Seasonal Variation in

FEED GRAIN AND ALFALFA HAY PRICES

And an Analysis of

STORAGE ALTERNATIVES

in Oklahoma

by

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Department of Agricultural Economics

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FOREWORD

An understanding of seasonal movements in feed prices is important for planning production and making marketing decisions. This bulletin provides information on seasonal price patterns for barley, oats, grain sorghum and alfalfa hay. Seasonal patterns for Oklahoma prices of these commodities as well as area prices are presented. These data should aid in deciding when to buy or sell one of these crops.

In addition to price information, techniques and data for analyzing the storage alternative are needed. Estimates of on-farm and off-farm storage costs are provided to assist producers and users of feed in making storage decisions. Storage costs may differ widely among farmers. Thus, cost components and techniques for budgeting the storage alternative are emphasized.

Assistance by Mr. Don Pittman and associates of the Oklahoma Federal-State Crop and Livestock Reporting Service in supplying state and area price data contributed materially to this study. This assistance is gratefully acknowledged.

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Prices for most crops fluctuate in a fairly regular month to month pattern within a crop year. Most commodity prices tend to be lowest at harvest time because of the large quantity offered for sale relative to the demand for the crop at this time. This seasonal demand is usually for immediate use and for storage. In subsequent months, prices tend to increase until the next crop is harvested.

Price movements within a crop year or marketing season are called seasonal price variations and reflect both costs of storing feeds from one period to another and relative use values of feeds in different time periods. Storage costs include an incentive payment to the storer for assuming the risk of storing a commodity with an uncertain future value as well as charges for equipment, labor, capital, and shrinkage.

SEASONAL VARIATION IN FEED GRAIN AND ALFALFA HAY PRICES

Data and Methods

The prices used to estimate seasonal price patterns were average prices received by farmers within the area or the state on the 15th of each month. The data were obtained from the Oklahoma Federal-State

The research reported herein was done under Oklahoma Station Project No. 1066.

Crop Reporting Service.[1] Prices for the following crops, periods and years were used in the analysis:

Barley—June through May—1946-47 through 1957-58

Oats—June through May—1949-50 through 1957-58

Grain Sorghum—November through October—1940-41 through 1959-60

Alfalfa Hay—June through May—1939-40 through 1957-58

A twelve-month moving average was computed from the price data in order to have a basis for determining net seasonal variation. This moving average is a flexible line which reflects any trend, cycle, or unusual condition that might have existed. The moving average was adjusted (centered) to make it directly comparable with the 15th of month actual prices, and each monthly price was expressed as a percentage of the moving average for that month.

The average pattern of seasonal variation in the prices of each crop was determined from the percentages of the moving average. For example, the percentage of the moving average for each January in the period was added and an average obtained. The same procedure was followed for February and for each of the remaining months. The average obtained for each month represents the relative standing of that month as compared with the overall average price index for all months.

The data and analysis used in this study should be considered when results are interpreted. For example, use of 15th of month prices does not allow estimation of price variation within the month. Buyers and sellers may affect their costs and returns by choosing a purchasing or selling time within a month when prices are most advantageous. The analysis used is designed to delineate only seasonal price movements. Thus, expected movements resulting from trends, cycles, or other influences must be added or subtracted to determine the net price change from one period to another.

Variation in Seasonal Patterns

There can be considerable variation in the price movements in individual years. Two common measures of such variation are the stan-

[1] Oklahoma Federal-State Crop and Livestock Reporting Service, Agricultural Marketing Service, U. S. Department of Agriculture, Oklahoma City, Oklahoma.

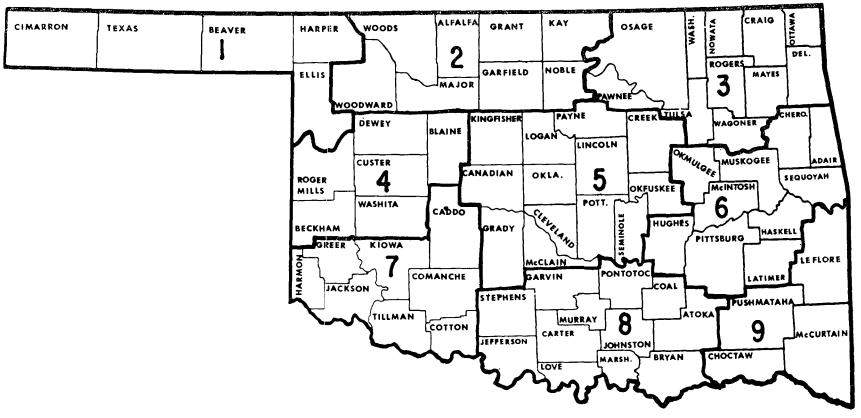


Figure 1. Oklahoma Crop Reporting Areas.

dard deviation of the individual items (percentages) for each month (s) and the standard deviation of the average of the items (percentages) for each month (s_x). These measures are commonly used to make generalized statements concerning future seasonal price patterns. For example, one might estimate the range within which the average index would be expected to fall two-thirds of the time by adding s_x to the average seasonal index to obtain an estimate of the upper limit, and subtracting s_x from the average seasonal index to obtain the lower limit. A similar procedure might be applied, using s, to obtain the 68 per cent confidence range for individual years' monthly indexes. Usefulness of such generalizations depends on the adequacy of the sample period, the assumption that no major changes in marketing paterns will occur, and the assumption that net seasonal price changes are under consideration.

Area Price Analysis

Climate, types of farming, and marketing practices and facilities differ between areas and may result in different seasonal price patterns between areas. Thus, area as well as state seasonal price patterns were estimated for each crop. Area delineations for the state of Oklahoma are shown in Figure 1. These areas conform to State Crop Reporting districts for which "prices received by farmers" were made available by the Oklahoma Federal-State Crop and Livestock Reporting Service.

Barley Seasonal Price Patterns

STATE

The prices of barley usually were lowest in June and increased to a seasonal high in the January to March period (Figure 2 and Appendix Table 1). They tended to decrease from March until the next harvest. Prices in June were 10 per cent below the annual average price while in January they were about 5 percent above average. Using June as a base, prices were about 18 per cent higher in January than at harvest time.

Substantial variation occurred in the seasonal patterns. The ranges of variation are shown by the shaded areas in Figure 2. The dotted area around the average (solid line) is the standard error of the average; and the cross-hatched area is the standard deviation of the individual percentages. Based on this sample period and a confidence level of 68 per cent (approximately two out of three years), the dotted area would include the average percentage, and the cross-hatched area would include percentages for an individual year. The dotted area might be more appropriate for long run consideration while the cross-hatched area might be more appropriate for a decision to store or sell in a particular year. For example, a decision to build storage might be based on average seasonal price increases over time; whereas a decision to store "next year" might be influenced by the possible range of price increases in a year relative to the manager's ability to accept the possible range.

AREAS

Seasonal price patterns were computed for Areas 2, 5, and 7 (Appendix Table 1). The area seasonal averages as percentages of the state average are shown in Figure 2. Seasonal patterns for areas were not significantly different from the state pattern.[2] However, the direction of differences shown in Figure 2 is consistent with the hypothesis that prices exhibit greater seasonal variation in areas where the crop is not the major crop and the practice of storing is not wide-spread. For example, prices in Area 7 were lower than for the state as a whole in June, increased to reach a consistently higher level than the state in November through February, then declined to considerably below that average in May.

