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Evaluating Post-Harvest Marketing Strategies For Grain Sorghum In the Texas Coastal Bend

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SUMMARY

A methodology based on decision analysis is developed for determining economic returns to alternative post-harvest marketing strategies for grain crops. Stochastic dominance techniques are used to assess the impact of producers' risk preferences on "optimal" strategies and to assess the usefulness of price outlook information to producers. The methodology considers commercial storage of grain sorghum in the Texas Coastal Bend for the 1972-1981 period. The value of price outlook information is contingent on producers' risk preferences.

Keywords: Grain sorghum/Texas Coastal Bend/marketing strategies/value of information/risk preferences.

Evaluating Post-Harvest Marketing Strategies For Grain Sorghum In The Texas Coastal Bend

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Grain sorghum prices fluctuate substantially, both within and between years. This price variability has characterized the industry since the mid-1970's (Fig. 1). Such marketing variability can be perplexing to producers who must decide when to price and which marketing instruments(s) to use. As a result, producers must also decide whether to use price forecasts in making those decisions and, if so, the maximum they can afford to pay for the information if it is offered by a private service.

The time continuum during which grain sorghum producers can price their crops extends from a few months prior to planting through several months past harvest. Pricing instruments available during part or all of this period include cash forward contracts, futures contracts, cash sales, delayed pricing, and on diversified farms, feeding through livestock. This publication presents an approach to assessing the efficacy of alternative post-harvest sales decisions for grain sorghum producers in the Texas Coastal Bend (Corpus Christi area).[1]

There has been an increase in the quantity of market information available to producers from public and private sources in response to increased price fluctuation of recent years. Market information traditionally supplied to producers includes summaries of what net returns would have been had producers followed particular strategies (e.g., selling one-twelfth of the crop in each month following harvest) (Ferris; Cornelius; Purcell; Shane and Meyer); pricing forecasts; and point forecasts of future price levels. The kind of information and the form in which it has been provided have not adequately accommodated the differences in the cash flow requirements, equity positions, and risk preferences of producers.

One approach to analyzing market risks is to construct "objective" probability distributions for the net returns associated with alternative marketing strategies. This study extends previous approaches by using stochastic dominance techniques to evaluate alternative marketing strategies, and it includes an assessment of the efficacy of publicly available forecasts for making the "sell at harvest vs. store" decision.

The decision analysis framework (Chernoff and Moses; Raiffa) is appropriate for examining marketing decisions faced by agricultural producers. The framework performs well when producers are assumed to be expected profit maximizers, but falls short when they are risk averse or risk loving because of the difficulties in eliciting utility functions. The generalization of the framework to include use of stochastic dominance with respect to a function (Meyer; Robison and King) to order choices and the development of a new interval approach to eliciting decisionmakers' preferences (King and Robison, 1981a)[2] reduces previous difficulties and opens new opportunities which should be investigated in an applied problem setting.

COMPONENTS OF THE OBJECTIVE FUNCTION: RETURNS TO STORAGE

A producer deciding whether to sell his crop at harvest or during the post-harvest period is interested in whether the anticipated price increase during the post-harvest period will be sufficient to cover the costs of storage and additional risk incurred. July is designated as the harvest month for Texas Coastal Bend grain sorghum producers and monthly prices are used in the analysis (Texas Department of Agriculture). All returns to post-harvest sales decisions are calculated with respect to the July monthly price. Since inflation was significant over the 1972-81 period, net returns are normalized to August 1981 dollars (USDA, *Agricultural Prices*, 1981). Three cost considerations are associated with a storage deci-

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GRAIN SORGHUM (1972-81)
CORPUS CHRISTI AREA

