense Planning Sheet,* a hay price of $92.19 per ton results in the same cash return of -59.84 as in the leasing pasture option. If hay can be delivered to the ranch for less than $92.19 per ton, 120 pairs in the drylot would then be the most profitable option. Hay quality would also impact the rate of gain and health expenses.

It is very important to keep in mind that the results produced from the spreadsheet template are no better than the inputs behind the results. For example, you may expose your cows to a disease by shipping them to Nevada and this could increase future vaccination costs and even your death losses. Labor costs might increase from feeding hay in the drylot. These factors could be built into your analysis using the spreadsheet template, but it is very important to realize that results produced are no better than the inputs behind the results.

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Figure 1. Supplemental Feeding: Feed Expense Planning Sheet Changes

Before

Ranch Analysis 98

	A	C	D	E	G	H	I	J
1	**FEED SUMMARY**				**SUPPLEMENT**			
2	©1999 University of Arizona		*48*	*$4,583*			*0*	*$0*
3								
4	Disclaimer: Neither the issuing ind			COST AT				COST AT
5			TONS	$95	LBS/		TONS	$0
6		DAYS	FED	PER TON	DAY	DAYS	FED	PER TON
7	**CALVES - Spr. Born**		**26**	**$2,432**			**0**	**$0**
8	STEER	30	13	$1,216			0	$0
9	HEIFER	30	13	$1,216			0	$0
10	**CALVES - Fall Born**		**2**	**$150**			**0**	**$0**
11	STEER	30	1	$71	0	0	0	$0
12	HEIFER	30	1	$78	0	0	0	$0
13	**YEARLINGS on Ranch for Sale**		**0**	**$0**			**0**	**$0**
14	STEERS	0	0	$0			0	$0
15	HEIFERS	0	0	$0			0	$0
16	**COWS, Breeding Stock**		**21**	**$2,001**			**0**	**$0**
17	Yearlings -- exposed w/out Calf	90	21	$2,001	0	0	0	$0
18	Bred Heifers/2 Year Olds	0	0	$0	0	0	0	$0
19	3 YEAR OLDS	0	0	$0	0	0	0	$0
20	4 YEAR OLDS	0	0	$0	0	0	0	$0
21	5 YEAR OLDS	0	0	$0	0	0	0	$0
22	6 YEAR OLDS	0	0	$0	0	0	0	$0
23	7 YEAR OLDS	0	0	$0	0	0	0	$0
24	8 YEAR OLDS	0	0	$0	0	0	0	$0
25	9 YEAR OLDS	0	0	$0	0	0	0	$0
26	10 YEAR OLDS	0	0	$0	0	0	0	$0
27	UNKNOWN >4	0	0	$0	0	0	0	$0
28	**BULLS**		**0**	**$0**			**0**	**$0**
29	YEARLING	0	0	$0			0	$0
30	2 YEAR OLDS	0	0	$0			0	$0
31	3 YEAR OLDS	0	0	$0			0	$0
32	4 YEAR OLDS	0	0	$0			0	$0

FEED EXPENSE PLANNING SHEET | GRAZING EXPENSE PLANNING SH

After

Ranch Analysis 98

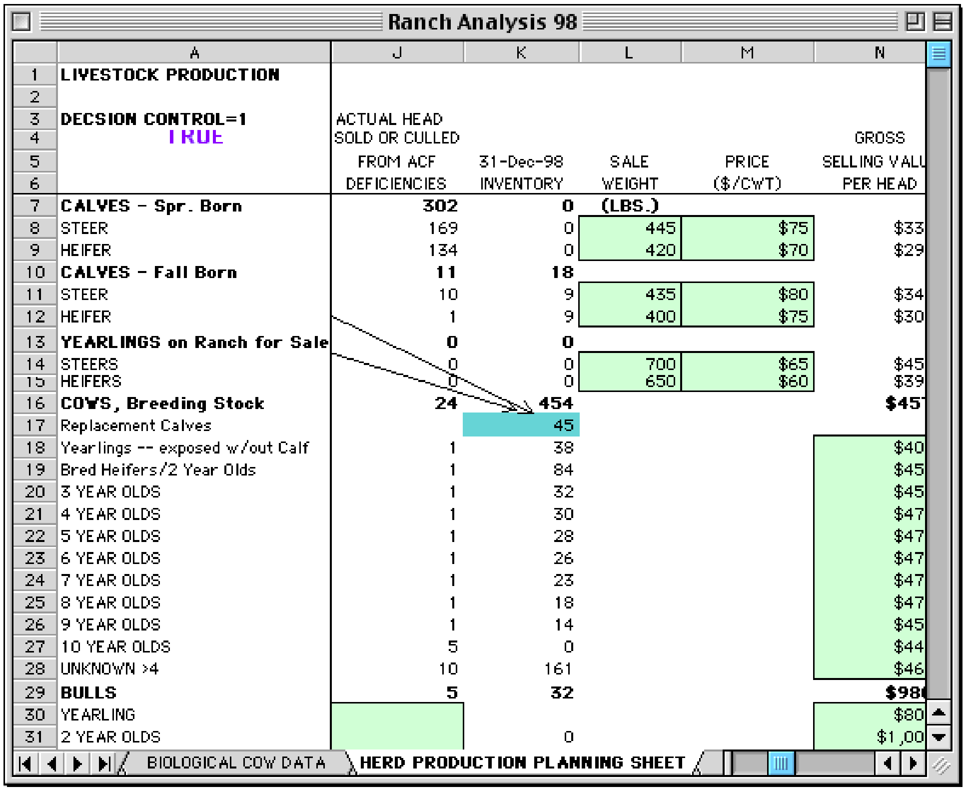
	A	C	D	E	G	H	I	J
1	**FEED SUMMARY**				**SUPPLEMENT**			
2	©1999 University of Arizona		*48*	*$4,583*			*29*	*$5,170*
3								
4	Disclaimer: Neither the issuing ind			COST AT				COST AT
5			TONS	$95	LBS/		TONS	$180
6		DAYS	FED	PER TON	DAY	DAYS	FED	PER TON
7	**CALVES - Spr. Born**		**26**	**$2,432**			**0**	**$0**
8	STEER	30	13	$1,216			0	$0
9	HEIFER	30	13	$1,216			0	$0
10	**CALVES - Fall Born**		**2**	**$150**			**0**	**$0**
11	STEER	30	1	$71	0	0	0	$0
12	HEIFER	30	1	$78	0	0	0	$0
13	**YEARLINGS on Ranch for Sale**		**0**	**$0**			**0**	**$0**
14	STEERS	0	0	$0			0	$0
15	HEIFERS	0	0	$0			0	$0
16	**COWS, Breeding Stock**		**21**	**$2,001**			**29**	**$5,170**
17	Yearlings -- exposed w/out Calf	90	21	$2,001	0	0	0	$0
18	Bred Heifers/2 Year Olds	0	0	$0	2	80	7	$1,238
19	3 YEAR OLDS	0	0	$0	2	60	2	$367
20	4 YEAR OLDS	0	0	$0	2	60	2	$346
21	5 YEAR OLDS	0	0	$0	2	60	2	$324
22	6 YEAR OLDS	0	0	$0	2	60	2	$302
23	7 YEAR OLDS	0	0	$0	2	60	2	$270
24	8 YEAR OLDS	0	0	$0	2	60	1	$216
25	9 YEAR OLDS	0	0	$0	2	60	1	$162
26	10 YEAR OLDS	0	0	$0	2	60	0	$54
27	UNKNOWN >4	0	0	$0	2	60	11	$1,890
28	**BULLS**		**0**	**$0**			**0**	**$0**
29	YEARLING	0	0	$0			0	$0
30	2 YEAR OLDS	0	0	$0			0	$0
31	3 YEAR OLDS	0	0	$0			0	$0
32	4 YEAR OLDS	0	0	$0			0	$0

Changes

FEED EXPENSE PLANNING SHEET | GRAZING EXPENSE PLANNING SH

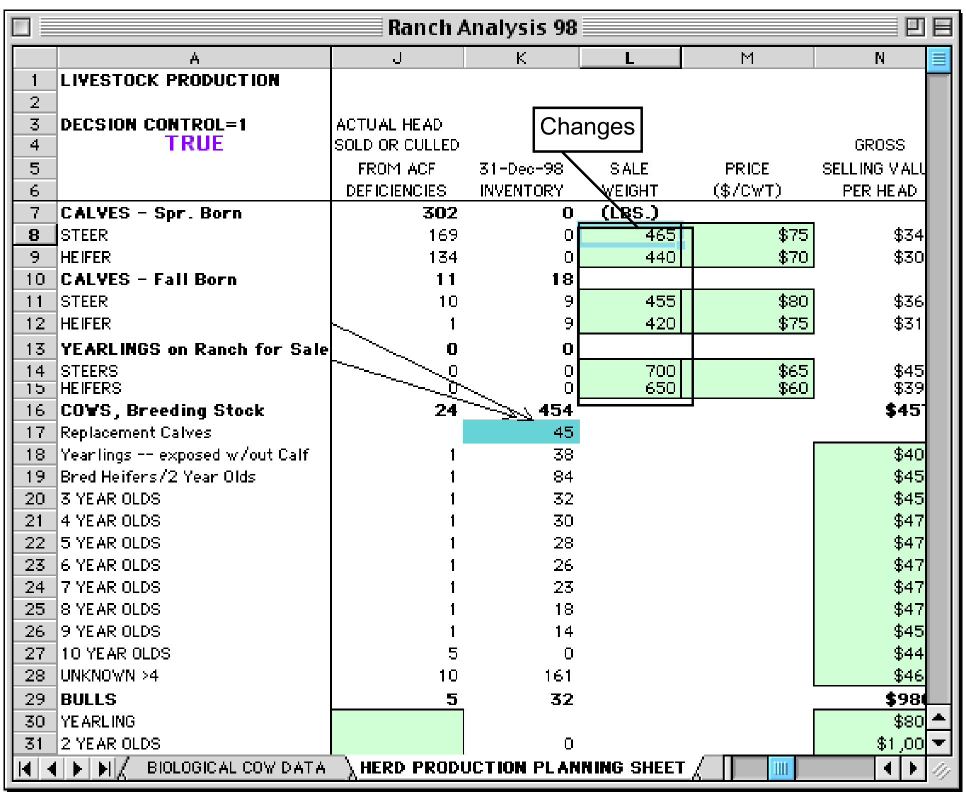
Figure 2. Supplemental Feeding: Herd Production Planning Sheet Changes

Before



	A	J	K	L	M	N
1	**LIVESTOCK PRODUCTION**					
2						
3	**DECSION CONTROL=1**	ACTUAL HEAD				
4	TRUE	SOLD OR CULLED				GROSS
5		FROM ACF	31-Dec-98	SALE	PRICE	SELLING VALU
6		DEFICIENCIES	INVENTORY	WEIGHT	($/CWT)	PER HEAD
7	**CALVES - Spr. Born**	**302**	**0**	**(LBS.)**		
8	STEER	169	0	445	$75	$33
9	HEIFER	134	0	420	$70	$29
10	**CALVES - Fall Born**	**11**	**18**			
11	STEER	10	9	435	$80	$34
12	HEIFER	1	9	400	$75	$30
13	**YEARLINGS on Ranch for Sale**	**0**	**0**			
14	STEERS	0	0	700	$65	$45
15	HEIFERS	0	0	650	$60	$39
16	**COWS, Breeding Stock**	**24**	**454**			**$457**
17	Replacement Calves		45			
18	Yearlings -- exposed w/out Calf	1	38			$40
19	Bred Heifers/2 Year Olds	1	84			$45
20	3 YEAR OLDS	1	32			$45
21	4 YEAR OLDS	1	30			$47
22	5 YEAR OLDS	1	28			$47
23	6 YEAR OLDS	1	26			$47
24	7 YEAR OLDS	1	23			$47
25	8 YEAR OLDS	1	18			$47
26	9 YEAR OLDS	1	14			$45
27	10 YEAR OLDS	5	0			$44
28	UNKNOWN >4	10	161			$46
29	**BULLS**	**5**	**32**			**$98**
30	YEARLING					$80
31	2 YEAR OLDS		0			$1,00

