PROCEEDINGS

of the

WESTERN FARM ECONOMICS ASSOCIATION

THIRTY-FIFTH ANNUAL MEETING

AUGUST 6, 7, 8, 1962

UNIVERSITY OF NEVADA
RENO, NEVADA

Held Jointly With:

Committee on the Economics of Water Resources Development

and

Committee on the Economics of Range Use and Development

of the

Western Agricultural Economics Research Council

CATTLE PRICE BEHAVIOR AND RANCHERS' DECISION MAKING[1/]

W. G. Kearl[2/]
Economic Research Service, USDA
Laramie, Wyoming

The objectives of this paper are (1) to show an approach or method for study of cattle price behavior which may allow for more explicit consideration and uses of cattle price expectations in making decisions, (2) to incorporate the cattle prices information to illustrate the decision making process and the results of decisions under different situations. The illustrations which will be presented deal with decisions regarding timing of marketing and timing of range improvement practices, and will tend to demonstrate the difficulty of optimizing in making some of these decisions.[3/]

TYPES OF PRICE MOVEMENTS

Cattle price movements are composed of a number of different types of movements of components superimposed upon one another. The components which are customarily thought of are (1) long term trends, (2) cyclical movements, (3) seasonal movements or variations, and (4) random or irregular fluctuations. Long term trends and cyclical movements are important in making major decisions such as to invest in land upon which to raise cattle, or not to invest in land. However, short term price movements are much more crucial in many management decisions.

Cattle price cycles are composed of shorter term price movements or phases as follows: (1) upward trending, (2) a price break, (3) downward trending, and (4) a period of relative price stability or recurrence of uptrend. Phases in the cattle price cycle will be defined as those movements which are rather steadily in one direction and exceed one year in length. Phases can be illustrated by monthly average prices for all weights and grades of stocker and feeder steers at Kansas City. Eleven different phases are distinguishable for the period 1925-1959.

The period from January of 1925 to September of 1945, almost 21 years, is characterized by only five different phases: a period of relative stability, an uptrend, a downtrend, a second uptrend, and finally another period of relatively stable prices. Thus there were only two significant reversals of trend over the 21-year period; those occurred in 1929 and 1934. The average annual changes occurring during this period were around 20 percent of the mid-range prices during the period of most rapid uptrend and the downtrend period, and were 11 percent or less in the three other periods.

1/ This paper is a condensed version of a paper by the same title appearing in the Proceedings Report No. 4 of the Committee on Economics of Range Use and Development of the Western Agricultural Economics Research Council.

2/ In cooperation with the Division of Agricultural Economics, Wyoming Agricultural Experiment Station.

3/ The illustration pertaining to timing of range improvements appears in the full length version (see footnote 1/) but is not included in this condensation.

In contrast, six different cycle phases occurred in approximately 14 years between 1945 and 1959. They were shorter in duration and generally more abrupt. The average annual change in prices was from 21 percent to 35 percent of the mid-range value during five of the six periods. Only one short period of relative stability occurred between 1945 and 1959. If the differences between the pre-war period and the post-war period in the frequency and abruptness of occurrence of different phases in cattle price cycles is indicative of what may be expected in the future, then it will be important for ranchers to be more cognizant of these phases in their decision making.

The Rancher's Decision Period

Ranchers in Wyoming market calves in the fall of one year, typically between August and December with the bulk of the calf shipments occuring in October and November, or hold their calves to be marketed in the subsequent year as yearlings with the shipments bulking in the months from August to November. A program of marketing yearlings after a production period of about 18 months is the most common in Wyoming.4/ From August of one year to December of the succeeding year is the period within which a rancher has the opportunity of deciding whether to market cattle as calves or as yearlings, and is defined here as the rancher's decision period. This decision period or major parts of it will be used in presentation of seasonal price indexes and other relevant data.

The usual methods of computing indexes of seasonal variation -- the simple averages method5/ or ratios to moving averages method6/ -- attempt to remove all influences other than the seasonal variation. This is accomplished by "averaging out" intermediate trends and irregular fluctuations or removing the effect by use of moving averages and ratios. Seasonal variations which ranchers must consider in making decisions are those which are superimposed upon phases of the price cycle. In this analysis seasonal variations will be shown as they are affected by intermediate and long term trends, in order to show more exactly the types of price movements which face ranchers from year to year.