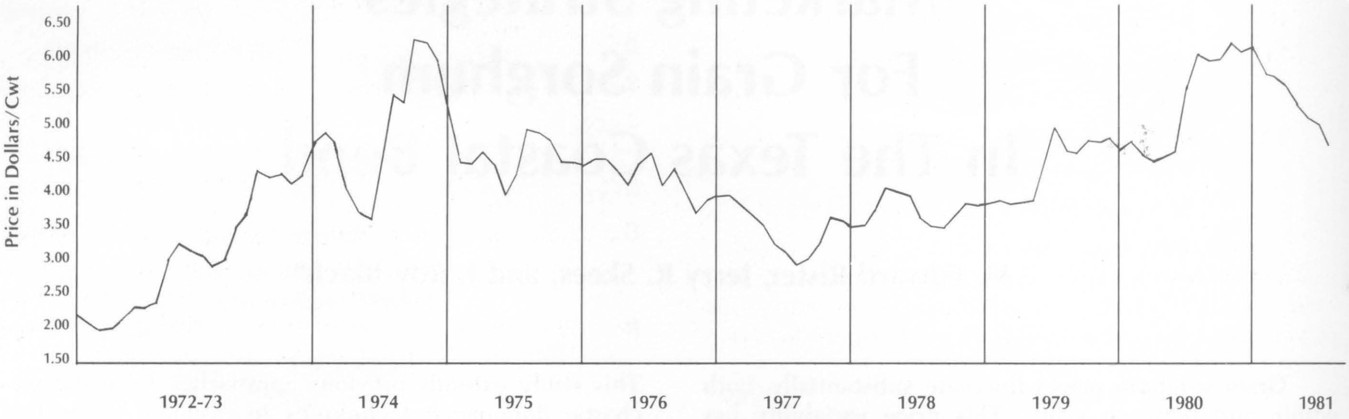

*Figure 1. Nominal grain sorghum prices in the Texas Coastal Bend Region (1972-1981).**

**Source: Texas Department of Agriculture,* Texas Cash Grain Prices.

sion: 1) cash storage costs, 2) opportunity costs, and 3) physical storage losses.

Cash Storage Costs

Post-harvest grain sales require storage from harvesttime until the time at which sales occur, and the expense of storage is borne by the producer. Cash storage costs occur in two forms: 1) fixed charges, and 2) monthly variable charges. The fixed charges cover: 1) initial handling costs and, in some instances, the first one-to-three months of storage, and 2) handling costs associated with final sale of the commodity. In the Texas Coastal Bend region, commercial elevator rates for these charges currently vary from 0 to 30 cents per hundredweight. Commercial storage cash variable costs are 4 to 5 cents per hundredweight per month.

Opportunity Costs

By storing at harvesttime, a producer is foregoing the opportunity to pay off existing loans and/or invest the sales revenue. A method of assessing this cost is to discount the net price received from the post-harvest sales strategy into harvest dollars. This is accomplished by using the following discount factor,

$$1/(1+r)^{TM/12}$$

where r represents the appropriate discount rate per year and TM refers to the number of months the crop is stored.

Physical Storage Losses

Storage of grain sorghum results in some physical loss due to increased handling and additional aeration and/or drying during the storage period. At the time a producer decides to use a commercial storage facility, the facility manager informs him of the assessed loss—usually .5 to 1.5% of the crop.

Calculations of Net Returns to Post-Harvest Storage

The following equation represents net returns to post-harvest sales as opposed to harvesttime sales:

$$NR_{tt_o} = [(PPH_t - SC_t) * (1 - W_t) * DF_t] - PH_{t_o} - IFSC$$

with

$$SC_t = TFSC + (M * MSC)$$

$$W_t = IL + (TM * ML)$$

$$DF_t = (1.0 + r)^{-TM/12}$$

where

NR_{tt_o}: net returns associated with a post-harvest sales strategy as opposed to a harvesttime sales strategy in month t_o ($/cwt.);

PPH_t: post-harvest sales price in month t ($/cwt.);

SC_t: storage costs associated with post-harvest sales in month t, assumes costs are paid at post-harvest sales date ($/cwt.);

W_t: proportional weight loss adjustment factor associated with a post-harvest sales strategy in month t (fraction of one cwt.);

DF_t: discount factor associated with a post-harvest sales strategy in month t;

IFSC: initial fixed storage costs, payable on commencement of storage period ($/cwt.);

TFSC: terminating fixed storage costs, payable on final sale of commodity ($/cwt.);

M: number of months stored past harvesttime for which monthly cash storage costs are assessed ($/cwt.);

MSC: monthly storage costs ($/cwt.);

IL: initial physical storage losses (% × .01);

ML: monthly physical storage losses (% × .01);

r: effective discount interest rate (% × .01);

TM: total number of months stored from harvesttime to post-harvest sales date[3]; and

PH_{t_o}: harvesttime sales price in month t_o ($/cwt.).