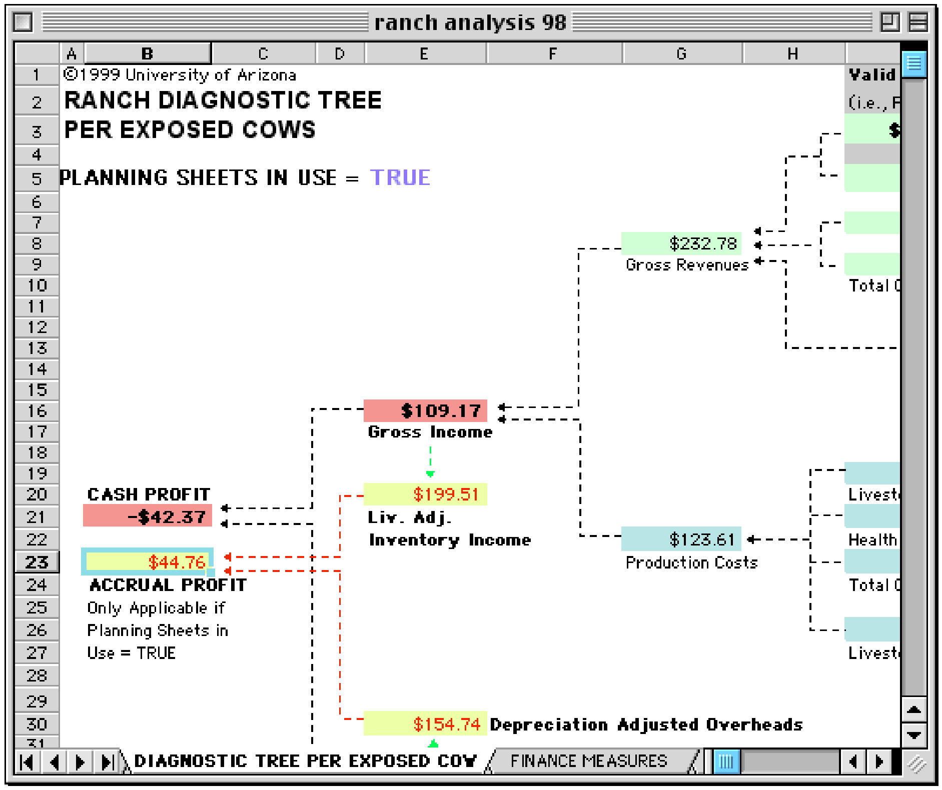
After



	A	J	K	L	M	N
1	**LIVESTOCK PRODUCTION**					
2						
3	**DECSION CONTROL=1**	ACTUAL HEAD				
4	TRUE	SOLD OR CULLED				GROSS
5		FROM ACF	31-Dec-98	SALE	PRICE	SELLING VALU
6		DEFICIENCIES	INVENTORY	WEIGHT	($/CWT)	PER HEAD
7	**CALVES - Spr. Born**	**302**	**0**	**(LBS.)**		
8	STEER	169	0	465	$75	$34
9	HEIFER	134	0	440	$70	$30
10	**CALVES - Fall Born**	**11**	**18**			
11	STEER	10	9	455	$80	$36
12	HEIFER	1	9	420	$75	$31
13	**YEARLINGS on Ranch for Sale**	**0**	**0**			
14	STEERS	0	0	700	$65	$45
15	HEIFERS	0	0	650	$60	$39
16	**COWS, Breeding Stock**	**24**	**454**			**$457**
17	Replacement Calves		45			
18	Yearlings -- exposed w/out Calf	1	38			$40
19	Bred Heifers/2 Year Olds	1	84			$45
20	3 YEAR OLDS	1	32			$45
21	4 YEAR OLDS	1	30			$47
22	5 YEAR OLDS	1	28			$47
23	6 YEAR OLDS	1	26			$47
24	7 YEAR OLDS	1	23			$47
25	8 YEAR OLDS	1	18			$47
26	9 YEAR OLDS	1	14			$45
27	10 YEAR OLDS	5	0			$44
28	UNKNOWN >4	10	161			$46
29	**BULLS**	**5**	**32**			**$98**
30	YEARLING					$80
31	2 YEAR OLDS		0			$1,00

Figure 3. Supplemental Feeding: Diagnostic Tree Per Exposed Cow Changes

Before



After

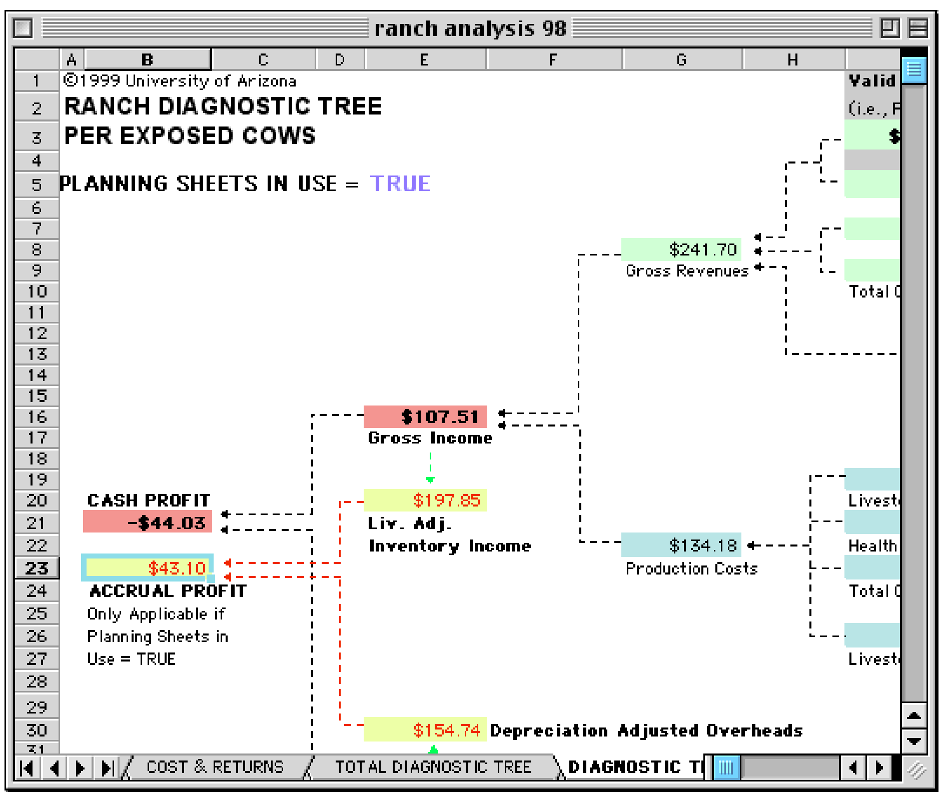
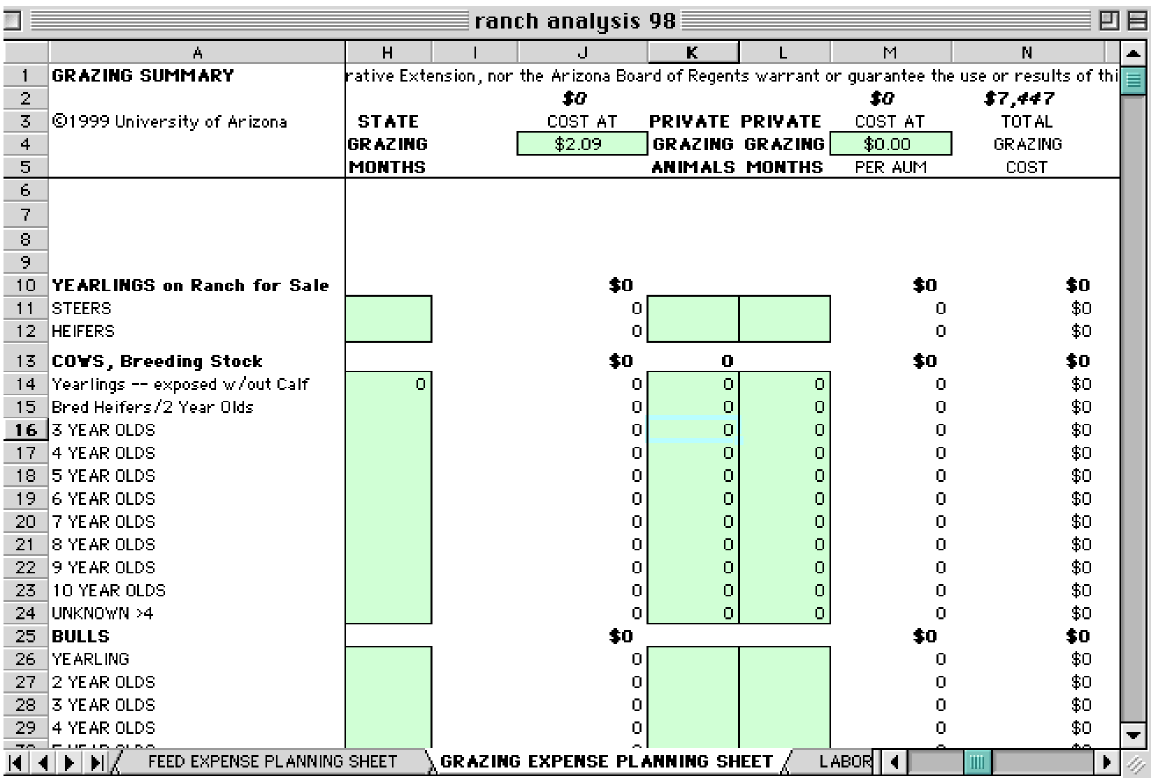


Figure 4. Range Fire (Leasing Pasture Option): Grazing Expense Planning Sheet Changes

Before

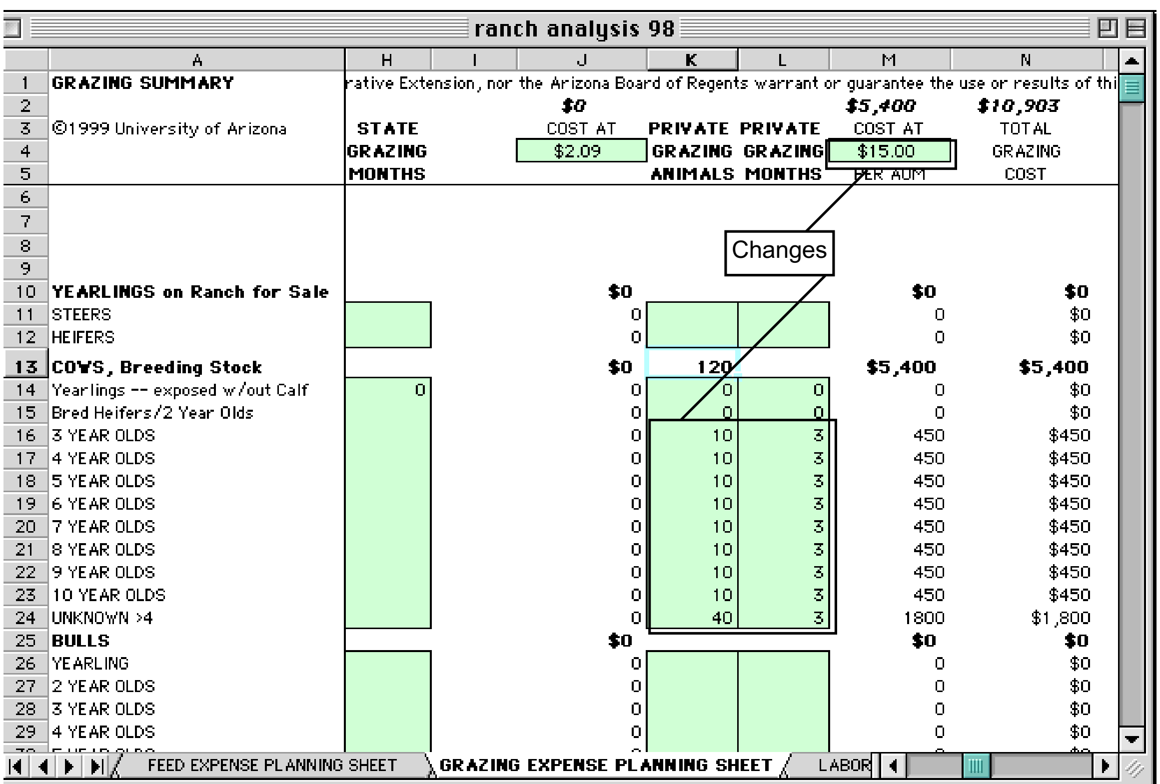


ranch analysis 98

	A	H	I	J	K	L	M	N
1	GRAZING SUMMARY	rative Extension, nor the Arizona Board of Regents warrant or guarantee the use or results of thi						
2				$0			$0	$7,447
3	©1999 University of Arizona	STATE		COST AT	PRIVATE	PRIVATE	COST AT	TOTAL
4		GRAZING		$2.09	GRAZING	GRAZING	$0.00	GRAZING
5		MONTHS			ANIMALS	MONTHS	PER AUM	COST
6								
7								
8								
9								
10	YEARLINGS on Ranch for Sale			$0			$0	$0
11	STEERS			0			0	$0
12	HEIFERS			0			0	$0
13	COWS, Breeding Stock			$0	0		$0	$0
14	Yearlings -- exposed w/out Calf	0		0	0	0	0	$0
15	Bred Heifers/2 Year Olds			0	0	0	0	$0
16	3 YEAR OLDS			0	0	0	0	$0
17	4 YEAR OLDS			0	0	0	0	$0
18	5 YEAR OLDS			0	0	0	0	$0
19	6 YEAR OLDS			0	0	0	0	$0
20	7 YEAR OLDS			0	0	0	0	$0
21	8 YEAR OLDS			0	0	0	0	$0
22	9 YEAR OLDS			0	0	0	0	$0
23	10 YEAR OLDS			0	0	0	0	$0
24	UNKNOWN >4			0	0	0	0	$0
25	BULLS			$0			$0	$0
26	YEARLING			0			0	$0
27	2 YEAR OLDS			0			0	$0
28	3 YEAR OLDS			0			0	$0
29	4 YEAR OLDS			0			0	$0