[2]A "t" test $\alpha \leqslant .05$ for differences between area and state means was applied, where α is the probability of obtaining a difference as large as the one obtained by chance.

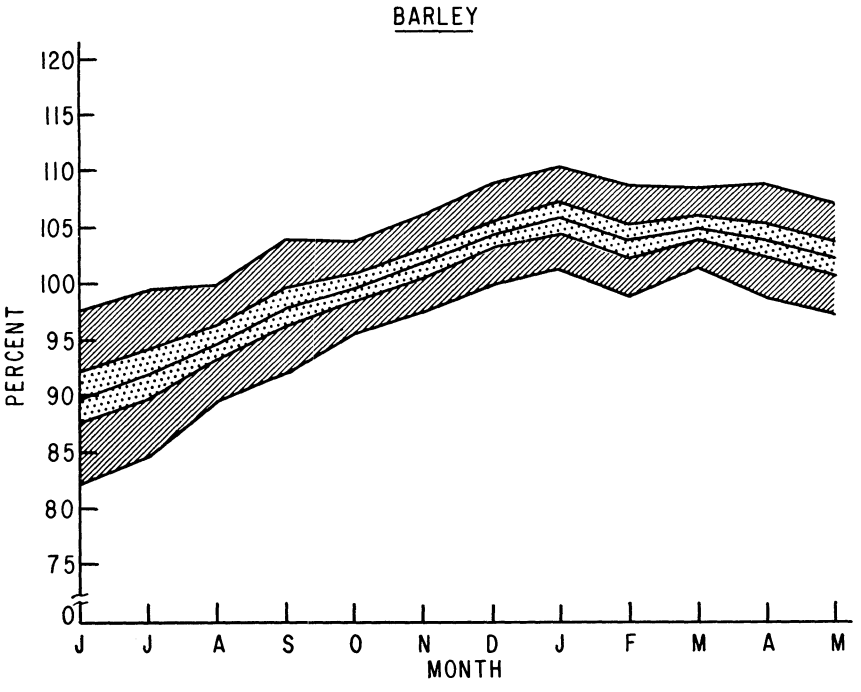
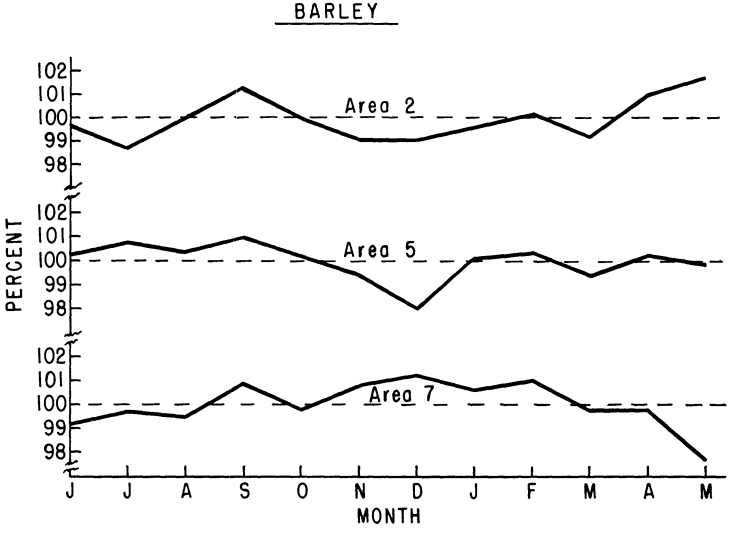


Figure 2. Seasonal Price Patterns for Oklahoma BARLEY Prices. The graph below shows Area monthly price indexes as a percent of state monthly price indexes.



Oat Seasonal Price Patterns

STATE

The seasonal price pattern for oats was based on price data for the years, 1949-50 through 1957-58. This period was used to reflect an apparent shift of seasonal price lows from July to June. This shift can be attributed to technological changes such as the use of new varieties and combines.

Prices of oats in June were about 12 per cent below the average, while in January and February they were about 7 per cent above the average price (Figure 3 and Appendix Table 2). February prices were about 22 per cent above harvest prices (June). Prices at early winter and at harvest were more variable than in other months because of fluctuating feed requirements in the fall and varying harvest conditions and sizes of crops. Ranges of variation in the seasonal pattern are shown in Figure 3.

AREAS

Seasonal indexes and standard deviations for Areas 2, 3, 5 and 7 are presented in Appendix Table 2. Area seasonal patterns as percentages of the state average are shown in Figure 3. Seasonal patterns for areas were not significantly different from the state pattern.[3] However, deviations of area averages from the state average are basically consistent with the different harvesting times, levels of production, amount of feeding, and storage practices which exist in each area. This result suggests that farmers in different areas may wish to study seasonal patterns for their area when making marketing decisions.

Grain Sorghum Seasonal Price Patterns

STATE

Sorghum prices were usually lowest in October and November and increased to a seasonal high in July (Figure 4 and Appendix Table 3). November prices were about 8 per cent below the average level. July prices were 7 per cent above the average price and 16 per cent above November prices. Figure 4 contains one standard deviation ranges for the seasonal price indexes of individual years and the average seasonal indexes.

[3] See footnote 1, page 6.

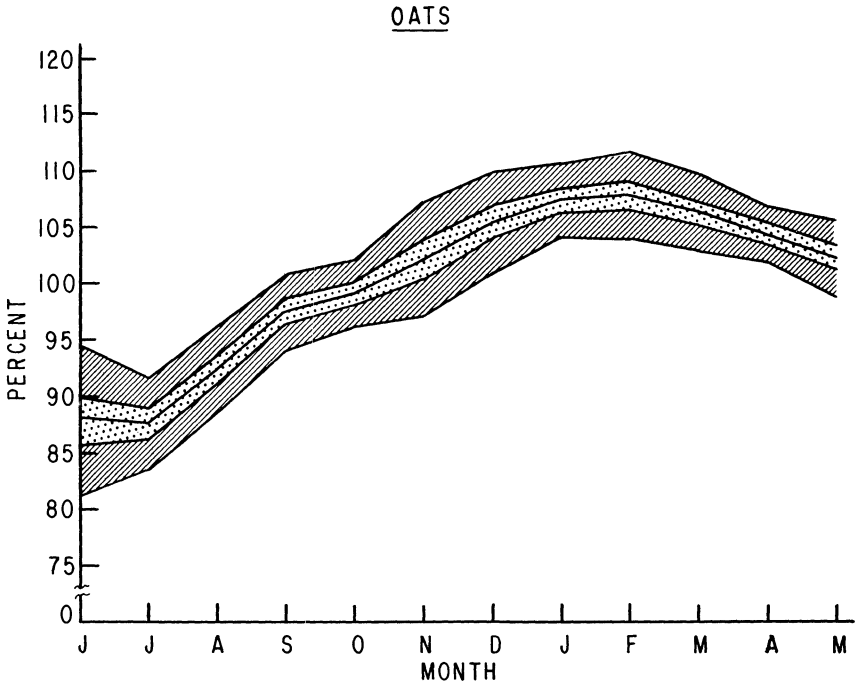
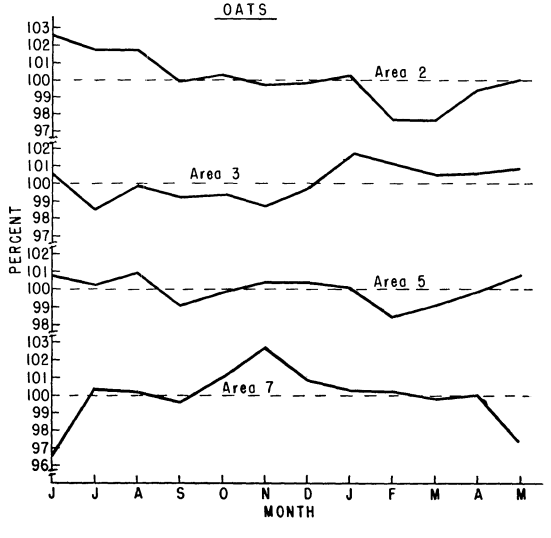


Figure 3. Seasonal Price Patterns for Oklahoma OAT Prices. The graph below shows Area monthly price indexes as a percent of state monthly price indexes.