The resulting NR_{tt_o}'s are returns to storage stated in terms of harvesttime (July) dollars. Since inflation causes each year's NR_{tt_o} to have a different level of purchasing power, the Index of Prices Paid by Farmers for commodities and services, interest, taxes, and wage rates was used to adjust the respective year's NR_{tt_o}'s to August 1981 dollars. This standard of identifying returns to storage permits: 1) evaluation of the returns of individual post-harvest sales alternatives (e.g., sell all in January) relative to selling all at harvest, and 2) comparison of composite post-harvest sales alternatives (e.g., sell 50% in October and 50% in May versus sell all in January).

RETURNS TO POST-HARVEST STORAGE

This publication considers only the commercial storage option. Storage costs for the Texas Coastal Bend region were developed for each year.[4] Table 1 depicts net returns on a per hundredweight basis which would have been realized had a producer delayed sale of grain sorghum beyond harvesttime to each post-harvest month. Average net returns were positive for the post-harvest months of August through January and were negative thereafter. Net returns were quite variable, and variability tended to increase the further the sales month was from harvest.

A producer attempting to identify the month(s) during which post-harvest sales should occur would be expected to incorporate market information into the decision-making process if it increased the expected utility. Thus, strategies that use information on current and forecast market conditions, including price forecasts, should be compared to strategies that do not. An analysis of the performance of both types of strategies for a Texas Coastal Bend producer marketing 20,000 cwt of grain sorghum during the post-harvest period is presented below (this reflects a 400 to 600 acre representative farm producing 3500 to 4500 pounds per acre). A basic premise is that the net returns to storage for the 1972-81 data period will be representative of the area's future marketing environment (Young).[5]

Strategies That Do Not Use Information on Current and Future Market Conditions

The net returns and associated probabilistic characteristics of the strategies which ignore forecast information are presented in Table 2. A producer, on the average, can realize substantial net returns by selling all of his grain sorghum in either August, October, or December (strategies 2, 3, and 4). The significant variation in the net returns of the "all or nothing" strategies suggests more diversified strategies would be considered by risk averse producers. Among these are strategies 9, 10, 11, and 12 which involve diversifying sales among months in the July-December period. A producer using these mar-

TABLE 1. NET RETURNS TO POST-HARVEST STORAGE FOR GRAIN SORGHUM IN THE TEXAS COASTAL BEND REGION, 1972-81 [a]

Storage Year	Net Returns Per Sales Month ($/cwt.)[b] August	September	October	November	December	January	February	March	April	May	June
1972-73	0.14	0.47	0.37	0.44	1.78	2.21	1.85	1.58	1.13	1.24	2.18
1973-74	1.17	0.85	0.81	0.41	0.57	1.41	1.59	1.13	-0.23	-1.05	-1.37
1974-75	1.62	1.29	2.77	2.55	1.95	0.48	-0.84	-0.98	-0.81	-1.21	-2.09
1975-76	0.96	0.77	0.49	-0.10	-0.23	-0.41	-0.38	-0.47	-0.79	-1.22	-0.84
1976-77	-0.92	-0.62	-1.32	-1.77	-1.60	-1.53	-1.64	-1.91	-2.23	-2.53	-2.98
1977-78	-0.39	-0.33	-0.12	0.38	0.26	0.04	0.00	0.22	0.61	0.45	0.31
1978-79	-0.28	-0.42	-0.21	-0.12	-0.25	-0.30	-0.34	-0.47	-0.56	-0.60	0.01
1979-80	-0.57	-0.65	-0.55	-0.65	-0.66	-1.00	-0.91	-1.21	-1.41	-1.41	-1.40
1980-81	0.36	0.20	0.12	0.26	0.02	-0.04	-0.52	-0.67	-0.89	-1.23	-1.51
Mean	0.232	0.173	0.262	0.155	0.204	0.095	-0.132	-0.309	-0.575	-0.840	-0.854
Std. Dev.	0.86	0.71	1.13	1.14	1.12	1.15	1.15	1.11	1.00	1.10	1.51
Coef. Var.	3.72	4.11	4.31	7.34	5.50	12.06	8.68	3.60	1.74	1.31	1.77

[a] Harvest month for grain sorghum in the Texas Coastal Bend region is July. Returns are net above commercial storage costs and opportunity cost and are normalized into August 1981 dollars for grain sorghum stored from harvest until the respective sales month.

[b] Each monthly distribution was tested for both linear and quadratic dependence of observations. Only in January was an apparent dependence observed. The level of significance did not merit removal of the dependency (Bessler).