FEED EXPENSE PLANNING SHEET | GRAZING EXPENSE PLANNING SHEET | LABOR

After



ranch analysis 98

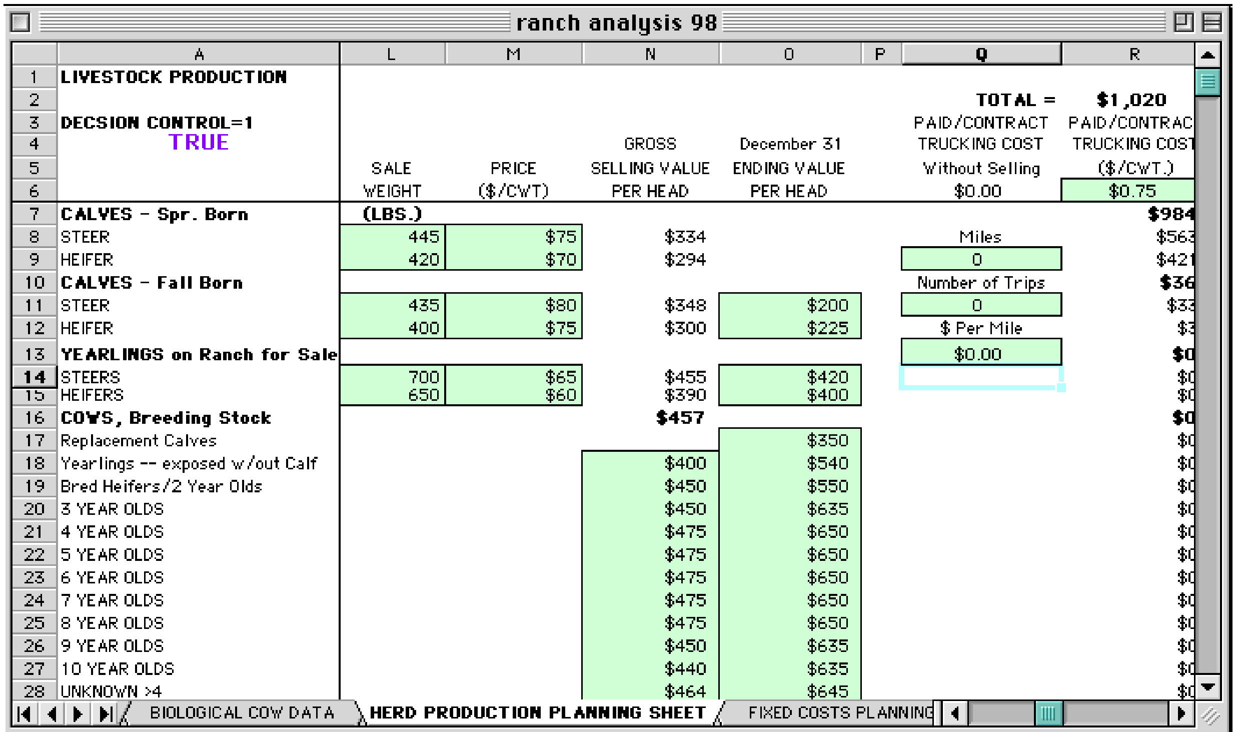
	A	H	I	J	K	L	M	N
1	GRAZING SUMMARY	rative Extension, nor the Arizona Board of Regents warrant or guarantee the use or results of thi						
2				$0			$5,400	$10,903
3	©1999 University of Arizona	STATE		COST AT	PRIVATE	PRIVATE	COST AT	TOTAL
4		GRAZING		$2.09	GRAZING	GRAZING	$15.00	GRAZING
5		MONTHS			ANIMALS	MONTHS	PER AUM	COST
6								
7								
8								
9								
10	YEARLINGS on Ranch for Sale			$0			$0	$0
11	STEERS			0			0	$0
12	HEIFERS			0			0	$0
13	COWS, Breeding Stock			$0	120		$5,400	$5,400
14	Yearlings -- exposed w/out Calf	0		0	0	0	0	$0
15	Bred Heifers/2 Year Olds			0	0	0	0	$0
16	3 YEAR OLDS			0	10	3	450	$450
17	4 YEAR OLDS			0	10	3	450	$450
18	5 YEAR OLDS			0	10	3	450	$450
19	6 YEAR OLDS			0	10	3	450	$450
20	7 YEAR OLDS			0	10	3	450	$450
21	8 YEAR OLDS			0	10	3	450	$450
22	9 YEAR OLDS			0	10	3	450	$450
23	10 YEAR OLDS			0	10	3	450	$450
24	UNKNOWN >4			0	40	3	1800	$1,800
25	BULLS			$0			$0	$0
26	YEARLING			0			0	$0
27	2 YEAR OLDS			0			0	$0
28	3 YEAR OLDS			0			0	$0
29	4 YEAR OLDS			0			0	$0

Changes

FEED EXPENSE PLANNING SHEET | GRAZING EXPENSE PLANNING SHEET | LABOR

Figure 5. Range Fire (Leasing Pasture Option): Herd Production Planning Sheet Changes

Before

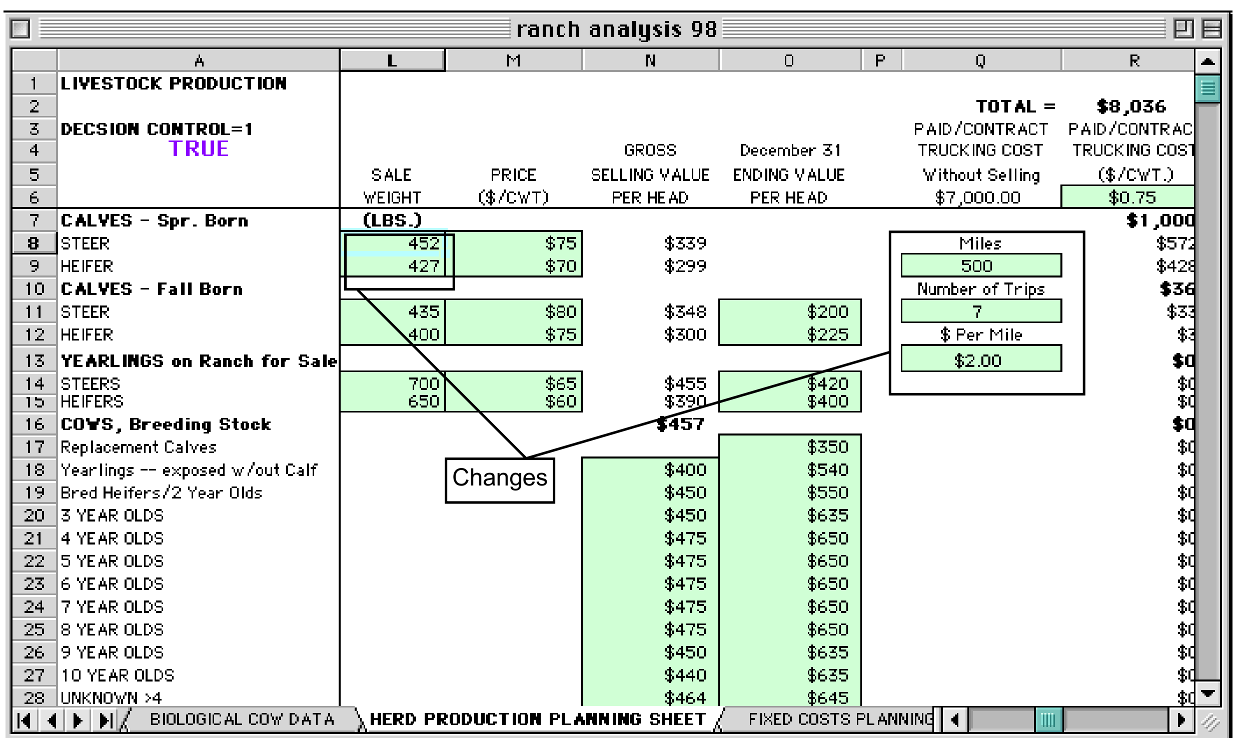


ranch analysis 98

	A	L	M	N	O	P	Q	R
1	LIVESTOCK PRODUCTION							
2							TOTAL =	$1,020
3	DECSION CONTROL=1						PAID/CONTRACT	PAID/CONTRAC
4	TRUE			GROSS	December 31		TRUCKING COST	TRUCKING COST
5		SALE	PRICE	SELLING VALUE	ENDING VALUE		Without Selling	($/CWT.)
6		WEIGHT	($/CWT)	PER HEAD	PER HEAD		$0.00	$0.75
7	CALVES - Spr. Born	(LBS.)						$984
8	STEER	445	$75	$334			Miles	$563
9	HEIFER	420	$70	$294			0	$421
10	CALVES - Fall Born						Number of Trips	$36
11	STEER	435	$80	$348	$200		0	$33
12	HEIFER	400	$75	$300	$225		$ Per Mile	$3
13	YEARLINGS on Ranch for Sale						$0.00	$0
14	STEERS	700	$65	$455	$420			$0
15	HEIFERS	650	$60	$390	$400			$0
16	COWS, Breeding Stock			$457				$0
17	Replacement Calves				$350			$0
18	Yearlings -- exposed w/out Calf			$400	$540			$0
19	Bred Heifers/2 Year Olds			$450	$550			$0
20	3 YEAR OLDS			$450	$635			$0
21	4 YEAR OLDS			$475	$650			$0
22	5 YEAR OLDS			$475	$650			$0
23	6 YEAR OLDS			$475	$650			$0
24	7 YEAR OLDS			$475	$650			$0
25	8 YEAR OLDS			$475	$650			$0
26	9 YEAR OLDS			$450	$635			$0
27	10 YEAR OLDS			$440	$635			$0
28	UNKNOWN >4			$464	$645			$0

BIOLOGICAL COW DATA / HERD PRODUCTION PLANNING SHEET / FIXED COSTS PLANNING

After



ranch analysis 98

	A	L	M	N	O	P	Q	R
1	LIVESTOCK PRODUCTION							
2							TOTAL =	$8,036
3	DECSION CONTROL=1						PAID/CONTRACT	PAID/CONTRAC
4	TRUE			GROSS	December 31		TRUCKING COST	TRUCKING COST
5		SALE	PRICE	SELLING VALUE	ENDING VALUE		Without Selling	($/CWT.)
6		WEIGHT	($/CWT)	PER HEAD	PER HEAD		$7,000.00	$0.75
7	CALVES - Spr. Born	(LBS.)						$1,000
8	STEER	452	$75	$339			Miles	$572
9	HEIFER	427	$70	$299			500	$428
10	CALVES - Fall Born						Number of Trips	$36
11	STEER	435	$80	$348	$200		7	$33
12	HEIFER	400	$75	$300	$225		$ Per Mile	$3
13	YEARLINGS on Ranch for Sale						$2.00	$0
14	STEERS	700	$65	$455	$420			$0
15	HEIFERS	650	$60	$390	$400			$0
16	COWS, Breeding Stock			$457				$0
17	Replacement Calves				$350			$0
18	Yearlings -- exposed w/out Calf			$400	$540			$0
19	Bred Heifers/2 Year Olds			$450	$550			$0
20	3 YEAR OLDS			$450	$635			$0
21	4 YEAR OLDS			$475	$650			$0
22	5 YEAR OLDS			$475	$650			$0
23	6 YEAR OLDS			$475	$650			$0
24	7 YEAR OLDS			$475	$650			$0
25	8 YEAR OLDS			$475	$650			$0
26	9 YEAR OLDS			$450	$635			$0
27	10 YEAR OLDS			$440	$635			$0
28	UNKNOWN >4			$464	$645			$0

Changes

BIOLOGICAL COW DATA / HERD PRODUCTION PLANNING SHEET / FIXED COSTS PLANNING

Figure 6. Range Fire (Early Weaning Option): Herd Production Planning Sheet Changes

Before

ranch analysis 98

	A	L	M	N	O	P	Q	R
1	**LIVESTOCK PRODUCTION**							
2							**TOTAL =**	**$1,020**
3	**DECSION CONTROL=1**						PAID/CONTRACT	PAID/CONTRAC
4	TRUE			GROSS	December 31		TRUCKING COST	TRUCKING COST
5		SALE	PRICE	SELLING VALUE	ENDING VALUE		Without Selling	($/CWT.)
6		WEIGHT	($/CWT)	PER HEAD	PER HEAD		$0.00	$0.75
7	**CALVES - Spr. Born**	**(LBS.)**						**$984**
8	STEER	445	$75	$334			Miles	$563
9	HEIFER	420	$70	$294			0	$421
10	**CALVES - Fall Born**						Number of Trips	**$36**
11	STEER	435	$80	$348	$200		0	$33
12	HEIFER	400	$75	$300	$225		$ Per Mile	$3
13	**YEARLINGS on Ranch for Sale**						$0.00	**$0**
14	STEERS	700	$65	$455	$420			$0
15	HEIFERS	650	$60	$390	$400			$0
16	**COWS, Breeding Stock**			**$457**				**$0**
17	Replacement Calves				$350			$0
18	Yearlings -- exposed w/out Calf			$400	$540			$0
19	Bred Heifers/2 Year Olds			$450	$550			$0
20	3 YEAR OLDS			$450	$635			$0
21	4 YEAR OLDS			$475	$650			$0
22	5 YEAR OLDS			$475	$650			$0
23	6 YEAR OLDS			$475	$650			$0
24	7 YEAR OLDS			$475	$650			$0
25	8 YEAR OLDS			$475	$650			$0
26	9 YEAR OLDS			$450	$635			$0
27	10 YEAR OLDS			$440	$635			$0
28	UNKNOWN >4			$464	$645			$0