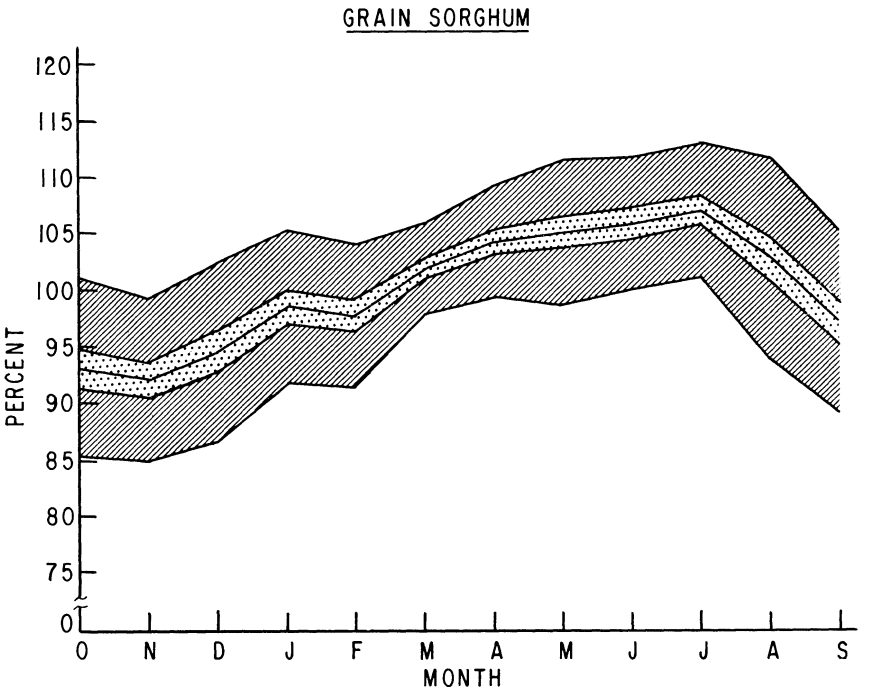
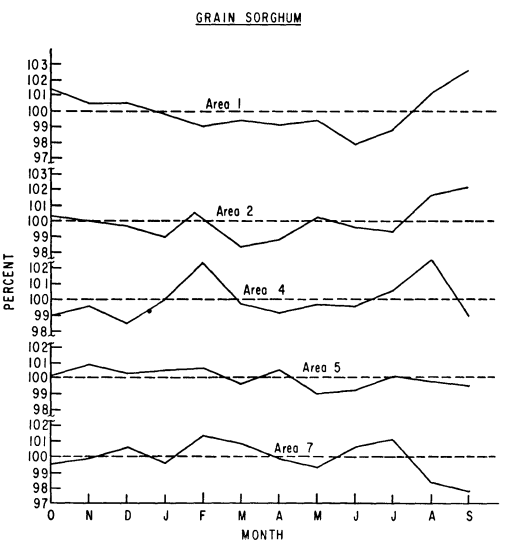


Figure 4. Seasonal Price Patterns for Oklahoma GRAIN SORGHUM Prices. The graph below shows Area monthly price indexes as a percent of state monthly price indexes.



A statistically significant trend toward higher November prices and lower September prices occurred during the 1940-41 through 1959-60 period. Thus, a shift to earlier seasonal lows and highs with respect to the crop year is apparently occurring. Declines in July, August, and October prices and increases in winter prices were also evident. These trends were significant with t_i, $\alpha \leqslant .05$.

AREAS

Area seasonal indexes as percentages of state averages are shown in Figure 4. Area price patterns are not significantly different (with t_i, $\alpha \leqslant .05$) from the state pattern. However, the relationships do reflect known production and marketing situations existing in different areas. Seasonal lows occur earlier in Areas 4 and 7 where harvest is earlier. Seasonal variation is lower in Areas 1 and 2 than for the state or other areas. Lower variation in these areas might be expected because of high total production and established storage and marketing channels.

Alfalfa Hay Seasonal Price Patterns

STATE

Alfalfa hay prices exhibited greater seasonal variation than other crops (Figure 5 and Appendix Table 4). State alfalfa prices were about 83 per cent of average in June and 112 per cent in January. Thus, January prices averaged 136 per cent of June prices over the period. Prices generally declined slowly from the January high to mid-spring.

One standard deviation ranges for alfalfa hay prices are shown in Figure 5. The prices were quite variable, particularly at late harvest, early fall, and early spring. Production conditions, varying feed requirements, and other roughage and pasture supplies are primarily responsible for this variation.

AREAS

Area alfalfa hay price patterns differed significantly from the state pattern and between areas (Figure 5 and Appendix Table 4). The range from low to high prices in Area 7 were larger than for the state. Using June as a base, prices were about 48 per cent higher in January than at harvest compared with 37 per cent for the state as a whole during the same period. Prices in Areas 1 and 4 had a 40 per cent seasonal increase. Areas in the east and southeast had a 30 per cent seasonal increase. Differences between areas resulted from geographic locations which affected availability of hay and winter feed requirements.

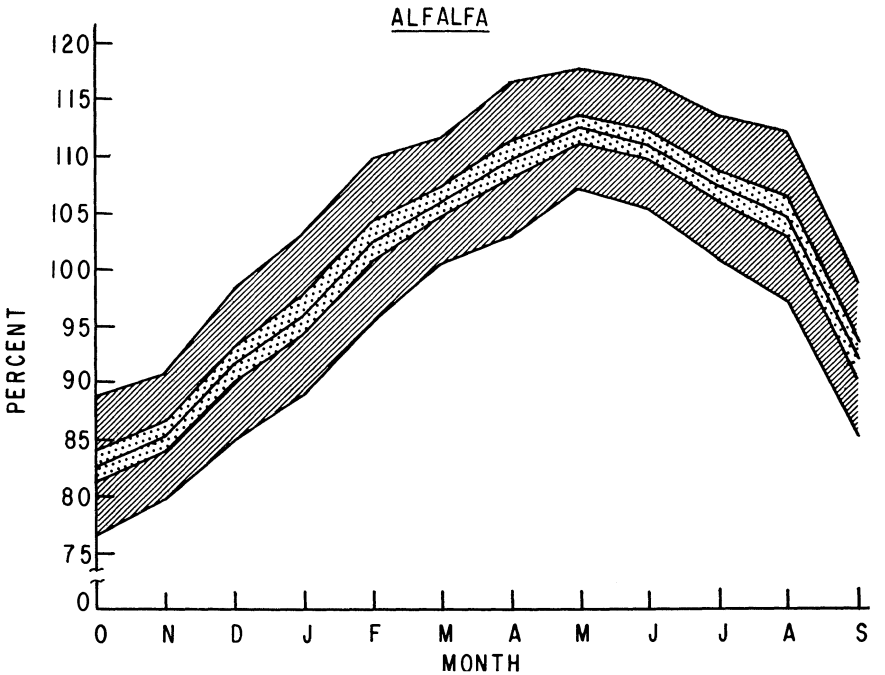
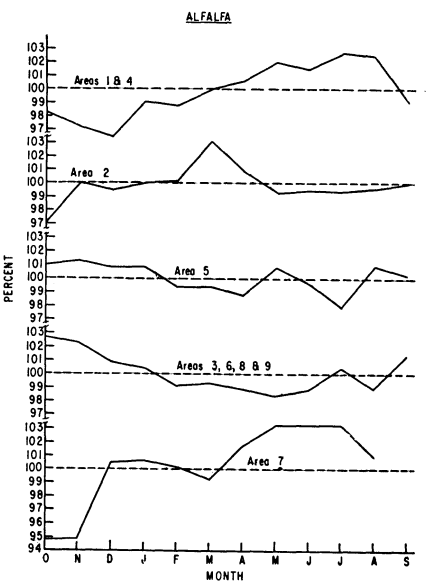