TABLE 2. STATISTICAL PARAMETERS OF SELECTED POST-HARVEST MARKETING STRATEGIES FOR GRAIN SORGHUM IN THE TEXAS COASTAL BEND REGION: 1972-1981 [a]

Strategies	Average Net Return	Standard Deviation	Coefficient of Variation	Skewness
No Outlook Information		August 1981 Dollars		
1. Sell all at harvest	0	0	∞	∞
2. Sell all in Aug.	4,644	17,292	3.72	.25
3. Sell all in Oct.	5,244	22,588	4.31	.87
4. Sell all in Dec.	4,088	22,470	5.50	.20
5. Sell all in Jan.	1,911	23,046	12.06	.43
6. Sell all in Feb.	-2,644	22,964	8.69	.62
7. Sell 1/12 each month	-2,644	15,760	5.96	-.27
8. Sell 1/4 in July, Oct., Jan. & April	-1,088	13,763	12.64	-.24
9. Sell 1/3 in July, Oct. & Jan.	2,400	13,323	5.55	.01
10. Sell 1/2 in July & Aug.	2,355	8,639	3.67	.25
11. Sell 1/2 in July & Oct.	1,333	12,473	9.36	.71
12. Sell 1/2 in July & Dec.	2,044	11,250	5.50	.20
13. Sell 1/2 in July & Jan.	955	11,462	12.00	.43
14. Sell 1/2 in July & Feb.	-1,311	11,470	8.75	.62
Use Outlook Information [b]				
15. FOLLOWS, Sell 1/12 each month	155	10,948	70.63	.48
16. CONTRARY, Sell 1/12 each month	-2,800	11,292	4.03	-1.77
17. FOLLOWS, Sell 1/4 in July, Oct., Jan. & April	488	9,407	19.28	.39
18. CONTRARY, Sell 1/4 in July, Oct., Jan. & April	-1,577	9,945	6.31	-1.22
19. FOLLOWS, Sell 1/3 in July, Oct. & Jan.	2,088	8,629	4.13	.57
20. CONTRARY, Sell 1/3 in July, Oct. & Jan.	311	10,223	32.87	.28
21. FOLLOWS, Sell in Aug.	1,822	9,609	5.27	.93
22. CONTRARY, Sell in Aug.	2,822	14,773	5.23	.66
23. FOLLOWS, Sell in Oct.	1,200	7,488	6.24	.43
24. CONTRARY, Sell in Oct.	4,044	21,565	5.33	1.18
25. FOLLOWS, Sell in Dec.	3,244	13,702	4.22	1.26
26. CONTRARY, Sell in Dec.	844	17,981	21.30	.38
27. FOLLOWS, Sell in Jan.	5,066	19,217	3.79	.85
28. CONTRARY, Sell in Feb.	-3,155	11,218	3.56	-1.45
29. FOLLOWS, Sell in Feb.	3,711	18,513	4.99	.77
30. CONTRARY, Sell in Feb.	-6,355	11,468	1.80	-1.33

[a] Net returns are for the marketing of 20,000 cwt. in the respective month(s) associated with each action or strategy.

[b] FOLLOWS - Indicates storage only in those years that the forecast suggest *storage*.
CONTRARY - Indicates storage only in those years that the forecast suggests *not to store*.

keting strategies would realize a lower average net return than those associated with strategies 2, 3, and 4, but would be subject to much less variability.

Seasonal demand and resulting prices for grain sorghum in the Texas Coastal Bend region have been dominated by developments in: 1) the export market, and 2) the size of a close substitute, the domestic corn crop. Since the corn crop in the Midwest is in the early development stages when grain sorghum harvest operations are underway in the Texas Coastal Bend region, there is considerable uncertainty about prospective market prices. Uncertainty poses a challenging task to the agricultural producer attempting to make marketing choices.

Strategies That Use Information on Current and Projected Market Conditions, and Price Forecasts

A relevant question is, "If we were in the producers' shoes, would we make better decisions based on the forecasts than we would otherwise? It's not the accuracy of the forecasts that is critical but whether or not we make better decisions." (Black and Dike) Assimilating and utilizing available outlook information should be considered. Texas Coastal Bend grain sorghum producers have at least four sources of outlook information readily available in June and early July while they are contemplating the "store/do not store" decision: *Progressive Farmer, Farm Journal, Doane's Agricultural Report* and *Feed Situation* (USDA, 1972-1980). The results of reviewing and subjectively interpreting the harvest period outlook information and pricing and storage recommendations available in these sources are: 1) "store" for crop years 1972, 1973, and 1978-80, and 2) "do not store" in 1974-1977 (i.e., sell all at harvest).

