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A Computerized Data Management Tool for Analysis of
Soybean Storage Hedging Returns in Selected Areas of Indiana*

Darrell L. Gerke and Gerald A. Harrison

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Our analysis benefits from a framework for analyzing basis patterns and storage returns developed by Richard L. Duffy in a 1969 M.S. thesis at Purdue supervised by Dr. J. William Uhrig. Two other M.S. theses at Purdue by Donald E. Nelson and James J. Fritz used the Duffy method under the supervision of Dr. Uhrig.

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Introduction

Farmers and county grain elevator managers have been instructed and encouraged to use the futures as a means to improve profits and reduce risk. However, in the case of commercial farmers in Illinois and Indiana, a survey has shown that in a five year period ending in 1972, only about 11% of those surveyed had hedged any commodity in any one of the years. This survey of farmers also indicated that of several major decisions in corn and soybean production and marketing, their most felt information shortages were in the areas of marketing and hedging. We believe that it is possible to use existing analytical techniques and computer technology to promote understanding and possibly profitable use of hedging in marketing management on commercial farms.

A research study was conducted with an objective of analyzing soybean hedging as a practical management tool for Indiana farmers (1). To fulfill the objective, several aspects of hedging were analyzed for seven locations in Indiana. The analysis was performed to identify soybean hedging characteristics at each location and to compare the findings to determine if any differences were present. A computer program was developed for use in this study and similar studies in the future. The program was also designed to be used as a management tool for hedgers via the Extension program.

Development of the Computer Management Tool

The computer program was written with several goals in mind. Although this particular study involved soybeans, the program was designed for analyzing weekly hedging periods for any commodity for any number of years. User input requirements were held to a minimum to facilitate possible future use by Extension personnel with remote access equipment. The user must supply only the cash price data and a few values used for program control. The output consists of several parts which are all optional to the user. These options reduce computer time needed and allow the user to tailor the output to fit his own needs and desires.

The general flowchart, as shown in Figure 1, illustrates the basic steps that the program follows to analyze hedging periods. The inputs to the program consist of control and information used by the program during execution, futures contract price data, and cash price data. Since hedging analysis consists of comparison of basis (futures minus cash price) and many sets of cash prices are compared to the same set of futures data, the futures data was assembled and read onto a random access device for speed and convenience. As mentioned above, the user must supply the cash price input which is matched against the futures data. The basis for each futures contract on each date is computed and stored in an array. Basis and spread data for each year and average basis and spread data for all years included in the analysis are computed and may be printed in list form. The average basis for each contract may also be plotted in graphical form for easy examination of average basis movements. The range of hedging periods to be analyzed is specified on the control card. The computer program computes all of the hedging and cash speculation information for each storage period analyzed. The user may have all of the output printed or