Figure 5. Seasonal Price Patterns for Oklahoma ALFALFA HAY Prices. The graph below shows Area monthly price indexes as a percent of state monthly price indexes.



ANALYZING THE STORAGE ALTERNATIVES

Returns and costs for analyzing the storage alternatives are presented in this section. Crop storage competes with crop production, livestock production, and other farm enterprises for available labor, capital, and farm facilities. Thus, the profit-maximizing rule guiding storage decisions is that returns from storage must be equal to or greater than returns expected from using the required resources elsewhere. Returns can be weighted for differences in risks and uncertainties associated with different enterprises.

Gross Returns From Storage

Average seasonal price increases for each crop are presented in Table 1. The storage period assumed was from harvest to the month having the highest price. Seasonal indexes for these months were applied to three price situations. Price increases could also be estimated by assuming that harvest month prices are known, and applying the "per cent of harvest month" index from Appendix Tables 1, 2, 3, and 4.

Long-term storage plans might well be based on the average price increases presented in Table 1. The seasonal patterns used were derived from series of years generally representative of market conditions. The period included good and bad crop years and a variety of livestock price and crop and livestock production levels. The average increases are net of trend, cyclic, and random price variation. If possible, the decision-maker should adjust his expected price increases for trend and cyclic price changes.

Some managers are interested in magnitudes of possible gains or losses from their enterprises as well as the average expectation. Thus, additional data which describe the variation of seasonal price increases are presented in Table 2. The one standard deviation ranges for average seasonal price increases are given on line 1, Table 2. Line 2 shows the one standard deviation ranges for price increases in individual years. Actual prices and seasonal indexes for individual years were used to compute the highest and lowest seasonal price increases (or decreases) occurring during the base periods used in this study.

Storage Costs

Storage cost items to be considered differ between buyers and sellers and between farmers who: (a) have storage facilities, (b) have

Table 1. Estimated Average Seasonal Price Increases* Resulting from Storing Oats, Barley, Grain Sorghum and Alfalfa Hay from Harvest to the Usual High Price Month.

	Oats			Barley			Grain Sorghum			Alfalfa Hay		
	(dollars/bu.)			*(dollars/bu.)*			*(dollars/cwt.)*			*(dollars/ton)*		
Price Level	.60	.75	.90	.90	1.10	1.30	1.40	1.75	2.10	20.00	25.00	30.00
Price Received**	.64	.81	.97	.95	1.16	1.37	1.50	1.87	2.25	22.44	28.05	33.66
Harvest Price†	.53	.66	.79	.81	.99	1.17	1.29	1.61	1.93	16.54	20.68	24.81
Seasonal Increase	.11	.15	.18	.14	.17	.20	.21	.26	.32	5.90	7.37	8.85

*Increases are based on state seasonal indexes.
**Harvest months assumed were: Oats, June; Barley, June; Grain Sorghum, November; and Alfalfa Hay, June.
†Months having highest prices were: Oats, February; Barley, January; Grain Sorghum, July; and Alfalfa Hay, January.

Table 2. Variation of Estimated Seasonal Price Increases for the Crops and Series of Years Studied.*

	Oats	Barley	Grain Sorghum	Alfalfa Hay
	(dollars/bu.)	*(dollars/bu.)*	*(dollars/cwt.)*	*(dollars/ton)*
One s.d. Range for Average Price Increases**	.13 to .17	.135 to .205	.216 to .304	6.82 to 7.92
One s.d. Range for an Annual Price Increases**	.087 to .213	.05 to .32	.09 to .43	5.07 to 9.67
Highest Price Increase Observed†	.23	.39	.55	19.33
Lowest Price Increase Observed†	.07	—.04	—.04	1.88

*Barley, June through May, 1946-1958; Oats, June through May, 1949-1958; Grain Sorghum, November through October, 1940-1960; Alfalfa Hay, June through May, 1939-1958.
**Prices assumed were: Oats, $.75/bu.; Barley, $1.10/bu.; Grain Sorghum, $1.75/cwt.; and Alfalfa Hay, $25.00/ton.
†Actual average prices and seasonal indexes for each year considered in this study were used to estimate the highest and lowest seasonal increase.

no storage facilities, and (c) wish to consider commercial storage. Levels of costs differ between farmers because of varying availability of labor and capital and profitability of using resources in alternative ways. In this section, levels and components of costs are analyzed and estimates of costs based on previous research are presented.

ON-FARM FIXED STORAGE COSTS

A farmer who builds storage space has fixed costs relating to the building and other equipment installed. These are called *fixed costs* because, once incurred, they must be paid regardless of how intensively the facilities are used. Fixed cost items include depreciation, interest, taxes, and insurance. Computation of these costs is illustrated in Table 3. Cost estimates are for a 1,000 bushel steel bin equipped with an unloading device. Additional bins could be added for about 80 per cent of the cost of the first bin because the auger could be transferred between bins.

Depreciation

Annual depreciation is the difference between initial cost and expected salvage value divided by "years to recover investment" (Table 3). The technical life of a granary is about 20 years. However, some farmers may use a shorter economic life ("years to recover investment") because of uncertainty about levels of storage returns, the number of years they will store or the salvage value of used bins. The effect of 6, 12, and 18-year amortization periods on annual costs is demonstrated in Table 3.

Interest

Average annual interest costs are approximately average investment[4] $\times$ interest rate. Appropriate interest rates differ between managers with different capital situations and alternative uses for funds. Capital for building storage facilities can be obtained for 4 to 6 per cent. However, use of this credit for storage may reduce credit available for other uses. The real cost of capital is the rate it will return in another investment alternative. Interest rates of 6, 9, and 18 per cent are used in Table 3.

Taxes and Insurance

Taxes and insurance costs are easily estimated and vary little between farmers. An insurance rate of $8.00 per $1,000 on the average value of the bin was used. Taxes were charged at $60.00 per $1,000 assessed

[4]Average investment is assumed to be cost plus salvage value divided by two.

Table 3. Fixed Costs for Grain Storage, 1,000 Bushel Bin With Unloading Device.