BIOLOGICAL COW DATA | **HERD PRODUCTION PLANNING SHEET** | FIXED COSTS PLANNING

After

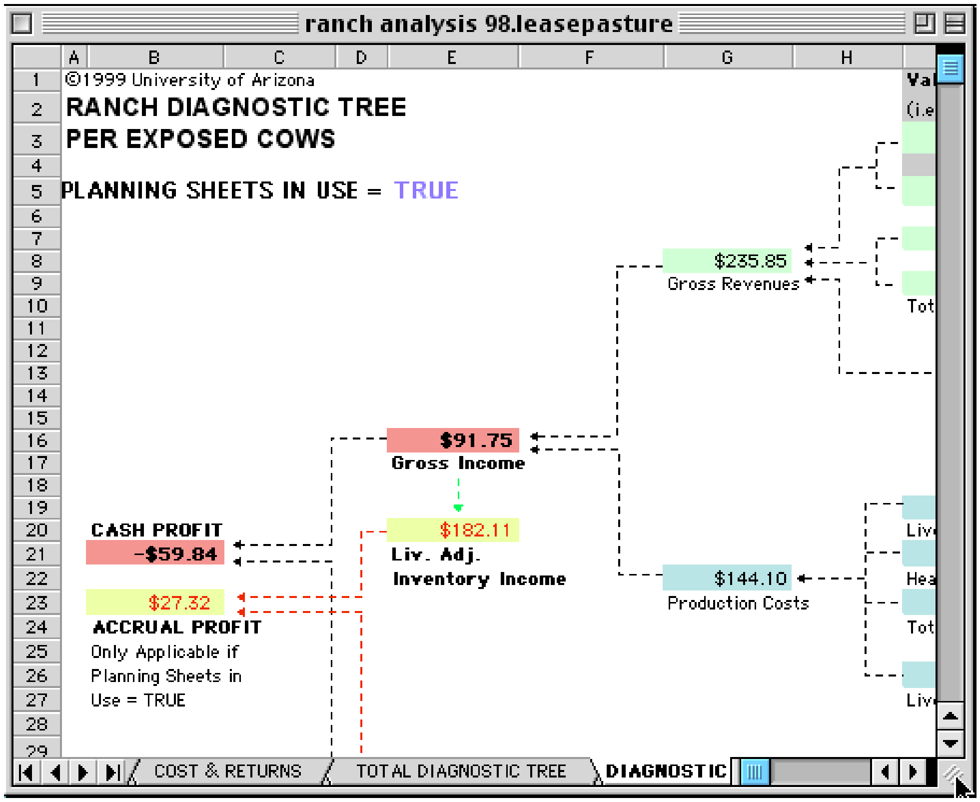
ranch analysis 98

	A	L	M	N	O	P	Q	R
1	**LIVESTOCK PRODUCTION**							
2							**TOTAL =**	**$680**
3	**DECSION CONTROL=1**						PAID/CONTRACT	PAID/CONTRAC
4	TRUE			GROSS	December 31		TRUCKING COST	TRUCKING COST
5		SALE	PRICE	SELLING VALUE	ENDING VALUE		Without Selling	($/CWT.)
6		WEIGHT	($/CWT)	PER HEAD	PER HEAD		$0.00	$0.75
7	**CALVES - Spr. Born**	**(LBS.)**						**$644**
8	STEER	295	$95	$280			Miles	$373
9	HEIFER	270	$90	$243			0	$271
10	**CALVES - Fall Born**						Number of Trips	**$36**
11	STEER	435	$80	$348	$200		0	$33
12	HEIFER	400	$75	$300	$225		$ Per Mile	$3
13	**YEARLINGS on Ranch for Sale**						$0.00	**$0**
14	STEERS	700	$65	$455	$420			$0
15	HEIFERS	650	$60	$390	$400			$0
16	**COWS, Breeding Stock**			**$457**				**$0**
17	Replacement Calves	Changes			$350			$0
18	Yearlings -- exposed w/out Calf			$400	$540			$0
19	Bred Heifers/2 Year Olds			$450	$550			$0
20	3 YEAR OLDS			$450	$635			$0
21	4 YEAR OLDS			$475	$650			$0
22	5 YEAR OLDS			$475	$650			$0
23	6 YEAR OLDS			$475	$650			$0
24	7 YEAR OLDS			$475	$650			$0
25	8 YEAR OLDS			$475	$650			$0
26	9 YEAR OLDS			$450	$635			$0
27	10 YEAR OLDS			$440	$635			$0
28	UNKNOWN >4			$464	$645			$0

HERD PRODUCTION PLANNING SHEET | FIXED COSTS PLANNING SHEET | QUICKBOOKS

Figure 7. Range Fire: Leasing Pasture vs. Early Weaning Comparison

Leasing Pasture



Early Weaning

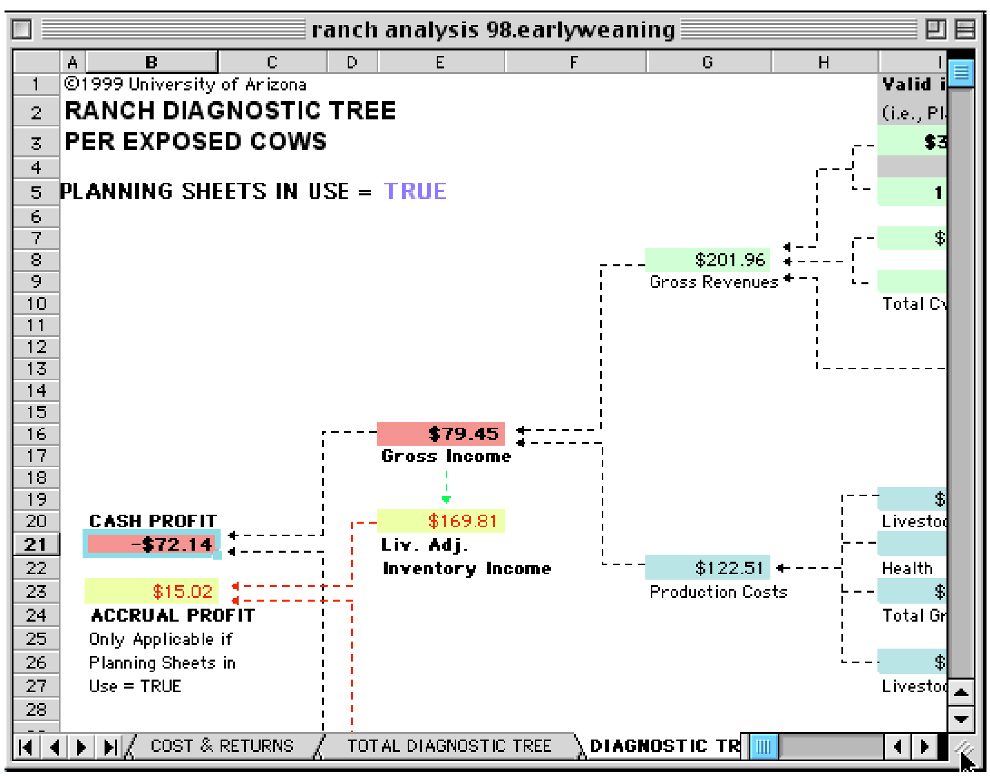


Figure 8. Range Fire (Drylot Option): Feed Expense Planning Sheet Changes

Before

ranch analysis 98

	A	B	C	D	E	F	G	H	I
1	**FEED SUMMARY**	**HAY**					**SUPPLEMENT**		
2	©1999 University of Arizona			***48***	***$4,583***				***0***
3									
4	Disclaimer: Neither the issuing ind				COST AT				
5		LBS/		TONS	$95		LBS/		TONS
6		DAY	DAYS	FED	PER TON		DAY	DAYS	FED
7	**CALVES - Spr. Born**			**26**	**$2,432**				**0**
8	STEER	5	30	13	$1,216				0
9	HEIFER	5	30	13	$1,216				0
10	**CALVES - Fall Born**			**2**	**$150**				**0**
11	STEER	5	30	1	$71		0	0	0
12	HEIFER	5	30	1	$78		0	0	0
13	**YEARLINGS on Ranch for Sale**			**0**	**$0**				**0**
14	STEERS	0	0	0	$0				0
15	HEIFERS	0	0	0	$0				0
16	**COWS, Breeding Stock**			**21**	**$2,001**				**0**
17	Yearlings -- exposed w/out Calf	12	90	21	$2,001		0	0	0
18	Bred Heifers/2 Year Olds	0	0	0	$0		2	0	0
19	3 YEAR OLDS	0	0	0	$0		2	0	0
20	4 YEAR OLDS	0	0	0	$0		2	0	0
21	5 YEAR OLDS	0	0	0	$0		2	0	0
22	6 YEAR OLDS	0	0	0	$0		2	0	0
23	7 YEAR OLDS	0	0	0	$0		2	0	0
24	8 YEAR OLDS	0	0	0	$0		2	0	0
25	9 YEAR OLDS	0	0	0	$0		2	0	0
26	10 YEAR OLDS	0	0	0	$0		2	0	0
27	UNKNOWN >4	0	0	0	$0		2	0	0
28	**BULLS**			**0**	**$0**				**0**

FEED EXPENSE PLANNING SHEET / GRAZING EXPENSE PLANNI

After

ranch analysis 98

	A	B	C	D	E	F	G	H	I
1	**FEED SUMMARY**	**HAY**					**SUPPLEMENT**		
2	©1999 University of Arizona			***183***	***$17,405***				***0***
3									
4	Disclaimer: Neither the issuing ind				COST AT				
5		LBS/		TONS	$95		LBS/		TONS
6		DAY	DAYS	FED	PER TON		DAY	DAYS	FED
7	**CALVES - Spr. Born**			**26**	**$2,432**				**0**
8	STEER	5	30	13	$1,216				0
9	HEIFER	5	30	13	$1,216				0
10	**CALVES - Fall Born**			**2**	**$150**				**0**
11	STEER	5	30	1	$71		0	0	0
12	HEIFER	5	30	1	$78		0	0	0
13	**YEARLINGS on Ranch for Sale**			**0**	**$0**				**0**
14	STEERS	0	0	0	$0				0
15	HEIFERS	0	0	0	$0				0
16	**COWS, Breeding Stock**			**156**	**$14,824**				**0**
17	Yearlings -- exposed w/out Calf	12	90	21	$2,001		0	0	0
18	Bred Heifers/2 Year Olds	0	0	0	$0		2	0	0
19	3 YEAR OLDS	0	0	0	$0		2	0	0
20	4 YEAR OLDS	0	0	0	$0		2	0	0
21	5 YEAR OLDS	0	0	0	$0		2	0	0
22	6 YEAR OLDS	0	0	0	$0		2	0	0
23	7 YEAR OLDS	0	0	0	$0		2	0	0
24	8 YEAR OLDS	0	0	0	$0		2	0	0
25	9 YEAR OLDS	0	0	0	$0		2	0	0
26	10 YEAR OLDS	0	0	0	$0		2	0	0
27	UNKNOWN >4	17	90	135	$12,823		2	0	0
28	**BULLS**			**0**	**$0**				**0**

Changes

FEED EXPENSE PLANNING SHEET / GRAZING EXPENSE PLANNI

Figure 9. Range Fire (Drylot Option): Health Expense Planning Sheet Changes

Before

ranch analysis 98

	A	K	L	M	N	O	P
1	**HEALTH EXPENSES**		**DECISION CONTROL=1**			**TRUE**	
2	©1999 University of Arizona	***$71***		***$0***		***$0***	
3							
4	Disclaimer: Neither the issuing in	COST	MED.	COST	MED.	COST	MED.
5		$0.20		$0			
6		EACH	3 WAY	EACH		EACH	
7	**CALVES - Spr. Born**	**$66.40**	**# Head**	**$0.00**	**# Head**	**$0.00**	**# Head**
8	STEER	$33.20	1	$0.00	0	$0.00	0
9	HEIFER	$33.20	1	$0.00	0	$0.00	0
10	**CALVES - Fall Born**	**$4.20**		**$0.00**		**$0.00**	
11	STEER	$2.00	1	$0.00	0	$0.00	0
12	HEIFER	$2.20	1	$0.00	0	$0.00	0
13	**YEARLINGS on Ranch for Sal**	**$0.00**		**$0.00**		**$0.00**	
14	STEERS	$0.00	0	$0.00	0	$0.00	0
15	HEIFERS	$0.00	0	$0.00	0	$0.00	0
16	**COWS, Breeding Stock**	**$0.00**		**$0.00**		**$0.00**	
17	Replacement Calves	$0.00	0	$0.00	0	$0.00	0
18	Yearlings -- exposed w/out Calf	$0.00	0	$0.00	0	$0.00	0
19	Bred Heifers/2 Year Olds	$0.00	0	$0.00	0	$0.00	0
20	3 YEAR OLDS	$0.00	0	$0.00	0	$0.00	0
21	4 YEAR OLDS	$0.00	0	$0.00	0	$0.00	0
22	5 YEAR OLDS	$0.00	0	$0.00	0	$0.00	0
23	6 YEAR OLDS	$0.00	0	$0.00	0	$0.00	0
24	7 YEAR OLDS	$0.00	0	$0.00	0	$0.00	0
25	8 YEAR OLDS	$0.00	0	$0.00	0	$0.00	0
26	9 YEAR OLDS	$0.00	0	$0.00	0	$0.00	0
27	10 YEAR OLDS	$0.00	0	$0.00	0	$0.00	0
28	UNKNOWN >4	$0.00	0	$0.00	0	$0.00	0