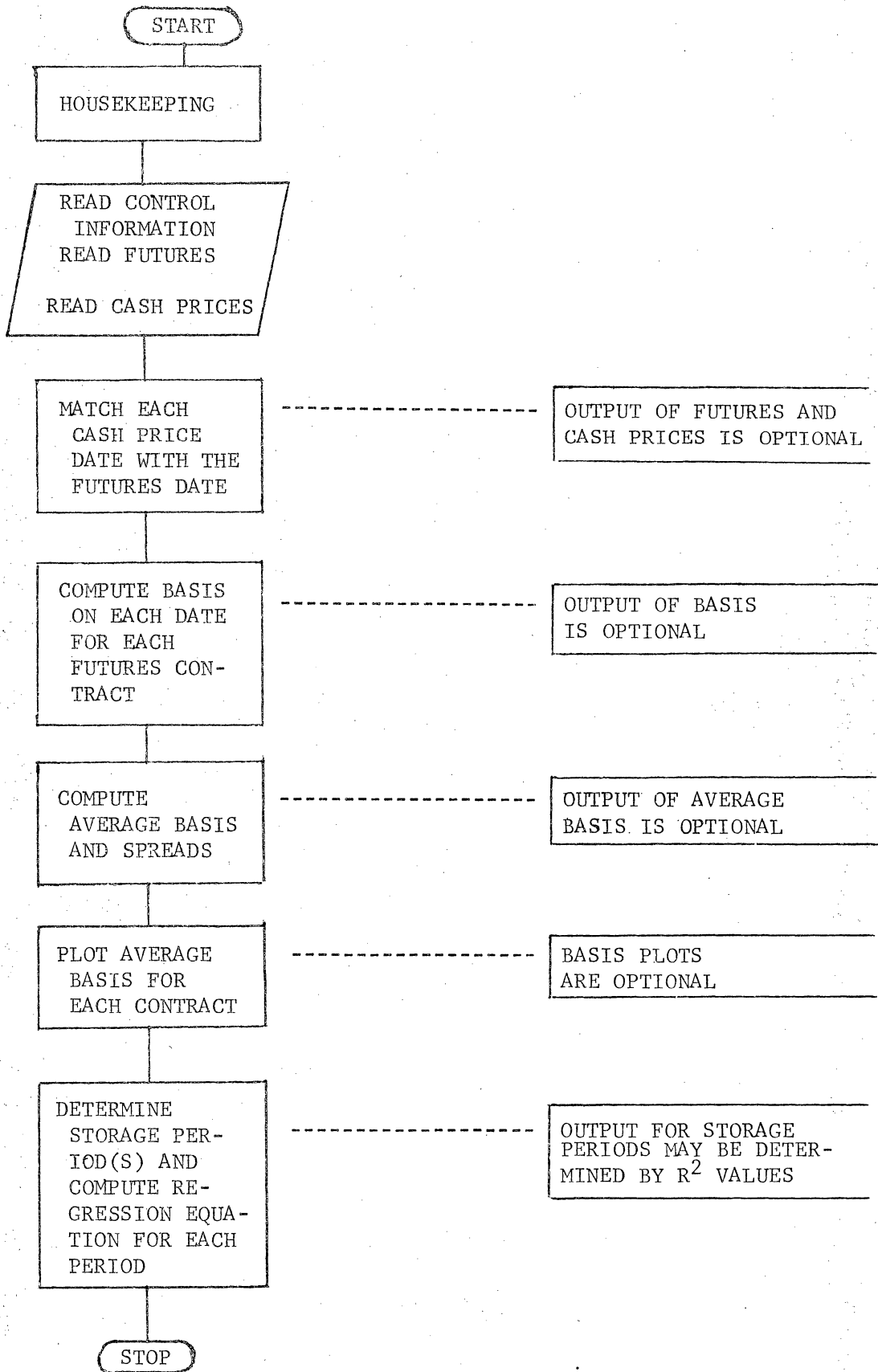


Figure 1. General Flowchart of Program

he may have the program print the hedging and cash speculation based upon a minimum R-squared value specified on the control card. A sample of the hedging information is shown in Figure 2. Table 1 describes the output items that are numbered in Figure 2. Both cash speculation and hedging results are listed so the user can easily compare the two storage methods. The cost to run the computer program is very nominal. Computer runs with all available output analyzing approximately 2,000 storage periods from eight years of data cost less than \$4.00 per run.

Indiana Soybean Storage Hedging Analysis

The Indiana soybean hedging study was conducted by examining several facets of basis and hedging. Basis patterns over several years at seven locations were analyzed to see if basis follows seasonal patterns. Definite seasonal basis patterns do exist at each location. Basis is widest at harvest time and then gradually narrows to near zero at contract maturity. Basis variations do occur because of changes in supply and/or demand expectations; however, these variations are generally of minor nature. The 1972-73 storage year did cause some extreme basis variations because of the irregular and uncertain supply and demand expectations during that year.