	Annual Cost				
Years Useful Life:	**6**	**12**	**12**	**18**	**18**
Interest Rate:	**6 %**	**6 %**	**9 %**	**9 %**	**18 %**
	(dollars)	*(dollars)*	*(dollars)*	*(dollars)*	*(dollars)*
Depreciation $\left(\frac{\text{Initial Cost* — Salvage Value**}}{\text{Years to Recover Investment}}\right)$	75.00	43.75	43.75	33.33	33.33
Interest $\left(\frac{\text{Cost + Salvage Value}}{2}\right) \times r$	22.50	20.25	30.37	27.00	54.00
Taxes†	7.20	5.40	5.40	3.60	3.60
Insurance††	3.00	2.70	2.70	2.40	2.40
Total Annual Fixed Cost	107.70	72.10	82.22	66.33	93.33
Cost Per Bushel:					
Used at Full Capacity	.108	.072	.082	.066	.093
Used at Two-thirds Capacity	.162	.108	.123	.099	.140

*Initial cost of the bin assumed was as follows:

14 foot bin with floor	$420.00
14 foot bin adapter assembly	37.00
Freight at $1.75/cwt.	28.00
Sweep auger	115.00
Total Installed Cost	$600.00

**Salvage values assumed were: 6 years, $150 salvage; 12 years, $75 salvage; and 18 years, no salvage.

†Taxes were computed at the rate of $60 per $1,000 with average assessments of 20 per cent of $600 for the 6 year period, 15 per cent for the 12 year period and 10 per cent for the 18 year period.

††Insurance was computed at the rate of $8.00 per $1,000 on one-half the bin and equipment value during the years useful life assumed.

value. Allowance was made for reduced valuation of the structure over its life by assessing the initial value (cost) at 20 per cent for the 6 year period, 15 per cent for 12 years, and 10 percent for 18 years.

Total Fixed Costs

Total annual fixed costs for different interest rates and planning periods are shown in Table 3. Per bushel costs based on full and two-thirds utilization of the 1,000 bushel capacity are also given. Annual per unit fixed costs increase 50 per cent when storage is used at two-thirds capacity rather than at full capacity. Thus, the storer must carefully choose the amount of storage to be built.

ON-FARM FIXED COSTS FOR HAY STORAGE

Costs of a pole-type barn with a 12-foot ceiling have been estimated at $1.50 per square foot.[5] One ton of baled hay would require approximately 11.25 square feet of floor space in such a structure. Thus, each ton would require an investment of $11.25 \times \$1.50 = \$16.88$ per ton of baled hay. Depreciation, interest, taxes, and insurance would be $1.95 per ton for 18 years of life, $2.30 for 12 years, and $3.30 for 6 years with interest at 9 per cent.

FIXED COSTS ON EXISTING FACILITIES

A farmer who has a granary or hay barn on his farm which will not be used unless he stores grain or hay need not consider fixed costs. Costs of his storage facilities must be paid whether he stores or not. Thus, while they affect the decision whether to build storage facilities, they do not affect the decision to use them once built. Costs of maintaining the structures are variable costs and are considered in the following section.

ON-FARM VARIABLE STORAGE COSTS

Variable storage costs result from shrinkage, insurance, hauling and handling, interest, insect control, and building repair and maintenance. Technical coefficients for estimating these costs are presented in Table 4 along with typical charges for these items. Shrinkage, interest, and insurance costs depend on prices of the crops. Thus, it was necessary to assume a cost level.

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[5]William F. Lagrone, Percy L. Strickland, Jr., and James S. Plaxico, *Resource Requirements, Costs and Expected Returns; Alternative Cropland and Livestock Enterprises; Sandy Soils of the Rolling Plains of Southwestern Oklahoma,* Oklahoma State Experiment Station and FERD Bulletin No. P-369, February, 1961, pp. 6-7.

Table 4. Estimated Variable Storage Costs for Oats, Barley, Grain Sorghum, and Alfalfa Hay.*

	Crop**			
	Oats	Barley	Grain Sorghum	Alfalfa Hay
	(dollars/bu.)	*(dollars/bu.)*	*(dollars/cwt.)*	*(dollars/ton)*
a. Shrinkage at 2 per cent for oats and barley, 1 per cent for grain sorghum and 6 per cent for hay	.011	.020	.016	1.240
b. Insurance on grain $8.00/$1,000/Year. (8 mos. storage assumed)	.003	.006	.010	.110
c. Extra handling and hauling†	.050	.050	.100	3.300
d. Interest at 6 per cent per year (8 mos. storage assumed)	.022	.040	.064	.836
e. Insect control	.007	.007	.010	---
f. Building repair and maintenance††	.010	.010	.010	.850
Total variable costs per unit	.103	.133	.210	6.330

*Technical coefficients required for estimating costs were primarily obtained from:
(1) Larson, Adlowe L., *et. al.*, "Comparative Costs of Grain Storage on Farms and in Elevators", Oklahoma Agricultural Experiment Station Bulletin 349, 1950.
(2) Morrison, W. R., "Costs and Use of Storage for Soybeans, Oats, and Wheat in Arkansas", Arkansas Experiment Station Bulletin 562, 1955.
(3) Hildreth, R. J. and C. A. Moore, "Profits and Losses from On-Farm Drying and Storage of Grain Sorghum in Central Texas and the Coastal Bend", Texas Agriculture Experiment Station Bulletin 887, 1958.

**Prices typical of current and projected market levels were used as follows: Oats, $.75 per bu.; Barley, $1.10 per bu.; Alfalfa Hay, $25.00 per ton; and Grain Sorghum, $1.75 per cwt. Since the prices used affect cost levels of items a, b. and d, adjustments of the cost estimates should be made as price levels change.

†The only labor included in these costs is that required in extra hauling and handling. Hauling and handling charges are custom rates (Jeffrey, D. B.; Cecil Maynard, and Odell L. Walker, *Oklahoma Custom Rates,* Oklahoma State University Extension Service, Leaflet L-50, 1960).

††Maintenance costs on grain bins are about 2 per cent of the new cost of the structure per year. Maintenance costs on hay barns would be about 5 per cent of the new cost of the structure per year.

Transportation Costs

Grain prices used in this study are assumed to be "delivered" prices at local elevators. Hay prices are assumed to be "in field" prices for June, July, August and September and "in farm storage" prices the rest of the year. These assumptions conform with usual marketing practices and sources of tabulated "prices received by farmers."

Given the above assumptions, sources of transportation costs can be classified as in Figure 6. A grain producer must pay hauling and handling charges for marketing paths AB and BD if he stores on the farm and sells at harvest time. Thus, the approximate net transportation cost for home storage relates to the route AB. Estimated hauling costs in Table 4 are the usual custom charges for hauling from field to farm bin. However, costs of hauling from field to market are considered equal to this charge. Farmers who can market grain for the same price at home as at the local elevator would have no additional hauling and handling costs. If timeliness and labor scarcity are not factors, the producer might use a lower handling cost. If timeliness and labor scarcity are factors, the producer can hire a custom hauler and add a cost for lack of timeliness and perhaps inconvenience. No other labor or handling costs are considered in Table 4; however, they may be added if relevant. If grain is stored in a commercial facility, no additional transportation charges are necessary. Hay producers must pay costs for the AB route if they store on the farm.