HEALTH EXPENSE PLANNING SHEET / FEED EXPENSE PLANNIN

After

ranch analysis 98

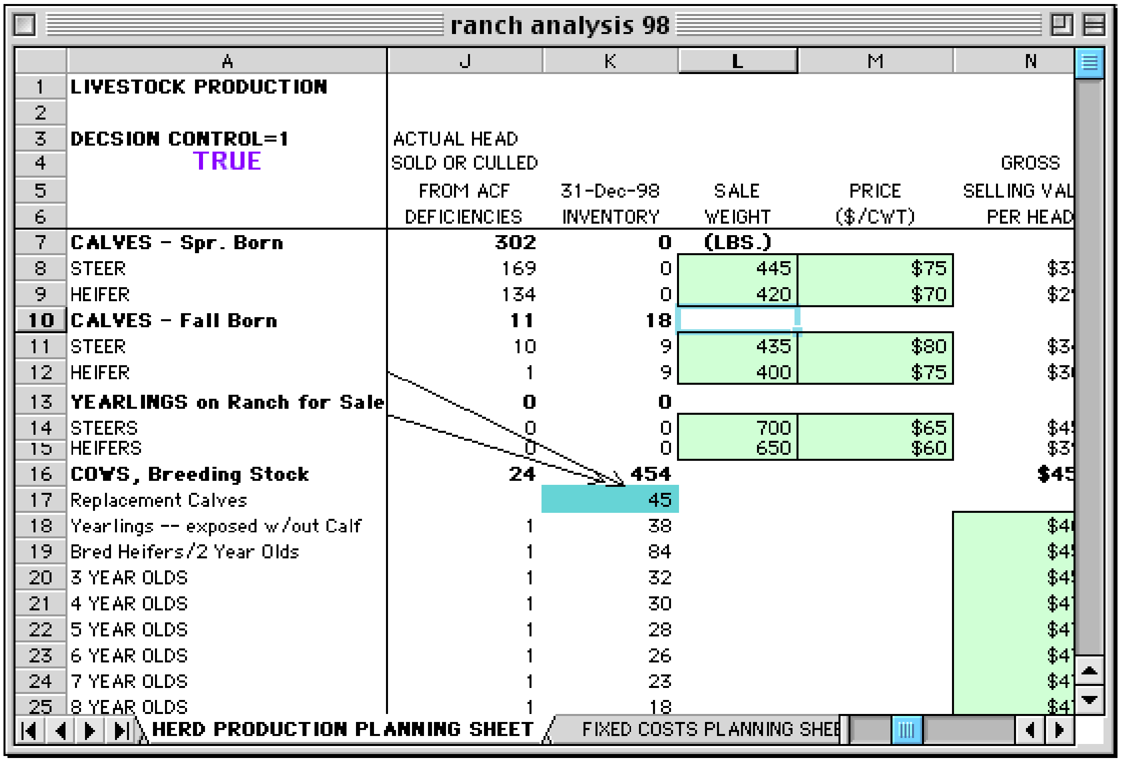
	A	L	M	N	O	P	Q
1	**HEALTH EXPENSES**	**DECISION CONTROL=1**			**TRUE**		
2	©1999 University of Arizona		***$0***		***$96***		***$0***
3							
4	Disclaimer: Neither the issuing in	MED.	COST	MED.	COST	MED.	COST
5			$0	LA 2000	$1		
6		3 WAY	EACH		EACH		EACH
7	**CALVES - Spr. Born**	**# Head**	**$0.00**	**# Head**	**$96.00**	**# Head**	**$0.00**
8	STEER	1	$0.00	60	$48.00	0	$0.00
9	HEIFER	1	$0.00	60	$48.00	0	$0.00
10	**CALVES - Fall Born**		**$0.00**		**$0.00**		**$0.00**
11	STEER	1	$0.00	0	$0.00	0	$0.00
12	HEIFER	1	$0.00	0	$0.00	0	$0.00
13	**YEARLINGS on Ranch for Sal**		**$0.00**		**$0.00**		**$0.00**
14	STEERS	0	$0.00	0	$0.00	0	$0.00
15	HEIFERS	0	$0.00	0	$0.00	0	$0.00
16	**COWS, Breeding Stock**		**$0.00**		**$0.00**		**$0.00**
17	Replacement Calves	0	$0.00	0	$0.00	0	$0.00
18	Yearlings -- exposed w/out Calf	0	$0.00	0	$0.00	0	$0.00
19	Bred Heifers/2 Year Olds	0	$0.00	0	$0.00	0	$0.00
20	3 YEAR OLDS	0	$0.00	0	$0.00	0	$0.00
21	4 YEAR OLDS	0	$0.00	0	$0.00	0	$0.00
22	5 YEAR OLDS	0	$0.00	0	$0.00	0	$0.00
23	6 YEAR OLDS	0	$0.00	0	$0.00	0	$0.00
24	7 YEAR OLDS	0	$0.00	0	$0.00	0	$0.00
25	8 YEAR OLDS	0	$0.00	0	$0.00	0	$0.00
26	9 YEAR OLDS	0	$0.00	0	$0.00	0	$0.00
27	10 YEAR OLDS	0	$0.00	0	$0.00	0	$0.00
28	UNKNOWN >4	0	$0.00	0	$0.00	0	$0.00

Changes

HEALTH EXPENSE PLANNING SHEET / FEED EXPENSE PLANNIN

Figure 10. Range Fire (Drylot Option): Herd Production Planning Sheet Changes

Before

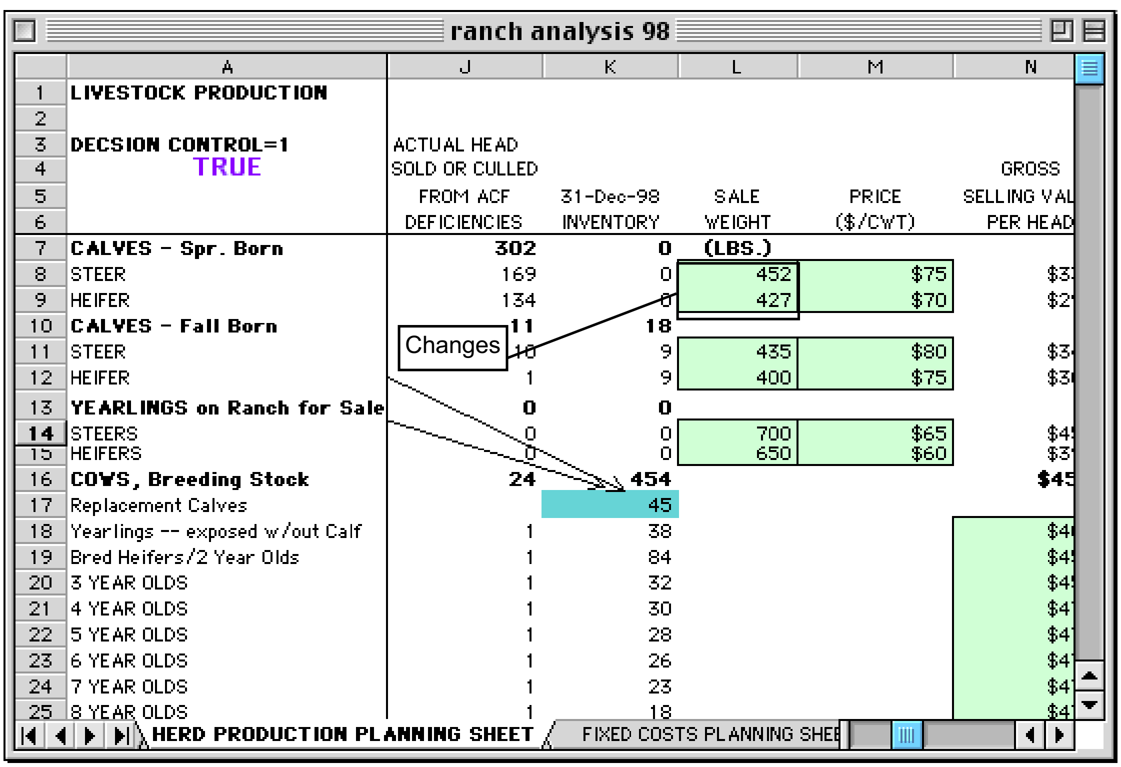


ranch analysis 98

	A	J	K	L	M	N
1	**LIVESTOCK PRODUCTION**					
2						
3	**DECSION CONTROL=1**	ACTUAL HEAD				
4	TRUE	SOLD OR CULLED				GROSS
5		FROM ACF	31-Dec-98	SALE	PRICE	SELLING VAL
6		DEFICIENCIES	INVENTORY	WEIGHT	($/CWT)	PER HEAD
7	**CALVES - Spr. Born**	**302**	**0**	**(LBS.)**		
8	STEER	169	0	445	$75	$3
9	HEIFER	134	0	420	$70	$2
10	**CALVES - Fall Born**	**11**	**18**			
11	STEER	10	9	435	$80	$3
12	HEIFER	1	9	400	$75	$3
13	**YEARLINGS on Ranch for Sale**	**0**	**0**			
14	STEERS	0	0	700	$65	$4
15	HEIFERS	0	0	650	$60	$3
16	**COWS, Breeding Stock**	**24**	**454**			**$45**
17	Replacement Calves		45			
18	Yearlings -- exposed w/out Calf	1	38			$4
19	Bred Heifers/2 Year Olds	1	84			$4
20	3 YEAR OLDS	1	32			$4
21	4 YEAR OLDS	1	30			$4
22	5 YEAR OLDS	1	28			$4
23	6 YEAR OLDS	1	26			$4
24	7 YEAR OLDS	1	23			$4
25	8 YEAR OLDS	1	18			$4

HERD PRODUCTION PLANNING SHEET | FIXED COSTS PLANNING SHEE

After



ranch analysis 98

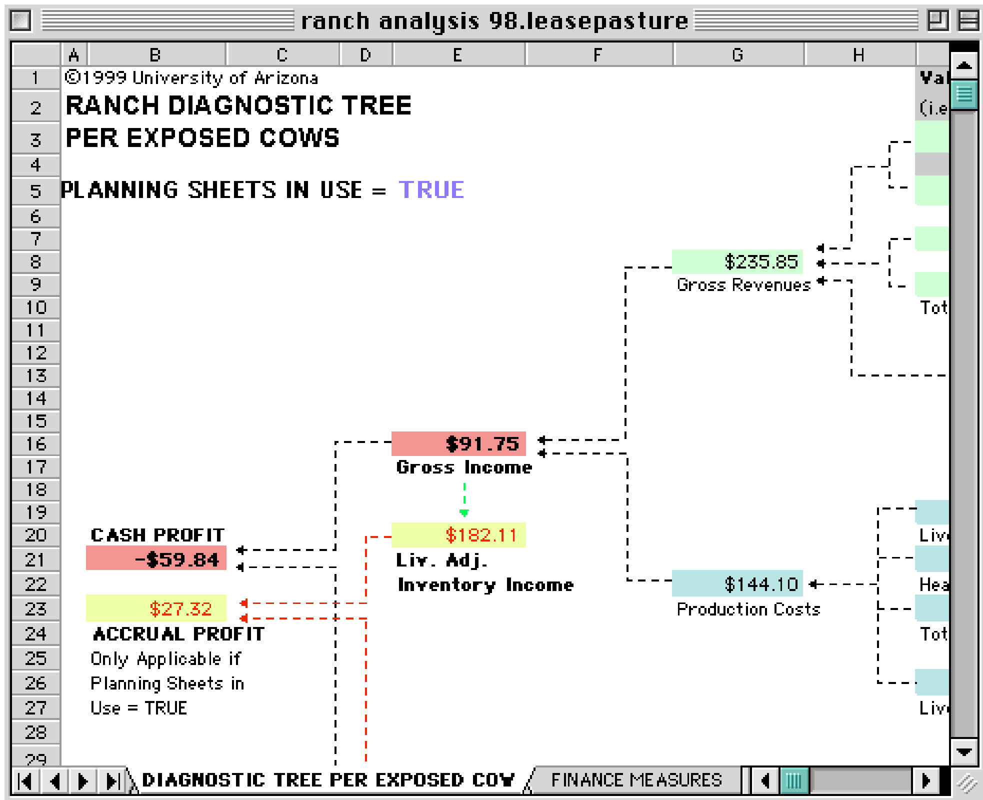
	A	J	K	L	M	N
1	**LIVESTOCK PRODUCTION**					
2						
3	**DECSION CONTROL=1**	ACTUAL HEAD				
4	TRUE	SOLD OR CULLED				GROSS
5		FROM ACF	31-Dec-98	SALE	PRICE	SELLING VAL
6		DEFICIENCIES	INVENTORY	WEIGHT	($/CWT)	PER HEAD
7	**CALVES - Spr. Born**	**302**	**0**	**(LBS.)**		
8	STEER	169	0	452	$75	$3
9	HEIFER	134	0	427	$70	$2
10	**CALVES - Fall Born**	**11**	**18**			
11	STEER	10	9	435	$80	$3
12	HEIFER	1	9	400	$75	$3
13	**YEARLINGS on Ranch for Sale**	**0**	**0**			
14	STEERS	0	0	700	$65	$4
15	HEIFERS	0	0	650	$60	$3
16	**COWS, Breeding Stock**	**24**	**454**			**$45**
17	Replacement Calves		45			
18	Yearlings -- exposed w/out Calf	1	38			$4
19	Bred Heifers/2 Year Olds	1	84			$4
20	3 YEAR OLDS	1	32			$4
21	4 YEAR OLDS	1	30			$4
22	5 YEAR OLDS	1	28			$4
23	6 YEAR OLDS	1	26			$4
24	7 YEAR OLDS	1	23			$4
25	8 YEAR OLDS	1	18			$4