Indexes of Seasonal Price Variations for Cattle of Various Weights

Price differentials exist between various weights of cattle of comparable class and grade. Therefore, it would be desirable to have indexes which would reflect the differentials and would permit direct comparisons over the various weights. Such indexes are computed for the various price cycle phases using average prices for good and choice grades of 300-500 pound steer calves and steers in the 500-800 pound and 800-1,050 pound classes. The average price for good and choice grades of 500-800 pound steers was used for a base in computing indexes for all three weight classes. As a result, the indexes show prices of good and choice steer calves and good and choice steers of heavier

4/ Wyoming Cooperative Crop and Livestock Reporting Service, Number of Wyoming Cattle and Calves Moved on Brands Certificates, 1960 and 1961, (Cheyenne: FED., 1962)

5/ Thomsen, F. L., and Foote, R. J., Agricultural Prices, (New York: McGraw-Hill Book Company, Inc., 1952).

6/ Foote, R. J., and Fox, Karl A., Seasonal Variation: Methods Measurement and Tests of Significance, (Washington: 1952) (U.S. Department of Agriculture) Agriculture Handbook No. 48.

weights in relation to prices for the 500-800 pound weight class and give an indication of price differentials between weights, as well as showing relative changes from month to month for each weight class. Since a calf grows and matures from one fall to the following fall the price a rancher can expect to receive for his animal does not follow any one of the price indexes shown for the different weights of calves and steers, but moves gradually from a calf price to medium steer price and perhaps to a heavy steer price as time passes and the calf grows and matures.

Indexes of "actual prices" through the rancher's decision period have been estimated for various cycle phases and for average or "normal" growth patterns for cattle (Figures 1 - 4). The normal growth pattern for cattle is based on data from the U. S. Range Livestock Experiment Station near Miles City, Montana, adjusted to levels more typical of range livestock operations in the northern plains area. The index of actual prices was determined by straight-line interpolation between the indexes for various weight classes assuming that the index represented the mid-point of the weight class. The index of actual price varies from approximately the initial price for calves to a level between that of the 800-pound and 1,050-pound steers. Indexes of actual prices can be converted to dollar prices by multiplying by a base price representing the price for 500-800 pound steers.

When prices are trending upward the index of prices which a rancher might actually expect to receive rises less rapidly than does the index for any particular weight class. In the other three price phases the index of actual price declines, with the decline being especially severe in the downward trending phase. Even under the most favorable situation, price increases from early summer into fall are rather unlikely (Figure 4).

Application of Prices Information in Decision Making

A number of factors have probably influenced ranchers in the Northern Plains and Mountain areas to market cattle in the fall. Growth rate of cattle becomes extremely slow in the fall, or stops altogether. Consequently, they are near their maximum weights for the particular year in their lives. Fall is also the time when cattle must be gathered and moved from summer ranges to winter ranges or feed grounds.

Even so, there is some question as to whether late fall is the best time of the year for marketing cattle. One can hypothesize that the cycle phase and prospective prices might modify the optimum time for marketing. Weather conditions, normal or drouthy, and their effect on the additional weight gains which cattle can make by grazing for an additional month or two, are a second consideration. A third factor which is important is the additional cost which is incurred in carrying the cattle for each additional month. Opportunity costs of using the range for one class of cattle instead of another, as well as opportunity costs of using it in one season instead of a different season must be considered. Cash costs are also important.

A rancher wishing to verify the best time for marketing cattle needs to obtain information on price outlook and knowledge about the physical production response of livestock, and to construct budgets which take into consideration these two factors along with the various direct and opportunity costs which may be incurred. An approach to the problem of prices has been indicated.