The authors of this publication independently assessed the "store/do not store" recommendations appearing in the four cited information sources for each of the respective year's harvest period. Although within a given year there was some ambiguity among the sources of information in terms of an implicit recommendation, the authors agreed that the information revealed identical perceptions of the overall recommendations for each marketing period.[6]

Table 2 depicts the mean, standard deviation, coefficient of variation and skewness for selected post-harvest marketing strategies. The strategies include: 1) those that explicitly *follow* the outlook information and store only in years when the recommendation is to store, and 2) strategies that are *contrary* and store only in years when the recommendation is not to store. The return to storage is zero in the years when grain is sold at harvest.

Average net returns are highest for strategies 24, 27, and 29 followed closely by strategies 19, 22, and 25. There is, however, a broad range of average net returns, variability in net returns, and nature of variability in net returns associated with these strategies. The "best" post-harvest marketing strategy for an individual grain sorghum producer in the Texas Coastal Bend will be contingent on risk preferences. Thus, the issue is ranking the strategies given producers' risk preferences.

RANKING STRATEGIES

Developing Cumulative Distributions for Marketing Alternatives

The cumulative distribution function of net returns associated with each strategy is developed from the nine years of the study period using the rule that the r^{th} smallest observation in a set of n ordered observations is an unbiased estimate of the $r/(n+1)^{th}$ fractile (Anderson et al., pp. 42-43; Mosteller and Rourke, pp. 234-236; Feller, pp. 211-212). Cumulative distributions for all or subsets of the strategies can be ranked using stochastic dominance with respect to a function for producers with various risk preferences (King and Robison, 1981b, pp. 2-6). This approach identifies those strategies (i.e., the "efficient set") which maximizes the decisionmaker's expected utility.[7]

Five pairs of Pratt coefficients of absolute risk-aversion were selected for this research to represent risk-preference characteristics varying from risk avoiders to risk lovers. Each pair of coefficients specifies the lower and upper bounds, respectively, on the absolute risk aversion function (King and Robison, 1981b, pp. 3-9; King R. P.). The pairs chosen and their general descriptions follow:

1. -.001 to .001; First Degree Stochastic Dominance (FSD) (These decisionmakers prefer more to less expected value of net returns to storage.)
2. .000 to .001; Second Degree Stochastic Dominance (SSD) (These decisionmakers have a marginal utility that is both positive and decreasing.)
3. -.00001 to .00001; Approximately Risk Neutral (These decisionmakers prefer to maximize the expected value of net returns to storage with tendencies towards low levels of risk loving and/or risk aversion.)
4. .00001 to .00004; Moderately Risk Averse
5. .00004 to .00008; Strongly Risk Averse.

The relative nature of Pratt coefficients of absolute risk aversion are highly dependent on the range of the performance measure analyzed (i.e., in this case, the expected value of net returns to storage). This relative nature, in turn, influences the ability of the stochastic dominance decision criteria to distinguish among alternatives in determining the efficient set. One means of assessing the relative nature of Pratt coefficients is to compare their respective certainty equivalents (CE) for a range of expected returns in a given utility function (King, R. P.). "As the name implies, a *certainty equivalent* is the amount exchanged with certainty that makes the decision maker indifferent between this and some particular risky prospect. . . . When the CE is less than the EMV [expected money value], the decision maker is said to display an aversion to risk . . ." (Anderson et al., p. 70).