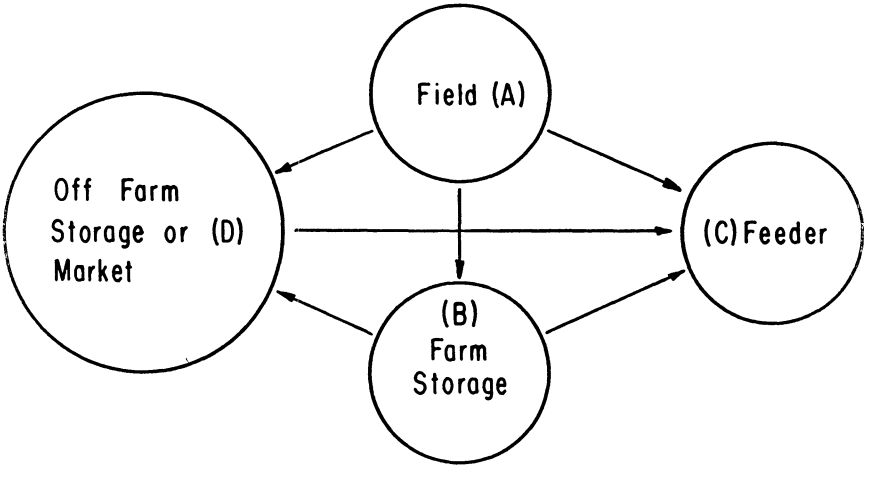

Figure 6. Transportation Patterns for Feed Grains and Hay.

A grain user must pay the amount that AC exceeds AD if he buys grain at harvest time. He must pay either the amount that route BD exceeds BC, or the amount of DC at other times of the year. The hay user typically pays handling and hauling charges for route BC after harvest and AC during harvest.

OFF-FARM STORAGE COSTS

Costs for commercial storage are currently about $.09 to $.10 per bushel for oats, $.11 to $.12 per bushel for barley, and $.12 to $.13 per cwt. for grain sorghum. These charges apply to a storage period of eight months and include receiving, shrinkage, and insurance costs. Interest costs from Table 4 can be added to this charge.

Returns From Storage

Estimates of seasonal price increases presented in this bulletin are useful for analyzing possible total returns from storage. Costs vary among farmers, and each farmer may use the procedures demonstrated in the preceding section to estimate his own storage costs and net returns from storage. However, the costs presented in Tables 3 and 4 are combined in this section to give an indication of returns which are possible from storage.

Table 5 shows expected differences between seasonal price increases and storage costs for five storage situations. Price levels for feeds were assumed as follows: Oats, $.75 per bushel; barley, $1.10 per bushel; grain sorghum, $1.75 per cwt.; and alfalfa hay, $25.00 per ton. For the price levels and costs used, storage was profitable if storage facilities were assumed available or commercial storage was used. For example, a farmer storing grain sorghum in existing storage which would be otherwise unused would receive a return of $.05 per hundred above variable costs of storage. Storage costs, as demonstrated in Table 4, include a charge of 6 per cent (i.e., $.064 per hundred pounds of sorghum) for interest on capital invested in stored sorghum. Transportation charges include payment for labor used in handling grain on a custom basis. Thus, the farmer using his own labor for hauling and handling would receive a labor return as well.

Higher feed prices, lower actual storage costs for individual farmers, and timeliness are considerations which might well offset the losses shown in Table 5 for cases in which storage facilities must be constructed. Higher prices increase shrinkage, interest, and insurance costs as well as seasonal prices. However, with oats, $.90 per bushel, barley, $1.30

Table 5. Estimated Returns from Storing Oats, Barley, Grain Sorghum and Alfalfa Hay

	Storage Situation																
								Storage To Be Built With:									
	Commercial Storage*			Storage Facilities Available				6 Year Depreciation 6 Per Cent Money			12 Year Depreciation 9 Per Cent Money				18 Year Depreciation 9 Per Cent Money			
	Oats	Barley	Grain Sorghum	Oats	Barley	Grain Sorghum	Hay	Oats	Barley	Grain Sorghum	Oats	Barley	Grain Sorghum	Hay	Oats	Barley	Grain Sorghum	Hay
Average Returns** from Storage	.15	.17	.26	.15	.17	.26	7.37	.15	.17	.26	.15	.17	.26	7.37	.15	.17	.26	7.37
Estimated Storage Costs:																		
Fixed†	--	--	--	--	--	--	---	.094	.094	.168	.071	.071	.127	3.30	.062	.062	.111	1.95
Variable	.117	.155	.189	.103	.133	.210	6.33	.103	.133	.210	.103	.133	.210	6.33	.103	.133	.210	6.33
Total	.117	.155	.189	.103	.133	.210	6.33	.197	.227	.378	.174	.204	.337	9.63	.165	.195	.321	8.28
Net Returns	.033	.015	.071	.047	.037	.050	1.04	-.047	-.057	-.118	-.024	-.034	-.077	-2.26	-.015	-.025	-.061	- .91
Range in Net Returns Over Time	.113 to -.047	.235 to -.195	.361 to -.229	.127 to -.033	.257 to -.177	.34 to -.25	13.00 to -4.45	.033 to -.127	.163 to -.267	.172 to -.418	.056 to -.104	.186 to -.244	.213 to -.977	9.70 to -7.75	.065 to -.095	.195 to -.235	.229 to -.361	11.05 to -6.40

*Costs for commercial storage include interest charges on capital invested in grain.

**Price levels used were: Oats, $.75 per bushel; barley, $1.10 per bushel; grain sorghum, $1.75 per cwt., and hay, $25.00 per ton.

†Three 1,000 bushel bins *used at full capacity* were assumed for this table. Fixed costs of two of the bins were estimated at 80 per cent of the first because auger equipment can be transferred between bins.

per bushel, grain sorghum, $2.10 per cwt, and hay, $30.00 per ton, gains in seasonal price increases would approximately absorb increased costs and allow a farmer to break-even if he stores in facilities amortized over 18 years with 9 per cent returns required on the capital investment.

The largest single storage cost component is for hauling and handling. Costs for hauling and handling might be lower than indicated in Table 4 if the farmer is able to utilize slack periods for labor and trucks to market or store hay. On-farm storage may facilitate the harvest operation by reducing lengths of hauls and harvest time requirements when labor is high and timing critical. As indicated in previous discussion, some farmers can sell farm-stored grains at terminal markets for the same price (net of hauling charges) that local elevators obtain. Quality losses in hay or grain may be reduced by timely storing at harvest.

Storage costs might also be reduced by buying bins at prices lower than "list prices" used here. For example, a $100 decrease in initial cost of the bin would decrease fixed storage costs $.01 to $.02 per bushel, depending on the interest rate and amortization period used. Larger bins provide cost economies if production or use of one feed is large enough for high utilization.

The period during which the investment in storage structures is to be recovered and the interest rate required clearly affect profitability of storage. Figure 7 shows combinations of years and interest rates for which profit would be positive, zero, and negative, assuming other storage costs are constant at levels used in this bulletin. Combinations of years and interest rates on the line for a particular crop represent break-even points. To the left of each line, profits would be obtained. Losses would occur for combinations of years and interest rates lying to the right of the lines. For example, storage would be profitable if the planning period for storing oats and the interest rate were 20 years and 3.5 per cent, respectively. The storer would break-even at 20 years and 4 per cent interest and lose at 20 years and 4.5 per cent interest. Dashed lines above 20 years show break-even combinations if the technical life of the facilities and the planning period exceed 20 years.

It is apparent that farmers short on labor, investment capital, and storage facilities would find little advantage in farm storage. However, farmers with these resources available might profitably store their own feeds. Each farmer must carefully assess his own situation to arrive at the final decision.