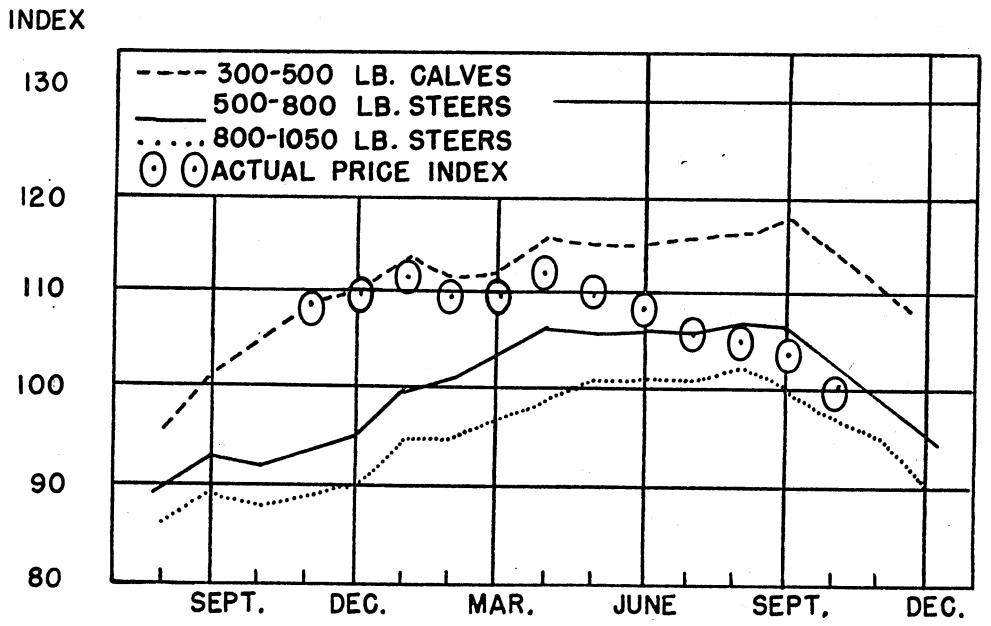

Figure 1. Indexes of Variation During Ranchers Decision Period in Prices of Steers at Omaha, Nebraska. "Topping Out" Price Situation. Average Price of 500-800 lb. Steers = 100.

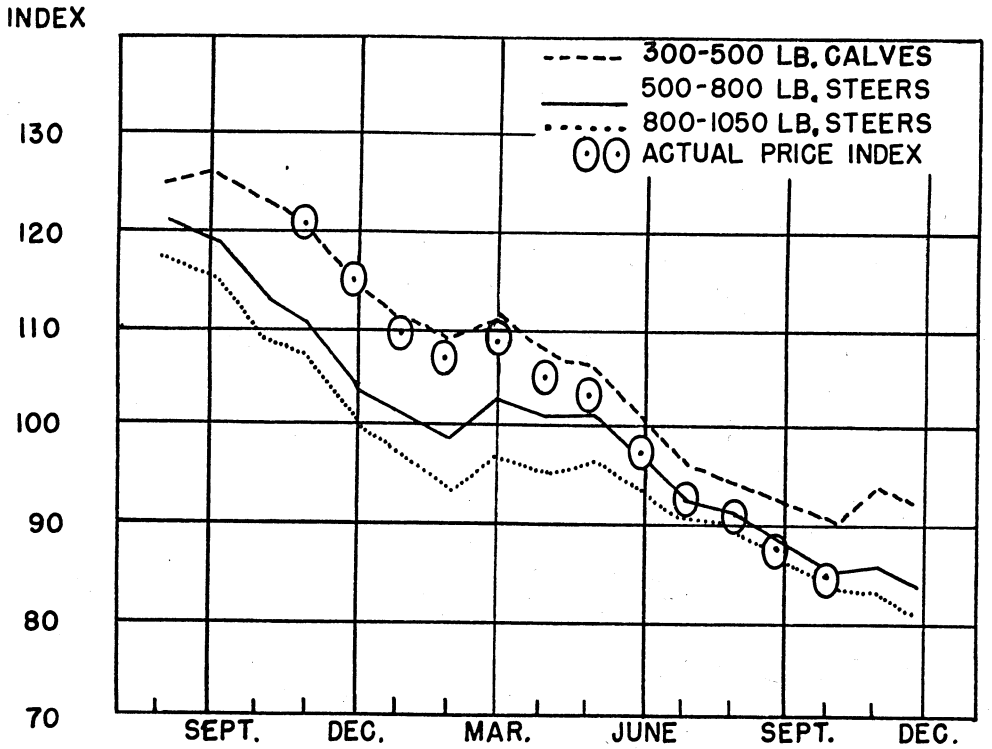

Figure 2. Indexes of Variation During Ranchers Decision Period in Prices of Steers at Omaha, Nebraska. Down Trending Price Situation. Average Price of 500-800 lb. Steers = 100.