This study's October distribution of expected returns to storage has a range of outcomes from -$26,400 to $55,400 with an EMV of $5,544. Assuming a negative exponential utility function (King, R. P.),

$$U(y) = -e^{-\lambda y}$$

where y is expected returns to storage and λ is the Pratt coefficient of absolute risk aversion, the following range of CE's are calculated with respect to the October distribution of expected returns to storage,

1. -.00001 to .00001 (Approximately Risk Neutral) CE's = $7,686 to $3,134
2. .00001 to .00004 (Moderately Risk Averse) CE's = $3,134 to -$1,798
3. .00004 to .00008 (Strongly Risk Averse) CE's = -$1,798 to -$6,720

The efficient sets of marketing strategies that do not use information on current and forecast market conditions are presented in Table 3. Application of first degree stochastic dominance (FSD) decision criteria eliminates only three of the 14 strategies; the sure bet "sell all at harvest" strategy with an expected net return of $0 dominates the eliminated strategies, all of which have negative average net returns. Application of second degree stochastic dominance (SSD) decision criteria eliminates nine strategies. The efficient set includes strategies 1, sell 100% in July; 2, sell 100% in August; 3, sell 100% in October; 9, sell one-third in July, August, and January; and 10, sell one-half in July and August. Assuming the cumulative distributions of the alternatives are normal, SSD is equivalent to identifying an EV set in which strategies with lower expected net returns and the same variance are eliminated (Anderson, et al., p. 287).

If risk preferences can be more narrowly defined, a smaller efficient set can be identified for an individual or a group of decisionmaker(s). For the approximately risk-neutral decisionmakers, strategies 2 and 3 are included in the efficient set. These results are not surprising since these strategies have the greatest average net returns and the choice criterion ignores the variance. The efficient set for moderately risk averse decisionmakers contains strategies 2 and 10. The efficient set for strongly risk averse decisionmakers contains strategies 1 and 10.

The Usefulness of Outlook Information

The efficient strategies of all 30 of the strategies introduced in Table 2 are presented in Table 4. Again, the risk parameters that approximate FSD and SSD do not significantly reduce the choice set. The efficient set of strategies for the approximately risk neutral decisionmakers contains strategies 2 and 3 (do not use outlook information) and strategy 27 (uses outlook information). As indicated in Table 2, these marketing alternatives have, by definition, the highest average net returns of the 30 strategies considered—$4,644; $5,244 and $5,066, respectively. They also have relatively large

TABLE 3. STOCHASTIC DOMINANCE RESULTS: MARKETING STRATEGIES THAT DO NOT USE OUTLOOK INFORMATION [a]

	Coefficients of Absolute Risk Aversion				
Marketing Strategy	-.001 to .001 (FSD)	.000 to .001 (SSD)	-.00001 to .00001 (Risk Neutral)	.00001 to .00004 (Risk Averse)	.00004 to .00008 (Risk Averse)
1. Sell all at harvest in July	√	√			√
2. Sell all in Aug.	√	√	√	√	
3. Sell all in Oct.	√	√	√		
4. Sell all in Dec.	√				
5. Sell all in Jan.	√				
6. Sell all in Feb.					
7. Sell 1/12 each month beginning in July					
8. Sell 1/4 in July, Oct., Jan., & April	√				
9. Sell 1/3 in July, Oct. & Jan.	√	√			
10. Sell 1/2 in July & Aug.	√	√		√	√
11. Sell 1/2 in July & Oct.	√				
12. Sell 1/2 in July & Dec.	√				
13. Sell 1/2 in July & Jan.	√				
14. Sell 1/2 in July & Feb.					

[a] For each respective pair of risk aversion coefficients, those actions which are checked comprise the efficient or undominated set of actions. The other actions are, therefore, to be interpreted as being inferior to some element of the efficient set.

standard deviations—$17,292; $22,588, and $19,217, respectively.

Moderately risk averse decisionmakers are represented by absolute risk aversion parameters of .00001 to .00004. Strategy 3 is not included in this efficient set and strategies 10 and 25 are included. The average net returns of strategy 10 (does not use outlook information), $2,355, and strategy 25 (uses outlook information), $3,244, are much lower than those of strategy 3, $5,244; but the variability characteristics associated with these marketing alternatives result in their inclusion in the efficient set. The efficient set for the strongly risk averse class of decisionmakers considered included strategy 1, the sure bet "sell all at harvest" alternative and strategy 10, sell one-half at harvest and one-half in August.

These results support previous discussion regarding the difficulty of prescribing a "best" post-harvest marketing strategy without due consideration of individual risk preferences. The significance of these results is threefold: 1) FSD is virtually useless in identifying decision choices; 2) SSD, while eliminating some choices, is unable to identify a manageable set of decision choices; and 3) stochastic dominance with respect to a function is able to identify a manageable set of alternatives when the classes of decisionmakers are narrowly defined by their respective absolute risk aversion parameters.