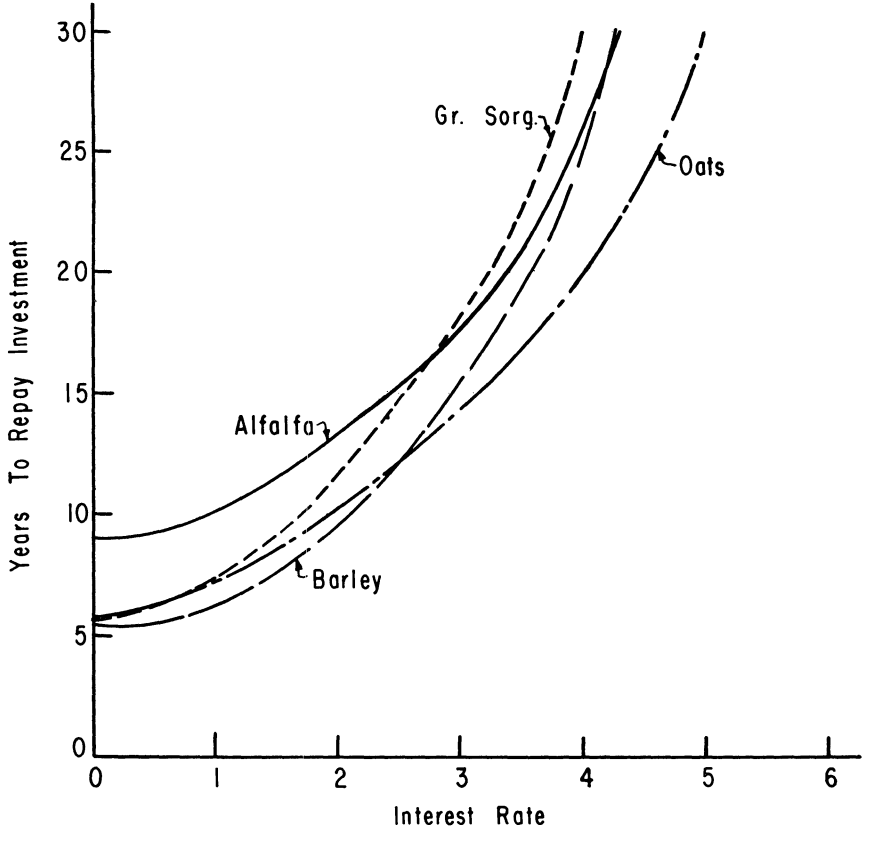

Figure 7. Interest Rates and Number of Years Required to Break-Even on Storage of Feed Grains and Alfalfa Hay.

APPENDIX TABLE 1
Seasonal Price Patterns for Barley with the Standard Deviations for Average and Annual Patterns as Estimated from "Prices Received By Farmers, " 1946-47 to 1957-58.

Month	Seasonal Price Index	s	s_x	Index as a Per Cent of Low Price Month	Seasonal Price Index	s	s_x	Index as a Per Cent of Low Price Month
		State				Area 2		
June	89.8	7.7	2.3	100.0	89.5	8.4	2.4	100.0
July	92.0	7.4	2.2	102.4	90.8	7.2	2.1	101.4
August	94.7	5.2	1.6	105.4	94.7	3.6	1.0	105.8
September	97.9	5.8	1.7	109.0	99.2	6.6	1.9	110.8
October	99.6	4.1	1.2	110.9	99.6	4.4	1.3	111.3
November	101.7	4.3	1.3	113.2	100.8	4.6	1.3	112.6
December	104.3	4.5	1.3	116.1	103.4	4.9	1.4	115.5
January	105.7	4.6	1.4	117.7	105.3	4.8	1.4	117.6
February	103.7	4.8	1.4	115.5	103.8	5.2	1.5	116.0
March	104.9	3.5	1.0	116.8	104.1	3.3	1.0	116.3
April	103.8	5.0	1.5	115.6	104.8	5.6	1.6	117.1
May	102.1	4.9	1.5	113.7	103.8	6.5	1.9	116.0
		Area 5				Area 7		
June	90.1	9.0	2.6	100.0	89.1	8.9	2.6	100.0
July	92.7	8.6	2.5	103.0	91.7	8.1	2.3	102.9
August	95.1	6.3	1.8	105.6	94.2	4.9	1.4	105.7
September	98.9	7.3	2.1	109.7	98.8	6.1	1.8	110.9
October	99.8	4.2	1.2	110.7	99.4	9.1	2.6	111.6
November	101.1	4.2	1.2	112.3	102.5	5.0	1.4	115.0
December	102.2	3.9	1.1	113.5	105.5	4.5	1.3	118.4
January	105.8	5.4	1.6	117.5	106.3	4.3	1.2	119.3
February	104.0	4.2	1.2	115.5	104.7	5.9	1.7	117.5
March	104.3	4.2	2.4	115.8	104.7	4.6	1.3	117.5
April	104.0	5.6	1.6	115.4	103.6	6.7	1.9	116.3
May	102.0	5.0	1.4	113.3	99.8	4.7	1.7	112.0

APPENDIX TABLE 2

Seasonal Price Patterns for Oats With the Standard Deviations for Average and Annual Patterns as Estimated from "Prices Received by Farmers," 1949-50—1957-58.

Month	Seasonal Price Index	s	s_x	Index as Per Cent of June Index	Seasonal Price Index	s	s_x	Index as Per Cent of June Index	Seasonal Price Index	s	s_x	Index as Per Cent of June Index
	State				Area 2				Area 3			
June	88.1	6.9	2.3	100.0	90.2	7.2	2.4	100.0	88.6	7.0	2.3	100.0
July	87.6	4.1	1.4	99.4	89.1	5.2	1.7	98.9	86.3	4.6	1.5	97.4
August	92.4	3.7	1.2	104.9	94.0	3.8	1.3	104.2	92.3	4.9	1.6	104.2
September	97.5	3.4	1.1	110.7	97.3	3.8	1.3	107.9	96.7	4.3	1.4	109.1
October	99.1	2.9	1.0	112.5	99.4	2.9	1.0	110.2	98.5	3.6	1.2	111.2
November	102.1	5.1	1.7	115.9	101.8	5.3	1.8	112.9	99 8	5.4	1.8	112.6
December	105.4	4.5	1.5	119.6	105.2	4.5	1.5	116.6	105.1	5.4	1.8	118.6
January	107.3	3.2	1.1	121.8	107.6	4.8	1.6	119.3	109.1	2.6	.9	123.1
February	107.7	3.8	1.3	122.2	105.2	4.4	1.5	116.6	108 9	3.4	1.1	122.9
March	106.3	3.4	1.1	120 6	103.9	4.6	1.5	115.2	106.8	4.3	1.4	120.5
April	104.3	2.6	.9	118.4	103.7	4.8	1.6	115 0	104.9	4.2	1.4	118.4
May	102.2	3.3	1.1	116.0	102.2	4.6	1.5	113.3	103.1	4.3	1.4	116.4
	Area 5				Area 7							
June	88.8	7.0	2.3	100.0	85.0	8.4	2.8	100.0				
July	87.9	3.7	1.2	99.0	88.0	6.2	2.1	103.5				
August	93.3	3.4	1.1	105.1	92.6	3.9	1.3	108.9				
September	96.6	4.7	1.6	108.8	97.1	3.4	1.1	114.2				
October	98.9	3.4	1.1	111.4	100.1	2.7	.9	117.8				
November	102.5	4.1	1.4	115.4	104.9	5.6	1.9	123.4				
December	105.9	5.0	1.7	119.2	106.4	5.7	1.9	125.2				
January	107.4	3.5	1.2	120.9	107.6	5.1	1.7	126.6				
February	106.1	3.8	1.3	119.5	107.9	4.2	1.4	126.9				
March	105.4	2.8	.9	118.7	106.1	4.9	1.6	124.8				
April	104.2	2.8	.9	117.3	104.3	2.2	.7	122.7				
May	103.1	3.7	1.2	116.1	99.5	4.8	1.6	117.1				

APPENDIX TABLE 3

Seasonal Price Patterns for Grain Sorghum with the Standard Deviations for Average and Annual Patterns as Estimated from "Prices Received by Farmers," 1940-41—1959-60.