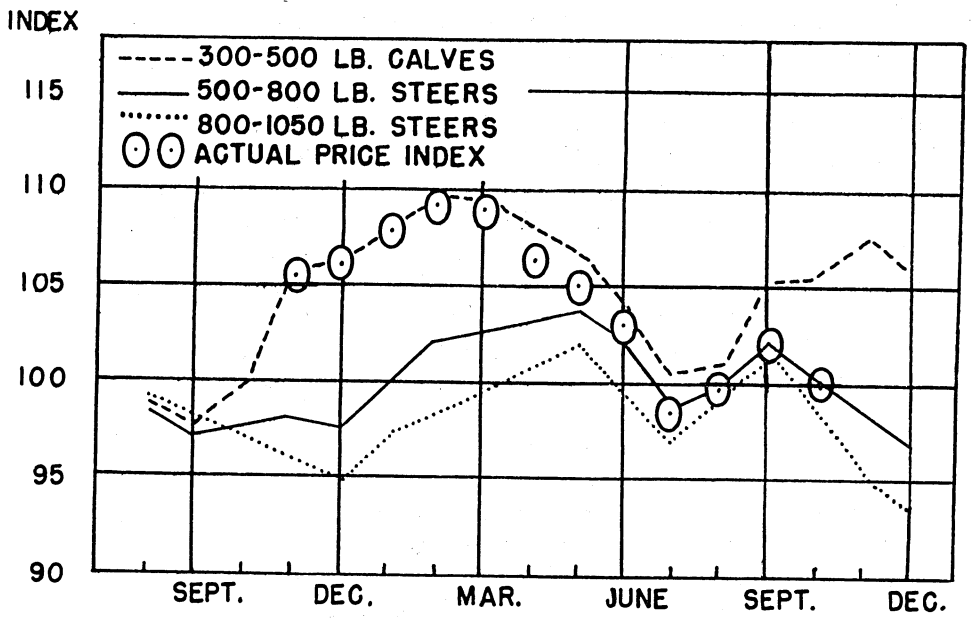

Figure 3. Indexes of Variation During Ranchers Decision Period in Prices of Steers at Omaha, Nebraska. Stable Price Situation. Average Price of 500-800 lb. Steers = 100.

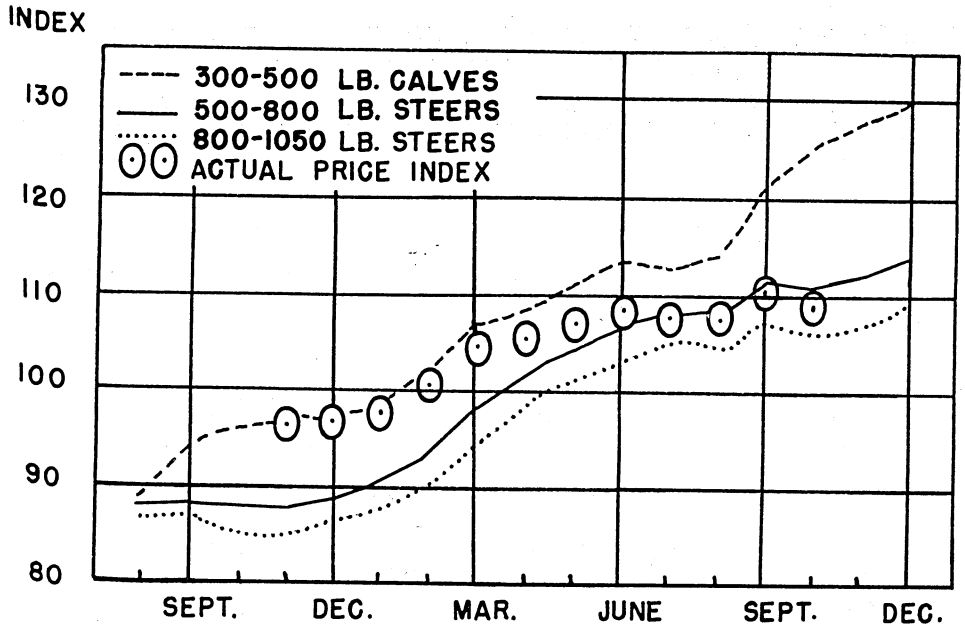

Figure 4. Indexes of Variation During Ranchers Decision Period in Prices of Steers at Omaha, Nebraska. Uptrending Price Situation. Average Price of 500-800 lb. Steers = 100.

Knowledge about the growth response of livestock might come from the rancher's experience, or from experimental data. Grazing experiments conducted at the Central Plains Experimental Range for the time period 1943-59 were deemed suitable for use in indicating the effects of precipitation on cattle gains. The extreme drouth year of 1954 was not included because weighing of livestock in that year was handled in a manner that did not provide comparable information. Precipitation during the April-September growing season ranged from about 6 to 18 inches for those years included. Rank correlations were calculated in preliminary attempts to relate precipitation to monthly gains, but neither rank correlations nor inspection of the data indicated any significant relationship between precipitation and animal gains for the ranges in precipitation considered.