Changes

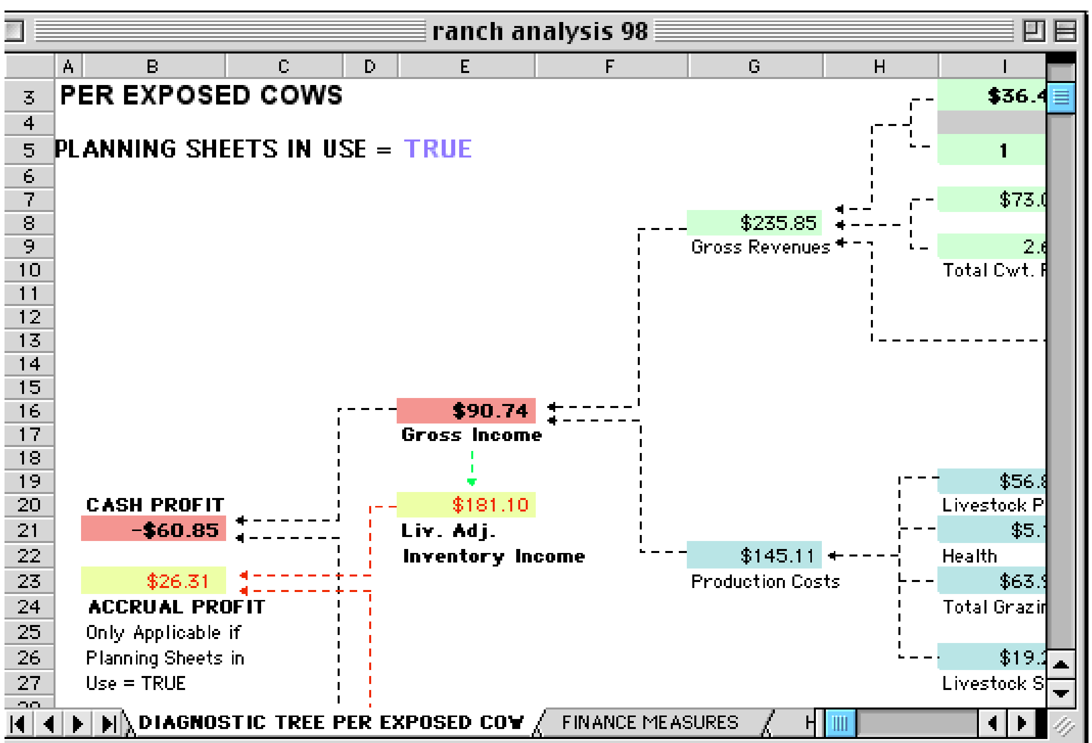
HERD PRODUCTION PLANNING SHEET | FIXED COSTS PLANNING SHEE

Figure 11. Range Fire: Leasing Pasture vs. Drylot Comparison

Leasing Pasture



Drylot



FROM:

Arizona Ranchers' Management Guide
Russell Tronstad, George Ruyle, and Jim Sprinkle, Editors.
Arizona Cooperative Extension

DROUGHT ASSISTANCE PROGRAMS AND TAX IMPLICATIONS OF DROUGHT INDUCED LIVESTOCK SALES

Russell Tronstad[1]

Government payment assistance during or after a drought is a very real possibility. Drought assistance has been more likely ever since the Disaster Assistance Act of 1988 was legislated. Through this act the Secretary of Agriculture can authorize feed assistance payments for a county or reservation due to a natural disaster or livestock emergency. Programs of relevance for Arizona include the Livestock Assistance Program (LAP), Livestock Indemnity Program, and the American Indian Livestock Feed Program (AILFP).

DROUGHT ASSISTANCE PROGRAMS

Livestock Assistance Program: LAP provides direct payments to eligible livestock producers who have suffered grazing losses due to a natural disaster. A county must have suffered a 40 percent or greater loss of available grazing for at least three consecutive months as a result of damage due to drought, hot weather, insects, etc. Producers must meet certain criteria which include having a financial risk in eligible livestock that they have owned for at least three months before the payment period. LAP assistance is based on the value of feed calculated on a corn equivalent basis. Information needed to apply for LAP benefits includes: 1) number and share of livestock owned, 2) acres, location and type of grass or forage used to support livestock, 3) estimated percentage of grazing loss, and 4) dates of any significant livestock inventory changes.

Livestock Indemnity Program: Another program administered by the Farm Service Agency is the Livestock Indemnity Program. LIP assistance is possible for areas that have received a Presidential Disaster Declaration or requested a Secretarial Disaster Designation and received this status. This program provides partial reimbursement of livestock losses to eligible producers. If a producer's livestock losses exceed the normal mortality rate for the animal category under consideration, a producer may be eligible for payments. Producers must provide documentation to support their claims, and animals used for purposes other than human food or the production of food are not eligible. To not discourage private means of insuring livestock losses, Livestock Indemnity Program payments are not reduced to account for any insurance indemnity payments received from other sources.

American Indian Livestock Feed Program: The purpose of AILFP is to provide emergency financial feed assistance to livestock owners on tribal-governed land affected by a natural disaster. Under AILFP, the Commodity Credit Corporation contracts with governments of affected tribes to administer the program. When a tribal government determines that a livestock feed emergency exists, the tribal government may submit a request to implement the program. Damaging weather conditions, such as drought, which cause more than a 35 percent reduction of feed produced in a region for a defined period may qualify for payments. Livestock owners need not be American Indian nor a member of a tribe in order to receive payments under this program. Eligible owners must own or lease tribal governed land in the approved region and have had livestock on this land during the time of the qualifying disaster. Payments of this program are based on the smaller of either a) 30 percent of Animal Unit Day feed minus any feed sales, or b) actual livestock feed purchases minus sales of livestock feed.

All of the above programs are generally subject to a fixed sum of dollars that is allocated to a program, region, and/or nation. Thus, even if your county or tribe has been declared eligible to receive disaster assistance, judging how much reimbursement or assistance you will actually receive can be difficult. You may have to decide to sell livestock, buy hay, or lease pasture from another region before drought assistance programs are known. Uncertainties surrounding payment assistance, the weather, future market prices, and potential income tax liabilities make decisions regarding livestock sales during a drought difficult. Both drought assistance benefits and added revenues from drought-induced livestock sales need to be considered.

DROUGHT-INDUCED SALES

Managing tax liabilities during a drought can be a challenge due to more livestock sales than "normal" and the tax consequences of drought assistance payments. Special tax treatment is generally available to producers that are forced to sell animals because of a shortage of water, feed, or other drought-induced consequences. There are two basic tax treatments to defer income from drought sales. Both require that drought sales exceed the normal level of sales. Eligibility for the two different treatments depends on the class of livestock sold and whether the federal government has designated your area as eligible for assistance.

TAX TREATMENT #1— POTENTIALLY ALL LIVESTOCK

The deferred sales receipt method has the broadest class of animals which qualify. That is, only breeding livestock are eligible for the involuntary conversion tax method which follows. Yearlings and even"sporting livestock" are potentially eligible for the deferred sales method described here. Income from livestock sold in excess of normal sales, whether raised or purchased, may be deferred for up to one year if the following are satisfied:

1. Your (the taxpayer's) principal business is farming or ranching.
2. You utilize the cash method of accounting.
3. You state you are making an election under I.R.C. section 451 (e) and attach it to your drought-year return. You also attach a statement explaining the reasons that forced sales were necessary (lack of water, feed, etc.).
4. You provide evidence that "excess livestock" sales are due to drought and not a sell-off that is beyond drought-induced conditions. A three-year average is used to compute normal sales levels when making the calculation for "excess livestock" sold.
5. Your county or a neighboring county is designated as eligible for federal disaster assistance. The designation may be made by the president, an agency of the federal government (e.g., the Federal Emergency Management Agency or the Small Business Administration), or a Department of Agriculture agency (e.g., Farm Service Agency). The sale of livestock can occur before or after an area is designated a disaster area.
6. You total the number of animals sold this year and the number sold because of the drought. Any gain realized from weather-related sales must be provided. Income from normal sales is reported on this year's Schedule F while excess sales are reported on next year's Schedule F.

Livestock held for sale (e.g., steers, feeder heifers) can only qualify for tax treatment #1 or a one-year postponement in drought-induced income. Not all income needs to be deferred to the following year though. An advantage to this treatment is that some drought sale income can be taken as income for that year and some can be deferred to the following year. How much income is to be reported in the year of the sale or the following year must be decided by the due date of the return for the tax year in which the drought sale occurred. Another advantage to this treatment is that the tax basis for purchased replacements is not reduced by the amount of the postponed gain. Thus, if a raised cow is sold for $500 and a replacement is later purchased for $500, the entire $500 paid for the replacement is depreciable.

If prices are low and you expect to be in a zero or low marginal tax bracket, counting some if not all drought-induced sales as income for the drought year may likely be your best alternative. Keep in mind that any drought-assisted aid will need to be declared as income for the tax year that monies are received regardless of the method used for reporting livestock sales. See the box below for an example of the deferred tax treatment method. A disadvantage to this method is that you must rely on your area being declared eligible for federal disaster assistance. Also, the "involuntary conversion" tax treatment below for breeding animals may be preferred since it allows for drought-induced gains to be deferred for two years or one year beyond the one-year postponement described above.

Example of Tax Treatment #1 [election under I.R.C. 451 (e)]

Every year in the fall, Rancher Joe normally sells 100 yearlings, 13 cows, and 2 bulls (most recent 3-year average). Due to the drought this year, Joe sold 100 yearlings in May along with 15 pairs (30 head). In June, Joe sold 30 cows, 5 bulls, and 50 lightweight calves that were born earlier in the year. Normally, Joe doesn't sell any pairs or calves that are less than a year old.

Sale prices were $275/head for the yearlings, $400 average for the 15 pairs sold, $325/head for the 30 cows sold, $600/head for each bull, and $150/head for the calves that were less than a year old.

An election is made for each generic class of animals (e.g. cattle, sheep), not specific to an animal's age, sex, or breed. Thus, the average sale price for cattle is determined by dividing the total income received by the number of all cattle sold ($53,750 / 215 hd. = $250/hd.).This average is multiplied by the excess number sold (i.e., 215-115=100) due to drought to give the "excess sales." In this example, 115 hd. x $250/hd., or $28,750 in sales may be deferred for up to one year.

The election of how much income to postpone must be made in the tax year of the drought sale. After accounting for drought assistance benefits and other income and expenses, a plan should be devised for minimizing tax liabilities. The decision to buy breeding stock or retain more heifers in the following year needs to be considered in determining the amount of income to postpone for one year.

TAX TREATMENT #2—
BREEDING CATTLE

Tax treatment #2 fits under the terminology of “involuntary conversion” in the tax guides. Gains from livestock sold as the result of a drought do not have to be recognized if the proceeds are used to purchase replacement livestock within two years from the end of the tax year in which the sale takes place. An advantage to this treatment is that your area need not be declared a disaster area by the federal government. Basic rules of this treatment, many similar to Tax Treatment #1, include the following:

1. Your drought-induced sales must exceed a normal three-year average.
2. You must purchase an equal or greater number of replacement livestock within two years of the end of the tax year of sale.
3. There is no minimum holding period. That is, bred heifers that you may have just purchased last year qualify as breeding livestock.
4. You must use replacement livestock for the same purpose.
5. An area need not be declared a federal disaster area, but there must be evidence that a drought occurred. For example, newspaper clippings or rainfall reports are generally sufficient proof.
6. You must provide a computation of the number and kind of livestock sold by category and the accompanying gain realized from drought sales.