Outlook information is clearly useful in the sense that strategies which use outlook information remain in the efficient sets of all but the most risk averse decisionmakers. Strategies that use outlook information, however, did not decisively dominate strategies that did not use outlook information for any of the choices considered, given the width of the risk aversion intervals used in the analysis. All efficient sets included at least one strategy that did not use outlook information. Also, where outlook information is used, the *contrary* strategies appear in the efficient set only when the risk parameters approximate FSD. This indicates the outlook information is of value to all but the most risk averse decisionmakers.

TABLE 4. STOCHASTIC DOMINANCE RESULTS: ALL MARKETING STRATEGIES [a]

	Marketing Alternative	Coefficients of Absolute Risk Aversion				
		-.001 to .001 (FSD)	.000 to .001 (SSD)	-.00001 to .00001 (Risk Neutral)	.00001 to .00004 (Risk Averse)	.00004 to .00008
1.	Sell all at harvest in July	√	√			√
2.	Sell all in Aug.	√	√	√	√	
3.	Sell all in Oct.	√	√	√		
4.	Sell all in Dec.	√				
5.	Sell all in Jan.	√				
6.	Sell all in Feb.					
7.	Sell 1/12 each month beginning in July					
8.	Sell 1/4 in July, Oct., Jan. & April	√				
9.	Sell 1/3 in July, Oct. & Jan.	√	√			
10.	Sell 1/2 in July & Aug.	√	√		√	√
11.	Sell 1/2 in July & Oct.	√				
12.	Sell 1/2 in July & Dec.	√				
13.	Sell 1/2 in July & Jan.	√				
14.	Sell 1/2 in July & Feb.					
15.	STORE, Sell 1/12 each month [b]					
16.	NOT STORE, Sell 1/12 each month					
17.	STORE, Sell 1/4 in July, Oct., Jan. & April					
18.	NOT STORE, Sell 1/4 in July, Oct., Jan. & April					
19.	STORE,Sell 1/3 in July, Oct. & Jan.	√	√			
20.	NOT STORE, Sell 1/3 in July, Oct. & Jan.	√				
21.	STORE, Sell in Aug.	√				
22.	NOT STORE, Sell in Aug.	√				
23.	STORE, Sell in Oct.	√	√			
24.	NOT STORE, Sell in Oct.	√				
25.	STORE, Sell in Dec.	√	√		√	
26.	NOT STORE, Sell in Dec.					
27.	STORE, Sell in Jan.	√	√	√	√	
28.	NOT STORE, Sell in Jan.					
29.	STORE, Sell in Feb.	√	√			
30.	NOT STORE, Sell in Feb.					

a For each respective pair of risk aversion coefficients, those actions and strategies which are checked comprise the efficient or undominated set. The unchecked actions and strategies are, therefore, to be interpreted as being inferior to some element of the efficient set.

b Strategies 15-30 make use of market information. Strategies marked as STORE follow the recommendations of this information and store only when it is suggested. Strategies marked as NOT STORE represent a contrary marketing approach, storing only when the outlook information suggests not to store.

Economic Value of Information

The usefulness of market outlook information for selected classes of decisionmakers raises the question, "How valuable is the information?" Insight into this question can be gained by solving for the annual charge at which strategies 25 and 27 (use outlook information) would be eliminated from the efficient set of the moderately risk averse decisionmakers. Strategy 27 was eliminated at a price of $450 per year, and strategy 25 was eliminated at a price of $600 per year.[8]

The information discussed herein is readily available for much less than this estimated value and as such should be obtained and utilized by most decisionmakers represented by the third and fourth class of Pratt risk aversion parameters. Naturally, the value of information for these classes of producers would increase as the volume of sales increases.

CONCLUSIONS

A major contribution of this analysis is the evaluation of market outlook information. Application of stochastic dominance criterion to compare strategies that use market outlook information to strategies that do not use market information permits evaluation of the conditions under which information has value. The sources of market information available to Texas Coastal Bend grain sorghum producers may be valuable to all but the most risk averse. Some strategies that use outlook information are not dominated by one or more strategies that do not use outlook information and vice versa. Those strategies that follow the outlook information tend to dominate those strategies that entail a contrary approach.