Month	Seasonal Price Index	s	s_x	Index as Per Cent of Low Price Month	Seasonal Price Index	s	s_x	Index as Per Cent of Low Price Month	Seasonal Price Index	s	s_x	Index as Per Cent of Low Price Month
	State				Area 1				Area 2			
October	93.1	8.0	1.8	101.1	94.4	10.3	2.3	101.9	93.4	8.5	1.9	101.4
November	92.1	7.2	1.6	100.0	92.6	8.1	1.8	100.0	92.1	7.4	1.7	100.0
December	94.5	8.0	1.8	102.6	95.0	9.4	2.1	102.6	94.2	8.7	2.0	102.3
January	98.5	6.7	1.5	106.9	98.3	7.2	1.6	106.2	97.5	6.2	1.4	105.9
February	97.7	6.3	1.4	106.1	96.7	7.2	1.6	104.4	98.2	4.6	1.0	106.6
March	101.9	4.0	.9	110.6	101.3	4.5	1.0	109.4	100.2	5.1	1.1	108.8
April	104.3	4.9	1.1	113.2	103.4	5.8	1.3	111.7	103.0	7.5	1.7	111.8
May	105.1	6.3	1.4	114.1	104.5	6.3	1.4	112.8	105.3	7.2	1.6	114.3
June	105.8	5.8	1.3	114.9	103.6	6.7	1.5	111.9	105.4	8.0	1.8	114.4
July	107.0	5.8	1.3	116.2	105.7	7.2	1.6	114.1	106.3	7.2	1.6	115.4
August	102.8	8.9	2.0	111.6	103.9	9.8	2.2	112.2	104.3	7.6	1.7	113.2
September	97.2	8.0	1.8	105.5	99.7	8.0	1.8	107.7	99.2	9.0	2.0	107.7
	Area 4				Area 5				Area 6			
October	92.2	8.3	1.9	100.5	93.2	8.0	1.8	100.3	92.6	8.5	1.9	100.7
November	91.7	7.4	1.6	100.0	92.9	6.7	1.5	100.0	92.0	7.3	1.6	100.0
December	93.1	8.8	2.0	101.5	94.8	6.6	1.5	102.0	95.1	7.7	1.7	103.4
January	98.5	6.5	1.4	107.4	99.0	6.2	1.4	106.6	98.1	6.9	1.5	106.6
February	99.9	5.9	1.3	108.9	98.4	5.6	1.2	105.9	99.0	6.0	1.3	107.6
March	101.6	4.2	.9	110.8	101.5	4.7	1.1	109.3	102.7	4.9	1.1	111.6
April	103.4	5.0	1.1	112.8	104.8	3.5	.8	112.8	104.2	5.4	1.2	113.3
May	104.8	6.0	1.3	114.3	104.0	6.8	1.5	111.9	104.4	6.4	1.4	113.5
June	105.4	7.4	1.6	114.9	105.0	5.6	1.2	113.0	106.4	7.2	1.6	115.7
July	107.6	6.7	1.5	117.3	107.1	6.0	1.3	115.3	108.2	8.2	1.8	117.6
August	105.4	11.5	2.6	114.9	102.6	9.4	2.1	110.4	101.2	9.1	2.0	110.0
September	96.2	9.1	2.0	104.9	96.7	6.7	1.5	104.1	95.1	9.2	2.0	103.4

APPENDIX TABLE 4

Seasonal Price Patterns for Alfalfa Hay With the Standard Deviations and Annual Patterns as Estimated from "Prices Received by Farmers," 1939-40—1957-58.

Month	Seasonal Price Index	s	s_x	Index as Per Cent of Low Price Month	Seasonal Price Index	s	s_x	Index as Per Cent of Low Price Month	Seasonal Price Index	s	s_x	Index as Per Cent of Low Price Month
	State				Areas 1 and 4				Area 2			
June	82.7	6.22	1.54	100.0	81.3	6.8	1.6	100.0	80.2	8.5	2.0	100.0
July	85.3	5.48	1.26	103.1	82.9	7.1	1.6	102.0	85.2	9.1	2.1	106.2
August	91.7	6.75	1.55	110.9	88.4	15.1	3.5	108.7	91.3	9.5	2.2	113.8
September	96.0	7.14	1.64	116.1	95.2	8.4	1.9	117.1	96.1	11.2	2.6	119.8
October	102.4	7.27	1.67	123.8	101.2	8.3	1.9	124.5	103.4	8.8	2.0	128.9
November	105.9	5.62	1.29	128.1	105.8	8.3	1.9	130.1	109.2	8.5	1.9	136.2
December	109.5	6.87	1.58	132.4	110.2	7.7	1.8	135.5	110.5	7.9	1.8	137.8
January	112.2	5.32	1.22	135.7	114.5	5.5	1.2	140.8	111.4	7.0	1.6	138.9
February	110.8	5.71	1.31	134.0	112.5	10.0	2.3	138.4	110.2	7.5	1.7	137.4
March	107.0	6.42	1.47	129.4	109.9	7.6	1.7	135.2	106.3	8.3	1.9	132.5
April	104.5	7.54	1.73	126.4	107.1	8.3	1.9	131.7	104.1	11.1	2.5	129.8
May	92.0	6.66	1.53	111.2	91.2	11.3	2.6	112.2	92.0	13.0	3.0	114.7
	Area 5				Areas 3, 6, 8, and 9				Area 7			
June	83.6	7.1	1.6	100.0	84.9	6.0	1.4	100.0	78.0	8.8	2.0	100.0
July	86.4	6.2	1.4	103.3	87.3	6.0	1.4	102.8	80.9	6.6	1.5	103.7
August	92.4	7.2	1.7	110.5	92.5	6.4	1.5	109.0	92.1	7.5	1.7	118.1
September	96.9	7.6	1.7	115.9	96.4	6.7	1.5	113.5	96.6	9.2	2.1	123.8
October	101.8	8.0	1.8	121.8	101.4	7.5	1.7	119.6	102.5	6.8	1.6	131.4
November	104.6	7.0	1.6	125.1	105.2	6.8	1.6	123.9	105.1	7.4	1.7	134.7
December	108.5	7.1	1.6	129.8	108.3	6.3	1.5	127.6	111.4	7.8	1.8	142.8
January	113.2	5.4	1.2	135.4	110.4	7.2	1.7	130.0	115.8	7.1	1.6	148.5
February	110.5	5.9	1.3	132.2	109.6	6.8	1.6	129.1	114.4	7.2	1.6	146.7
March	104.8	7.2	1.6	125.4	107.4	6.0	1.4	126.5	110.4	8.0	1.8	141.5
April	105.2	9.5	2.2	125.8	103.3	10.1	2.3	121.7	105.4	10.3	2.4	135.1
May	92.2	9.9	2.3	110 3	93.2	7.8	1.8	109.8	87.3	9.1	2.1	111.9