Data which are available for the extreme drouth year of 1954 indicate that livestock gains differ drastically from those in years of more moderate precipitation (Table 1). The livestock were weighed differently and experiments were terminated early in order to protect the ranges from serious overuse. Technicians stated, however, that gains were probably very slow or nonexistent at the time that tests were terminated. Perhaps one may conclude that two significant states of nature which ranchers might consider in decision making relating to choice of marketing time are conditions of extreme drought and conditions of more normal precipitation.

Table 1. Comparison of Livestock Gains at the Central Plains Experimental Range Under Various Weather Conditions

Conditions	Gains to Dates Indicated			May-October Gains		Precipitation	
	Steers to June 25 (Pounds)	Heifers to July 2 (Pounds)	Heifers to July 15 (Pounds)	Steers (Pounds)	Heifers (Pounds)	April-June (Inches)	April-Sept. (Inches)
Drouth (1954)	87	52	95			1.43	3.60
Low Precip.	103	125	151	295	287	4.17	6.91
Med. Precip.	108	123	145	286	246	5.04	9.83
High Precip.	109	126	150	280	271	7.87	12.29

Source: Appreciation is expressed to G. E. Klipple of the Rocky Mountain Forest and Range Experiment Station for making these and other data available.

Assuming that weight gains and price expectations have been specified satisfactorily to determine a gross value of sales, it is now necessary to give some attention to costs. The common situation is for a rancher to own land or lease it by the acre. In this case variable costs of carrying cattle for additional time periods tend to shrink and become difficult to identify. Fixed costs are high, but not relevant for decision making. There is a third category of costs, however, which is important. These are opportunity costs which may be thought of more explicitly as the returns or reduction in costs which could be realized from the use of range grass for one purpose, or at one time of year, but which are unrealized because the grass is used for a different purpose, or at a different time of the year. There are situations in which well defined opportunity costs can arise in the use of range grass. One such situation can occur in a year of serious drouth. Range grass is

likely to be less plentifuly than normally, and harvested feed for use in winter will be scarce and expensive. The opportunity cost for using range grass to carry through late summer and fall the steers, heifers, and dry cows that are to be sold will be high. Early marketing would permit the diversion of some feed to help carry the breeding herd through the summer and fall and perhaps into the early winter. The regular winter range then would be more nearly adequate for winter grazing with less of the scarce and high-priced harvested feeds and supplements required.

Table 2. Weights of Steers Under Typical Wintering and Summering Conditions Near Miles City, Montana. Adjusted to Represent Ranch Conditions.

Date	Steers		Heifers[a/]		Dry Cows[a/]	
	Year of Experiment					
	1955-58 Average	1959-60 Drouth	Normal Weather	Drouth	Normal Weather	Drouth
	(Pounds)	(Pounds)	(Pounds)	(Pounds)	(Pounds)	(Pounds)
May 1	523	502	470	452	1,000	1,000
May 15	547	544	492	490	1,010	1,019
June 1	574	588	517	529	1,022	1,038
June 15	595	618	535	556	1,031	1,052
July 1	642	628	578	565	1,052	1,056
July 15	676	632[b/]	609	569	1,067	1,058
Aug. 1	704		634		1,080	1,058
Aug. 15	726		653		1,070	1,058
Sept. 1	742		668		1,097	
Sept. 15	756		680		1,103	
Oct. 1	769		692		1,109	
Oct. 15	760		684		1,105	
Nov. 1	745		670		1,100	

a/ Heifer and cow weights are not based on experimental data, but are hypothetical.
b/ Experiment terminated due to drouth conditions.

Thus, there is a definite opportunity cost on the use of range grass in late summer and fall for market cattle, and the more severe the drouth the higher such opportunity cost is likely to be.

A second and less obvious opportunity cost arises in the use of forage by market animals through the late summer and fall even in years of normal precipitation. Early marketing would leave a certain amount of range forage that could be diverted to the use of the breeding herd. The additional numbers of breeding animals that could be carried would produce more market animals and more revenue. At some point a balance would be achieved between additional revenue obtained from carrying the additional breeding stock and the loss in revenue from marketing animals earlier at lighter weights. If the program for marketing a greater number of cattle earlier in the year did produce a greater net revenue than the program for marketing a smaller number late in the year, then the difference in net revenue produced would represent the opportunity cost of using the forage in the late marketing program.