The results of this study must be regarded with caution due to the limited sample on which the inferences are based.[9] The approach described herein can be extended to encompass the broader spectrum of both pre- and post-harvest marketing strategies involving cash, forward contracting and the futures market, among other available marketing alternatives. The approach taken needs to be replicated in more areas. Future applications should include additional marketing instruments and should provide for updating strategies as new information becomes available during a marketing period. By pursuing a vigorous application of this methodology, one should be able to ascertain what the evidence to date indicates about our ability to forecast market movements and if we are indeed providing valuable information to producers.

NOTES

1. Although this does limit the analysis, these producers generally limit their enterprises to grain sorghum and cotton, and as such, do not have the alternatives of feeding their grain to livestock. Limited utilization also is made of the futures market and delayed pricing. Although forward contracting is a viable marketing alternative, this publication limits its analysis to commercial storage and cash sales during or following the harvest period in July.

2. Our inability to definitively measure utility thwarts practical application of the decision analysis framework. King and Robison (1981b), however, present a means of bounding utility functions within a flexible range of income or wealth. Application of the techniques discussed by King and Robison (1981b) to such bounded utility functions in combination with a measure of producers' risk preferences allows for ranking available alternatives to a risk decision.

3. TM identifies the total number of months the commodity is stored past harvest and M indicates the number of months for which variable monthly storage costs are assessed. It is a common practice for Texas Coastal Bend commercial elevator managers to provide producers with 1 to 5 months of "free" storage in association with the payment of the IFSC. (TM – M) identifies the number of such "free" months associated with the storage arrangement being analyzed. TM is used in calculating the opportunity costs of capital.

4. Interviews were conducted with two Texas Coastal Bend region commercial grain elevator managers (Campbell; King, B.) and a Texas Agricultural Extension Service Farm Management Specialist who had worked in the region during the data period (Lippke). Based on these interviews, fixed storage charges ranging from $.00 to $.05/cwt and monthly storage charges ranging from $.03 to $.045/cwt were determined to be appropriate for the 1972-1981 data period. Initial physical storage losses of 1% and no monthly physical storage losses are assumed to be representative of typical commercial assessments during the period. Annual Production Credit Association interest rates were obtained from a confidential source for use in calculating opportunity costs.

5. A longer data period is, of course, desirable. The structural shift in the feed grain markets associated with increased exports in the mid-1970's however, precluded use of a longer data series. Recognizing these data limitations and assuming Young's hypothesis of objective probability distributions, the analysis presented herein is assumed to be a valid approximation of future events.

6. The subjective judgment approach used in this study is intended to be an approximation of the process producers use in assimilating available market information. After reviewing the forecasts in private, many producers discuss their interpretations with others. Seldom do all market information sources provide identical forecasts of price movements, either in terms of direction and/or magnitude of change. For instance, the following information was available during the 1975-76 marketing period:

> "Weak domestic feed demand has apparently overridden the extremely tight supplies, contributing to a dramatic decline in the market since last fall... If feed prospects are favorable this summer, some further decline in sorghum prices is likely" (USDA, *Feed Outlook and Situation,* May 1975, p. 15).

> "Sorghum prices are getting a lift from the turn around in feedlot inventory on the Texas High Plains... the upturn was encouraging" *(Farm Journal,* June/July 1975, p. 5).

"Some price strength is likely to resume after harvest, but profits from short-term storage will be modest" *(Progressive Farmer,* July 1975, p. 9).

"We would suggest selling 30% to 40% of the crop at current prices, then plan to hold the balance for a short time after harvest for possible export developments" *(Doane's Agricultural Report*, July 4, 1975, p. 2).

Each of the authors independently assessed this and other information available in the four sources and all determined the implicit recommendation for the 1975-76 marketing period was "Do Not Store."

7. A modified version of a Fortran software package developed by Richardson was used to conduct the stochastic dominance analysis. A detailed mathematical description of stochastic dominance can be found in Anderson et al., King and Robison (1981b), and Kramer and Pope.

8. This is not the standard Bayesian method of calculating the value of information in a decision theoretical framework. The increase in expected profits or increase in utility of expected profits associated with having the additional information available is not determined. The analysis was done by reducing net returns to storage by $25 for each observation comprising the cumulative distributions of strategies 25 and 27 until the respective strategies were deleted from the efficient set. As long as the strategies remained in the efficient set of marketing alternatives, the inference was their value exceeded the imposed cost.

9. Methods for developing tolerance intervals for non-parametric data sets of limited size are presented by Mosteller and Rourke and also by Ziemer.

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