When you buy replacements, attach to the tax return the date replacements

Example of Tax Treatment #2 [election under I.R.C. 1033 (e)]

Rancher Bob normally sells 20 cows and bulls from his beef herd every year but this year he sells 50, 30 more than normal due to the drought. The average selling price for all 50 head is $300/head. Thus, Bob defers the income of 30 head or $9,000 for this year if the cows were raised and have a zero basis.

If in the following two years Bob buys only 25 cows to replace the 30 sold, a gain of $300/head for five head must be reported regardless of what was paid for the 25 replacements purchased. Bob would need to report an additional $1,500 ($300 x 5) of income to an amended return for the year in which the drought sales occurred and any additional taxes must be paid.

If Bob purchased replacements for $400/head, then the tax basis for the 25 replacements would be $100 (replacement price minus the gain on the drought-induced sale that wasn’t taxed). But if Bob purchased 25 replacements for only $250/head then an additional $1,250 gain ($50/head x 25 head) would have to be filed to an amended tax return for the drought year.

Keep in mind that any gains associated with feed assistance or indemnity payments have to be claimed for the tax year that they are received. It is conceivable that feed assistance combined with having to file an amended return of additional income could push a rancher into a higher marginal tax bracket for a drought year than planned.

were purchased, the cost of replacement animals, and the number and kind of replacements. Carefully consider your future intentions for rebuilding your herd when opting for the involuntary conversion treatment. Raised replacements are not eligible for "replacement livestock." Also, attention needs to be given to the selling price and expected purchase price. Consider the example of involuntary conversion on page 178.

Since every tax situation and ranch plan is different, no standard recommendation can be given as to whether the one-year postponement is preferred to the two-year involuntary conversion. Close consultation and planning with a tax advisor or accountant is likely to pay a heavy dividend if you have or plan to make substantial drought sales this year. Please refer to the Farmer's Tax Guide (Publication 225) or contact the IRS (1-800-829-1040) for more current and complete tax information. The Farmer's Tax Guide along with other tax forms and publications are available on the Internet at

http://www.irs.gov

Current information related to drought-assisted aid programs can be found at

http://www.fsa.usda.gov

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FROM:

Arizona Ranchers' Management Guide
Russell Tronstad, George Ruyle, and Jim Sprinkle, Editors.
Arizona Cooperative Extension

TRADE-OFF BETWEEN COW NUMBERS, CALF SIZE, AND SALE DATE INCORPORATING SEASONAL FACTORS AND SUPPLEMENTAL FEEDING

Russell Tronstad[1]
Trent Teegerstrom[2]
Xing Gao[3]

Rigid sale dates are sometimes adopted to take advantage of seasonal forage availability or aggregate numbers for a given sale to attract more buyers. Arizona ranchers that primarily depend on winter rains for forage typically sell their calves in the spring while regions that most heavily depend upon monsoon rains for forage (e.g., southeast Arizona) sell in the fall. Both regions sell mainly according to the time of year, irrespective of the weight of their calves and very few supplement calves to increase their calf weights. Because ranchers often question the economic trade-offs between sale calf weights, herd size, rates of gain, and feeding supplement with a spring versus fall sale date, our primary objective is to analyze these issues.

The tradeoff between sale weight and timing of sales is complicated by seasonal forage and price conditions along with dramatic variation in the price spread between light and heavy calves. Generally, lighter calves sell for a higher per pound price than heavier calves and calf prices in the spring are greater than in the fall, but exceptions to these generalities occur. Selling calves at a heavier weight generally comes with an opportunity cost of reducing the number of cows that can be maintained on the ranch or calves that can be sold. In addition, variability in seasonal rainfall and the ability to feed supplement complicates analyzing the trade-offs between rates of gain, sale weight, herd size, and the timing of calf sales.

BIOLOGICAL CONSIDERATIONS

Quantifying the future rate of gain for a calf kept on the ranch is a critical element for evaluating the profitability of selling the animal now or at a later date. This analysis defines the calf growth cycle from birth to 20 months of age and evaluates the profitability of sale weight and season (i.e., mid-May or mid-November) under non-supplement and supplement range feeding scenarios. Weight gain was estimated as a function of age, sex, rainfall, compensatory gain, and prior weight levels. Weight data was collected from the Registered Hereford herd of the San Carlos Apache Tribal Ranch, Arsenic Tubs, Arizona for the eight years of 1980, 1981, 1983 to 1986, 1988, and 1989. A birth date and calf weight at birth was recorded for each calf. In addition, weights were taken when the entire calf crop was at an average age of roughly 3, 8, 12, and 20 months of age. Weight and animal combinations are such that we have 1,368 calves and 5,862 unique calf weights. Different calving dates provide age variation around each weighing date so that we can estimate daily weight gains as a function of age.

The solid line in figure 1 shows our calf weight estimates as a function of age for a steer calf with normal rainfall and no compensatory gain effects. The dots in figure 1 represent the weight of a given animal at a specified age and year. On average, calf weights at the 12 month weighing were 8.47 lbs. less than at their 8 month weight due to weaning and poor seasonal forage conditions that typically followed weaning. At any given age, heifer calves were estimated to weigh 4.97%

Figure 1. Calf weight data and estimated growth function

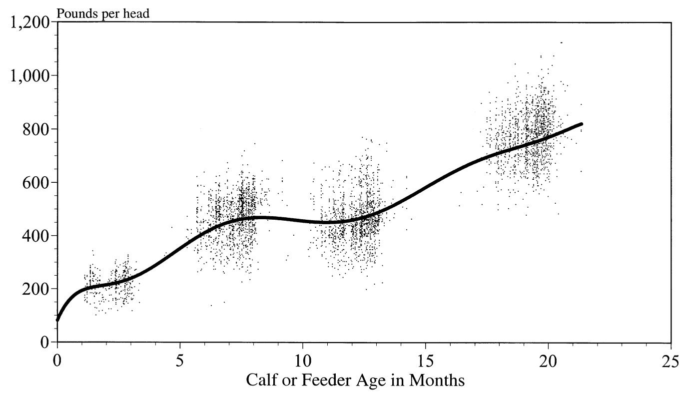
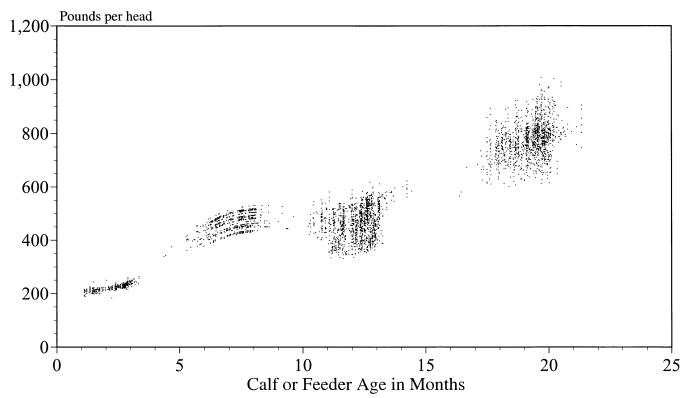


Figure 2. Calf weight estimates based on growth function, rainfall, compensatory gain, prior calf weights, and sex



less than a steer calf. Figure 2 provides weight predictions for each animal weighing. Variations from the solid line in figure 2 are due to differences in sex, cumulative rainfall from a prior weighing, prior weight from the estimated growth function, and compensatory gains.

To gain insights into the trade-off between different sale weights and dates, average real profits for two different ranching regions were simulated from 1980 through 1998 using either mid-May or mid-November sale dates for steer calves that weighed either 350, 450, 550, 650, or 750 lbs. A 350 lb. sale weight was matched with Cattle-Fax sale weight categories of 300 to 400 lb. sales and similarly for the heavier sale weights. The two regions examined have distinct seasonal forage differences. Regions that mainly depend on winter rain for forage rely on cooler season grasses and legumes like jojoba while “monsoon dependent regions” count mainly on warm season grasses for their primary forage production.

Table 1 shows the expected daily gains estimated for different sale weights and dates by region plus the equivalent cow numbers than can be maintained for each scenario. Rates of gain for the two regions were set up to mirror each other with the most favorable gains occurring prior to November and May sales for the “monsoon” and “winter” rain dependent regions, respectively. The most favorable forage conditions under supplementation assume a growth rate of 1.77 lbs./day for weights from birth to 350 lbs. and 1.75 lbs./day for weights from 450 to 750 lbs. These rates of gain were reduced by 10% for when forage is less abundant in each region prior to the animal’s sale date. To calculate the cows that could be supported on an Animal Unit Year (AUY) of forage, reductions of .5, .6, and .7 AUYs were charged for the number of days it took calves to go from 450 to 550, 550 to 650, and 650 to 750 pounds, respectively. The AUY reduction for producing calves heavier than the 450 lb. weight has the effect of reducing total cow numbers and thereby reducing the number of calves available for sale.

Birth dates and supplement requirements to meet the daily rates of gain in table 1 are described in table 2. Birth dates were calculated working backwards from the sale date and the corresponding rate of gain for each protocol. The amount of supplement required is dependent upon sale weight, sale date, and region. Respectable gains of 1.77 and 1.65 lbs. per day are viewed as attainable without feeding any supplement for 350 and 450 lb. sales in November and May for the monsoon and winter rain dependent regions, respectively. Supplemental feeding ranged from 100 to 400 lbs. per Animal Unit (AU), varying in average annual cost from $10.31 to $41.23 per

AU. The retail cost of a 50:50 corn meal and cottonseed meal mixture was charged for supplement. Because some ranchers may be able to obtain more of a wholesale than retail price for supplement, we did not charge additional labor or fuel expenses for distributing supplement to the cow herd. However, the distribution costs for supplement may be very noticeable, depending on the terrain of the ranch.

Cull cows were assumed to weigh 1,000 lbs. when they were culled, irrespective of the herd's mix or supplementation regime. In addition, a calf crop percentage of 85% per exposed cow, calf death loss after birth of 2.5%, and a culling percentage of 16% with a 4% annual death loss for cows was applied to all scenarios. The calf crop is assumed to be a 50:50 mix of steers and heifer. Thus, 40% of all heifers or 20% of all calves are retained each year to replenish the cull cows that either die or are sold. For example, a 100 AUY ranch selling 350 lb. or 450 lb. calves would expect to sell 16.0 cows, 41.4 (i.e., 100•0.85•0.975•0.5) steer calves, and 24.9 (i.e., 100•0.85•0.975•0.3) heifer calves annually.

Another expense item that varied with different sale date and weight options was the opportunity cost of money. That is, calves sold at 450 lbs. could have been sold at 350 lbs. and so forth. The opportunity cost of funds was charged at a real annual interest rate of 4%. Except for grazing expenses, cash costs for each scenario were obtained from Economic Research Service's cow-calf production costs for the west. Cash grazing costs were calculated using the grazing fees and accompanying percentages of grazing land in Arizona owned by the State (33%), Bureau of Land Management (17%), Forest Service (40%), or Private entity (9%) as reported in Mayes and Archer. Common variable and fixed cash expenses for all sale weight and date combinations are given in tables 3a. and 3b. Gao provides more detail to the cost items incorporated.

Table 1. Average daily gain (ADG, lbs./day) and equivalent cow numbers[a] (ECN)

Calf Weight (lbs./head)	"Monsoon Dependent Regions" May Sales ADG ECN	"Monsoon Dependent Regions" Nov. Sales ADG ECN	"Winter Rain Dependent Regions" May Sales ADG ECN	"Winter Rain Dependent Regions" Nov. Sales ADG ECN
No Supplemental Feeding				
Birth to 350	1.593 (1.000)	1.770 (1.000)	1.770 (1.000)	1.593 (1.000)
350 to 450	1.485 (1.000)	1.650 (1.000)	1.650 (1.000)	1.485 (1.000)
450 to 550	0.396 (0.743)	0.440 (0.763)	0.440 (0.763)	0.396 (0.743)
550 to 650	1.530 (0.688)	1.700 (0.710)	1.700 (0.710)	1.530 (0.688)
650 to 750	0.981 (0.606)	1.090 (0.631)	1.090 (0.631)	0.981 (0.606)
Supplemental Feeding				
450 to 550	1.575 (0.920)	1.750 (0.927)	1.750 (0.927)	1.575 (0.920)
550 to 650	1.575 (0.839)	1.750 (0.853)	1.750 (0.853)	1.575 (0.839)
650 to 750	1.575 (0.762)	1.750 (0.780)	1.750 (0.780)	1.575 (0.762)

[a] Equivalent cow numbers were obtained by reducing available Animal Unit Years for cows by 0.5, 0.6, and 0.7 for the number of days it took calves to go from 450 lbs. to 550 lbs., 550 lbs. to 650 lbs., and 650 lbs. to 750 lbs., respectively. No distinction was made for weights less than 450 lbs. since these calves always reached their weight before 8 months of age, within the normal bounds of a one-year breeding and calving cycle.