Decisions on timing of marketing with the possibility of varying numbers of breeding animals are intermediate or long term decisions. An example has been worked out to illustrate the determination of more nearly optimal marketing times, taking into consideration various price trend situations, different weather conditions, and costs. In working out this illustration a typical northern plains ranch of about 300 head of cattle was budgeted. Revenues in the budgets were based upon the seasonal growth curves of cattle previously illustrated and under two weather situations, normal and drouth, and six different price phase situations: downward trending at higher and lower levels, stable prices a lower levels, upward trending at lower and higher levels, and prices topping out at a high level. It was assumed that weather situations and price trend situations were independent. Thus twelve combinations exist that, in the jargon of decision theory, are "states of nature". The probabilities assigned to the states of nature were 0.162 for drouth, 0.838 for normal weather, 0.375 for the stable price situation, and 0.125 for each of the other five price situations. These probabilities are based upon the relative frequencies of drouth (less than 5 inches of April-September precipitation) at Miles City, Montana, during the last 37 years, and upon the frequencies of price trend situations during the eight-year cattle price cycle, 1952-59. The probability for each of the twelve states of nature is the product of the corresponding weather and price trend probabilities.

Costs for operating a typical northern plains cattle ranch of 300 breeding cows were budgeted for normal weather and for drouth.7/ In constructing these costs of operation it was assumed that the ranch would be stocked at a level which would utilize all harvested feed produced in a normal year. Incremental costs for carrying additional numbers of breeding cows were also budgeted, assuming that the additional cows would require purchase of supplemental feed for wintering, but could be carried during the grazing season on rangeland released through earlier marketing of young animals and dry cull cows. It was also assumed that the rancher would carry his normal breeding herd through drouths by purchasing feed, although that may not be the most economical or the most profitable alternative.

The cattle weights, prices, and ranch costs information developed were used to determine net ranch income estimates assuming that steers and heifers could be marketed at the first of the month or mid-month from the fifteenth of May until the fifteenth of October. These net ranch income estimates were developed for the eleven possible marketing times or alternative courses of action and twleve different states of nature. A variant of the Bayes (La Place) Criterion for economic decision theory suggests assigning probabilities to various states of nature8/, weighting the alternatives by the appropriate probability of occurrence for the given state of nature and aggregating over the different states of nature.

7/ Costs information for this budgeting are based on survey information reported in Kearl, W. G., Cattle Ranching in the Northern Plains Area of Wyoming: A Preliminary Report. Wyoming Agricultural Experiment Station Mimeo Circular 155. Laramie, Wyoming, June, 1961.

8/ Baumol, William J. Economic Theory and Operations Analysis, Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 1961.

The alternative having the highest expected value, that is, the highest expected net ranch income, is then considered the best alternative. In this case it is marketing about mid-September and carrying 312 head of breeding cows (Table 3).

Table 3. Expected Net Ranch Incomes on Northern Plains Cattle Ranch for Various Breeding Herd Sizes and Marketing Dates

Marketing Date	Ranch Capacity in Breeding Cows	Expected Net Ranch Income
	(Number)	(Dollars)
May 15	358	5,921
June 1	353	6,890
June 15	348	7,599
July 1	343	8,792
July 15	337	9,289
Aug. 1	331	9,873
Aug. 15	325	10,102
Sept. 1	319	10,295
Sept. 15	312	10,433
Oct. 1	306	9,876
Oct. 15	300	8,852

Given that the best intermediate or long term decision has been made on the optimum time when one should expect to market and on the corresponding optimum scale of operations, there remains an opportunity to make short run decisions for special conditions within the year. In order to determine optimal short run marketing decisions, net ranch incomes were calculated assuming the alternatives of marketing at two week intervals from May 1 to November 1, but with numbers of cows in the breeding herd fixed at 312 head. Assumptions were made regarding the additional costs for carrying steers, heifers, and dry cows for additional two week intervals from May until September. These additional costs were assumed to be 50¢ per head per month under normal weather conditions and $4.00 per AUM under drouth conditions. The $4.00 per AUM represents the cost of purchasing feed for wintering to replace the grass that could have been diverted to winter use.

Net ranch incomes were calculated under these assumptions and for the twelve different states of nature. With normal weather conditions, the optimal time for marketing will vary from August 15 to around October 1 depending upon the price cycle phase and level (Table 4). In the downward trending situation, marketing as early as August 15 would appear to be preferable. Marketing around mid-September would be best in the stable price situation and with prices topping out. The first of October would be the preferred marketing time in the upward trending price situation.

Under conditions of severe drouth, marketing as early as June 15 or July 1 would be the most profitable procedure. June 15 would be the best marketing date with price trends stable or topping out, or trending downward. During the most favorable price trend, that is with prices trending upward, marketing as late as July 1 might be preferable.

Table 4. Short Run Decisions: Net Ranch Incomes From Marketing at Various Dates, Normal Weather and Drouth Conditions. (**Denotes Maximum Net Ranch Income in Each Column)

	Price Level and Trend Situations					
	Down-Trends		Stable	Upward-Trends		Topping-Out
Marketing Date	Higher level	Lower level	Lower level	Lower level	Higher level	
	Normal Weather Conditions					
May 1	14,034	97	235	3,859	12,842	13,614
May 15	15,068	704	870	4,930	14,307	14,746
June 1	15,654	1,030	1,574	6,103	15,911	15,924
June 15	15,800	1,078	2,019	7,017	17,167	16,716
July 1	17,269	2,090	3,025	8,867	19,598	18,576
July 15	17,944	2,590	3,500	10,166	21,294	19,633
Aug. 1	18,573	2,954	4,410	11,017	22,537	20,779
Aug. 15	18,887**	3,130**	5,151	11,645	23,482	21,647
Sept. 1	18,589	3,033	5,822	12,571	24,749	22,083
Sept.15	18,150	2,863	6,435**	13,422	25,916	22,386**
Oct. 1	17,710	2,640	6,328	13,575**	26,134	22,125
Oct. 15	16,255	1,755	5,463	12,793	25,111	20,708
Nov. 1	15,389	1,212	4,505	12,211	24,299	19,080
	Drouthy Weather Conditions					
May 1	5,581	-7,862	-7,722	-4,258	4,373	5,153
May 15	7,422	-6,815	-6,638	-2,680	6,572	7,096
June 1	8,750	-6,087	-5,516	-1,004	8,906	9,035
June 15	9,200**	-5,916	-4,922**	122	10,505	10,165**
July 1	8,478	-6,356	-5,434	255**	10,671**	9,742
July 15	7,442	-7,007	-6,165	84	10,513	8,978
Aug. 1	6,526	-7,689	-6,395	-389	10,055	8,451
Aug. 15	5,597	-8,371	-6,626	-863	9,595	7,934
Sept. 1	4,422	-9,096	-6,733	-848	9,711	7,349
Sept.15	3,255	-9,803	-6,828	-823	9,841	6,771
Oct. 1	2,153	-10,521	-7,503	-1,360	9,204	5,762
Oct. 15	1,066	-11,241	-8,171	-1,900	8,567	4,761
Nov. 1	700	-11,534	-8,757	-2,058	8,382	3,808

Based on what is known about cattle shipments and ranchers' responses to various price trend situations and to drouth, it would appear that ranchers might well become more cognizant of these situations and the opportunity to make management decisions taking them more explicitly into account.

There are two problems of great importance in rancher decision making which I have assumed away here. These are the problems of estimating the physical response and formulating price expectations. It would appear that some additional work is needed in price forecasting or in assisting ranchers in formulating price expectations. Price forecasting is not simple, yet the requirement is really only for a fairly accurate estimate on direction and

extent of price trend movement for a three or four month period. Bostwick has suggested that Markov Chain analysis may be an appropriate tool for study of cattle prices.9/ Perhaps weekly average prices could be used and workable price forecasts made on the basis of Markov techniques. The problem of forecasting prices is especially important in situations of normal weather or only very moderate drouth, as is forecasting of livestock growth response.

In severe drouth the forecasting of livestock growth responses should not be too difficult. Furthermore, retention of livestock for marketing late in the year would not appear to be profitable even under the most favorable expected price phase situation, so the problem of forecasting prices may not be of any particular consequence in drouth situations. The problem in the case of drouth is perhaps to get more data, especially on costs and alternatives for adjusting to drouth situations, and to further analyze appropriate breeding herd management as well as marketing strategy. Regardless of herd management strategy used, early marketing is probably appropriate in case of drouth.

An important and final point in connection with this part of the paper is to stress again the possibility of ranchers making more explicit use of price information in their decision making. The traditional treatment of prices and seasonal movements has not been particularly useful, but a new approach may be more fruitful.