Table 2. Supplement requirements and birth dates by sale date, sale weight, and location

Calving Date: Monsoon Dependent	Calving Date: Winter Rainfall	Sale Weight (lbs.)	Supplement Required[a]: Calf (lbs.)	Supplement Required[a]: Calf/Cow (lbs.)
May Sales	Nov. Sales			
Nov. 27	May 30	350	—	—
Sept. 21	Mar. 24	450	—	—
July 19	Jan. 19	550	200	0
May 17	Nov. 17	650	250	50
Mar. 14	Sept. 14	750	300	100
Nov. Sales	May Sales			
June 16	Dec. 14	350	—	—
April 16	Oct. 14	450	—	—
Feb. 18	Aug. 18	550	0	100
Dec. 23	June 22	650	0	200
Oct. 27	April 26	750	0	300

[a] 50:50 Corn & Cottonseed Meal Ration

ECONOMIC RESULTS

Calf weights were estimated as a function of age, sex, climate, 20 month compensatory gain, and prior weights, as described in equation (1). Table 4 provides the parameter estimates and corresponding statistics for this model.

Table 3a. Common real ($1999 dollars) variable and fixed cash expenses for each Animal Unit Year, 1980–1989

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Variable Cash Expenses										
Grazing Fees	62.15	56.66	46.12	36.29	35.34	34.03	30.58	28.81	32.96	35.97
Protein Supplement	23.80	20.55	19.84	17.36	18.12	15.54	15.80	15.37	17.27	17.53
Salt & Minerals	2.93	2.98	2.99	2.93	2.78	2.81	2.82	2.76	2.66	2.67
Vet & Medicine	9.91	10.02	10.42	10.31	10.39	10.14	10.14	10.03	9.95	10.29
Livestock Hauling	4.04	4.15	4.34	4.22	4.16	4.17	3.94	3.84	3.78	3.87
Custom Rates/Operation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Marketing	5.49	5.54	5.81	5.75	5.77	5.80	5.76	5.71	5.86	5.94
Hired Labor	36.62	35.83	35.00	34.43	33.56	33.08	33.70	31.73	32.21	32.29
Fuel, Lube, Electricity	29.77	30.83	28.06	25.67	20.78	19.81	15.90	15.66	15.67	17.20
Machinery & Bld. Repairs	28.42	28.90	30.29	30.78	28.86	29.15	28.86	28.16	28.46	28.35
Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Variable Cash Exp.	203.13	195.45	182.87	167.74	159.75	154.54	147.51	142.06	148.83	154.12
Fixed Cash Expenses										
General Farm Overhead	43.67	37.76	34.53	31.18	38.48	33.55	42.96	55.42	34.90	35.29
Taxes & Insurance	32.05	25.16	24.66	23.91	20.54	19.26	25.13	33.93	35.19	35.62
Interest	94.55	81.93	80.57	72.78	74.19	66.25	58.58	60.04	69.58	64.30
Total Fixed Cash Exp.	170.26	144.85	139.76	127.87	133.20	119.06	126.66	149.40	139.67	135.22
Total Cash Expenses	**373.39**	**340.30**	**322.63**	**295.61**	**292.95**	**273.60**	**274.17**	**291.46**	**288.50**	**289.33**

Table 3b. Common real ($1999 dollars) variable and fixed cash expenses for each Animal Unit Year, 1990–1998 [a]

	1990	1991	1992	1993	1994	1995	1996	1997	1998	AVG.
Variable Cash Expenses										
Grazing Fees	34.04	35.31	34.16	33.04	33.82	30.47	31.36	30.08	30.47	36.40
Protein Supplement	22.93	21.93	22.47	22.01	23.46	21.83	10.04	9.78	0.00	17.66
Salt & Minerals	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.49
Vet & Medicine	14.30	12.51	14.98	18.44	18.90	18.39	26.56	27.28	35.33	15.17
Livestock Hauling	4.21	5.27	5.08	6.02	0.00	0.00	0.00	0.00	0.00	3.22
Custom Rates/Operation	0.00	0.00	0.00	0.00	0.00	0.00	43.94	45.13	55.17	7.59
Marketing	6.75	6.39	3.36	3.78	3.87	3.77	6.14	6.31	4.59	5.39
Hired Labor	43.95	43.58	44.65	42.16	40.64	41.65	62.17	64.63	15.39	38.80
Fuel, Lube, Electricity	19.27	19.70	17.53	17.88	0.00	0.00	0.00	0.00	22.44	16.64
Machinery & Bld. Repairs	22.98	23.14	23.05	23.02	23.35	24.39	22.94	23.44	18.74	26.07
Other	4.56	4.49	4.50	4.28	0.00	0.00	0.00	0.00	0.00	0.94
Total Variable Cash Exp.	173.00	172.32	169.77	170.63	144.03	140.51	203.16	206.65	182.12	169.38
Fixed Cash Expenses										
General Farm Overhead	47.28	36.70	36.14	47.40	45.06	46.40	39.09	45.09	50.57	41.13
Taxes & Insurance	21.35	18.07	17.86	22.36	21.89	21.93	17.34	17.07	30.49	24.41
Interest	75.25	60.40	51.33	59.38	52.71	59.09	58.58	35.17	12.62	62.49
Total Fixed Cash Exp.	143.88	115.17	105.33	129.14	119.66	127.42	115.01	97.33	93.69	128.03
Total Cash Expenses	**316.88**	**287.49**	**275.10**	**299.76**	**263.70**	**267.93**	**318.16**	**303.99**	**275.81**	**297.41**

[a] Changes in USDA reporting classifications occurred from 1994 to 1998 and account for the large dollar changes in several categories from one year to the next. See the 1982–1998 Cow-Calf Production Cash Costs and Returns report for more detail on these changes.

Note that the model to estimate calf weights is constructed so that if climate, compensatory gain, and prior weight deviations are "normal," weight gain is an 8th order polynomial function of calf age in months with a constant weight percentage differential between steers and heifers.

If rainfall was above (below) the 30 year average for the months prior to their last weighing, calves would weigh more (less) than otherwise. For example, if the accumulated rainfall between the 3 and 8 month weighing was above (below) the 30 year average by 1 inch, calves would weight 11.196 lbs. more (less) than otherwise. The magnitude and statistical significance of the rainfall variable decreased as the animal increased in age. We believe that this result is because of the 20 month compensatory gain effect and the greater importance of lagged weight components as the animal increased in age. That is, these factors were able to better capture both genetic and environmental components as the calves increased in age compared to the rainfall variable.

Table 4. Average real return (APR) and standard deviation (SD) of returns ($ / Animal Unit Year), 1980–1998

Sale Weight (lbs./steer)	**"Monsoon Dependent Regions"**		**"Winter Rain Dependent Regions"**	
	No Supplemental Feeding			
	May Sales	Nov. Sales	May Sales	Nov. Sales
350	36.15 (61.78)	23.66 (57.58)	36.49 (61.85)	23.32 (57.52)
450	86.87 (67.70)	70.60 (63.90)	87.52 (67.82)	69.97 (63.79)
550	4.72 (50.84)	2.30 (50.34)	15.19 (52.67)	-7.79 (48.54)
650	1.00 (49.18)	6.91 (51.40)	13.75 (51.38)	-5.55 (49.11)
750	-20.71 (46.01)	-17.77 (63.14)	-5.08 (48.68)	-32.83 (60.20)
	Supplemental Feeding			
550	70.53 (66.10)	69.29 (64.57)	85.18 (66.97)	54.91 (63.78)
650	50.57 (63.10)	60.51 (65.41)	68.81 (64.62)	42.52 (63.97)
750	28.55 (61.55)	52.70 (84.79)	50.23 (63.70)	13.35 (79.38)

The average and standard deviation of real returns for different sale dates and weights are given in table 4. These figures are determined using the rate of gains estimated, Cattle-Fax prices for calf and cow sales, and the opportunity cost of forage described in table 1 (i.e., reduced cow numbers for heavier calf weights). With no supplemental feeding, a sale weight of 450 lbs. for May is the most profitable alternative for both regions. Under this management plan, an average real return of $86.87/AUY for the monsoon dependent and $87.52/AUY for the winter rainfall dependent region was realized for the 19 years from 1980 to 1998. November sales of 450 lbs. are the next most profitable strategy for both regions, and this strategy has a somewhat lower standard deviation of return than the May sales of 450 lbs. It is interesting to note that cull cow sales in May rather than November account for the largest share of the $17.05 per AUY favorable revenue differential between these two seasons. Cull cow sales account for $9.39 or 55 percent of the revenue differential, while 450 lb. steer and heifer calf sales account for $5.22 and $2.44, respectively, of the favorable revenue for May sales.

Without feeding supplement, the growth function estimated is essentially flat after reaching 7 months of age or 450 lbs. for the next 5.5 months. Thus, the opportunity cost of lower cow numbers and lower calf prices outweigh the gains from heavier sale weights for weights beyond 450 lbs. without supplement. However, heavier weights offset lower calf prices when going from 350 to 450 lb. weights carrying the same cow numbers. No opportunity cost of fewer cows is added when going from 350 to 450 lb. weights since 450 lb. calves are weaned at about 7 months of age, which allows ample time for cows to breed back in a year-round calving system.

Supplemental feeding is able to remove the long flat period for range calves from 7 to 12.5 months of age. Given the supplement requirements and weight gains described in table 2, supplementation has a considerable impact on returns when selling heavier calves. For example, supplementation for May

Table 5. Average real return (ARR) and standard deviation (SD) of returns ($ / Animal Unit Year) for extra grass year scenarios, 1980–1998

Sale Weight (lbs./steer)	"Monsoon Dependent Regions"				"Winter Rain Dependent Regions"			
	May Sales		Nov. Sales		May Sales		Nov. Sales	
	ARR	SD	ARR	SD	ARR	SD	ARR	SD
	Supplemental Gains at No Supplement Cost							
550	91.42	(66.31)	79.63	(64.63)	95.63	(67.08)	75.59	(63.87)
650	81.96	(63.46)	81.22	(65.44)	89.75	(64.87)	73.62	(63.99)
750	70.47	(62.07)	83.82	(84.03)	81.69	(64.10)	54.90	(78.34)
	Non-Supplemental Gains with No AUY Reduction							
550	116.09	(70.86)	101.04	(68.81)	118.08	(71.23)	99.10	(68.46)
650	147.05	(75.36)	139.61	(77.01)	149.42	(75.80)	137.29	(76.59)
750	178.59	(82.20)	161.28	(103.80)	181.64	(82.75)	158.28	(103.42)

sales and 550 lb. calves increased the average revenues per AUY by $65.81 and $69.99 for the monsoon and winter rainfall dependent regions, respectively. The $85.18 return associated with supplemental feeding and 550 lb. May sales for the Winter rainfall dependent regions almost attains the $87.52 return for 450 lb. May sales and no supplemental feeding for this region.

Table 5 illustrates what the return to different sale weights and dates would be if a rancher had "extra grass" so that supplemental gains were obtainable without feeding supplement or no reduction in AUYs was charged for selling calves at heavier weights. Even when supplemental gains are available at no extra feed cost, 550 lb. sales are the most profitable except for November sales in the monsoon dependent region. However, the difference between 550 and 750 lb. sales for this scenario is rather modest at $4.19 per AUY. In general, the opportunity cost associated with foregone calf numbers and lower prices does not outweigh the benefit of heavier calf weights, even when supplemental gains are imposed with no added feed cost. But if no AUY reduction is charged for producing heavier calves, the heaviest calf weight of 750 lbs. yields the highest return with May sales still somewhat preferred over November sales for both regions.

CONCLUSIONS

We found that the benefit of higher sale weights was not enough to overcome lower calf prices and fewer calf and cull cow sales for calf weights above 450 lbs. While feeding supplement was never the optimal strategy, supplemental feeding increased average returns by $45 to $70 per AUY for sale weights above 550 lbs. May sales were found to be more profitable than November sales, even with discounted rates of gain. More favorable market conditions for May than November sales are the main reason why May sales were often more profitable than November sales. It is also interesting to note that cull cow sales account for the largest share of the favorable revenue differential between these two months. Cull cow sales accounted for 55 percent of the favorable revenue differential, while 450 lb. steer and heifer calf sales accounted for 31 and 14 percent, respectively, of the favorable revenue for May sales in the mainly monsoon dependent rainfall region.

It is important to note that a more flexible sale date, weight combination, and supplemental feeding strategy could have generated more net return than the "fixed strategies" above. In addition, fertility was assumed to be high enough so that no increase in fertility was associated with feeding supplement. An increase in fertility from feeding supplement would most likely make a supplemental feeding regime as one of the most profitable strategies. But high labor and distribution costs to remote and difficult to access range sites would also make supplemental feeding less attractive than what we have expensed in our analysis. In addition, a strategy that could take advantage of market opportunities for buying replacements when they are cheap or feeding calves to a heavier weight when corn prices are high and forage is available would probably outperform the best "fixed strategy" of always producing and selling 450 lb. calves in May.

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