9/ Bostwick, Don, Analysis Techniques in Industry Wide Adjustments, Report No. 3 Committee on the Economics of Range Use and Development of Western Agricultural Economics Research Council, 1951. Also see Bostwick, Don, Yield Probabilities as a Markov Process, Agricultural Economics Research, Vo. XIV, No. 2 Economic Research Service, U. S. Department of Agriculture.

DISCUSSION: CATTLE PRICE BEHAVIOR AND RANCHERS' DECISION MAKING

Calvin C. Boykin
Economic Research Service, USDA
Davis, California

In cattle production as in almost any business, stockmen are reluctant to change from a known and relatively successful method of operation, including usual marketing practices, or to invest in range improvement unless there is substantial evidence that such changes or investments are likely to result in greater profit within a relatively short period of time. Because of the variability of the two main influences on range cattle production--namely, cattle prices and range forage production--and also because of the length of the cattle production period, stockmen are skeptical about the certainty of future events, and therefore proceed cautiously.

Mr. Kearl has effectively illustrated the wide variation in net ranch income that would have occurred for a fixed set of ranch resources in the Northern Great Plains with the breeding cow inventory at several different levels, with alternative marketing dates under calculated price conditions of the recent past, and with range forage production under normal and drought conditions. He has divided the types of decisions into long term decisions

involving the stocking of breeding cows at various levels and marketing at different dates, and short term decisions with breeding cows at a constant level and with varying price and forage conditions.

Net income resulting from cattle growth rates under two forage condition probabilities and six price trend probabilities were determined and the situation with the highest net income level identified. The problem of the short term decision was solved by holding breeding cow numbers at a constant level as determined by the previous analysis and determining net income under two levels of forage production, 13 different marketing dates, and 6 price trend situations. The highest net income figure was selected for each price trend and forage condition.

Mr. Kearl's point that phases of the price cycle could become more important than seasonal variations is well illustrated and he uses these phases in recent time periods to predict future price cycle behavior. As a result he gets across his idea that alternatives exist in ranching to increase profits through changes in marketing dates and herd composition. The results he obtained no doubt would have been altered had prices at a different terminal market been used in his analysis, and likewise had prices received at auction or through direct buying been used. It is here also that considerable information could be developed that would assist stockmen in making decisions about timing of production and marketing and place of marketing.

Further budgeting would have been necessary had more than two forage conditions been considered and would have greatly complicated an already extensive investigation. Yet to be more precise in the presenting of alternatives this would have been desirable, considering the fact that range forage productivity levels vary considerably over time. Another place where more information is needed is in the assignment of probabilities of forage productivity levels in terms of cumulative rainfall deficiencies over a period of years as well as the deficiency for each year.

In the second part of Mr. Kearl's paper is illustrated the importance of cattle price behavior in the optimal timing of range improvement practices. Given the distribution of costs and physical production attributable to an improvement such as sagebrush spraying, different price conditions were used to determine the most profitable time for initiating the improvement. Because the amount of beef available for sale appeared to be higher a few years after initiation than at any other time, and because of the change in price that occurred with time, different net returns resulted depending on when the practice was carried out. From this analysis Mr. Kearl concluded that investment in range improvement under conditions of stable prices, or when prices were at the peak, was more profitable than investment when prices were approaching or falling away from the peak. However, here again forage growth, seasonal and prospective, must be taken into account.

The assumption that weather and price trend situations were independent was necessary for the analysis made. Perhaps a less restrictive assumption is realistic for long term decisions regarding inventory size and composition.

Mr. Kearl has done an effective job of pointing out that if price and range forage conditions of the recent past are indications of future conditions, stockmen in the Northern Great Plains have a number of alternative ways to obtain a higher net income. Or, even if they are not repetitive, a predictive and management device for minimizing cost and maximizing net

returns have real advantage. He has made a strong case for the development and use of additional information on prices, range forage production, and livestock growth rates and its organization into a practical logic of managerial decisions.

There are many problems in making livestock growth estimates and these were not minimized. These problems may become less burdensome with accurate estimates of range condition and forage production. These estimates would be important in the type of analysis that Kearl has used, for forage production relates to growth rates and to weights and grades of livestock, which are in turn related to livestock price differentials.

There is also the problem of getting the working model down to the ranch level and of getting ranchers to appreciate and use the procedures. A serious handicap of all predictive devices is their ability to, in fact, predict. Nevertheless, Mr. Kearl's paper handles, in a systematic and ordered way, a very complex subject. It is one in which the interaction and mutual dependence of the many variables is agonizing to untangle. More work needs to be done on this subject and in this paper are some insights on how the question of marketing and investments with respect to price might be handled.