Basis patterns for the four corners of the state were compared to see if regional basis differences occur and if regional storage earnings are different. Regional basis differences were present in the four locations analyzed. The four locations are ranked below according to basis differences with the location with the widest basis listed first:

1. Southeast
2. Northeast
3. Northwest
4. Southwest

STORAGE PERIOD	FUTURES CONTRACT	RETURNS TO HEDGING AVE	MAX	MIN	BEGINNING AVE	BASIS MAX	MIN	UPPER LIMIT	LOWER LIMIT	STAND DEV	RANGE OF LIMITS	REGRESSION EQUATION	R SQRD	B-E PT.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
OCT 19	JAN 11	JAN	8.27	13.50	2.62	20.52	24.00	14.87	11.09	5.38	3.44	5.63	$Y = -11.27 + .952X$.707	11.83
	CASH RESULTS		8.86	40.00	-12.00		2.76		20.65	-3.14	16.33	23.99			18.13
			13	19	20	21			22	29	24	25			17

THIS RUN COMPUTED 80 POSSIBLE HEDGING PERIODS.
 16 PERIODS SHOWED R SQUARE VALUES OF .8410 OR GREATER.
 28 PERIODS SHOWED R SQUARE VALUES BETWEEN .6500 AND .8410
 THIS RUN EXAMINED HEDGING PERIODS BEGINNING AS EARLY AS OCT 5 AND AS LATE AS MAY 9
 AND HEDGING PERIODS ENDING AS EARLY AS NOV 9 AND AS LATE AS AUG 15.
 MONTHLY STORAGE COSTS USED IN THIS RUN WAS 4.00 CENTS PER MONTH.

Figure 2. Sample Output of the Computer Program.

Table 1. Description of Program Output Items.

1. Beginning date of the storage period analyzed.
2. Ending date of the storage period.
3. Futures contract that was used for the storage period.
4. Total average hedging return for the period.
5. Maximum hedging return computed for all of the years analyzed.
6. Minimum hedging returns computed.
7. Average beginning basis for the hedging period.
8. Maximum beginning basis computed for all of the years.
9. Minimum beginning basis computed.
10. Upper limit to a 90 percent confidence interval computed for the total average hedging return.
11. Lower limit of the confidence interval.
12. Standard deviation of the total averaging hedging return.
13. Range of the confidence interval limits (this is simply the difference between the upper and lower limits).
14. Regression equation determined by using the beginning basis as the independent variable (x) and the hedging return as the dependent variable (y).
15. R^2 value of the regression equation (two asterisks denote an R^2 value equal to or greater than the largest specified R^2 value on the control card. One asterisk denotes an R^2 equal to or greater than the lowest R^2 value but greater than the highest specified value. No asterisk denotes an R^2 value below the lowest specified R^2 value).
16. Beginning basis required to break even with no variable costs as computed from the regression equation.
17. Beginning basis required to break even with the variable cost as specified on the control card.
18. Average cash returns computed from the same storage period used to analyze hedging returns.
19. Maximum cash return computed for the storage period.
20. Minimum cash return computed for the period.
21. Average hedging return computed on a per month basis.
22. Upper limit to a 90 percent confidence interval calculated for the average cash returns.
23. Lower limit of the confidence interval.
24. Standard deviation of the average cash returns.
25. Range of the confidence interval limits.

The first three locations listed above are also in order of distance to Chicago with the southeast being farthest away. The southwest location is under a strong Gulf port influence which may have caused the basis to be very narrow. Regional storage hedging earnings were analyzed for hedges placed on October 19 and November 30 and lifted on July 11 using the July contract by a X^2 test for independent samples. Earnings for hedges placed on November 30, after the bulk of the harvest is completed, were not significantly different at any of the four locations. However, hedges placed on October 19, during the peak of harvest, were significantly different at the 95 percent level. Local supply and demand factors and elevator operators' bidding tendencies caused wide regional basis variations during harvest. The hedger must be very careful when placing hedges during the peak of harvest.

Carrying charges (hedging earnings) were tested for reliability and predictability. Standard deviations and 90 percent confidence intervals for average hedging earnings computed by the computer program are indicators of the reliability of carrying charges. Predictability of carrying charges based upon the basis at the beginning of the hedging period (beginning basis) were also tested. The R-squared value for the regression equation was used as the indicator of the predictability of the hedging earnings. Regression equations with high R-squared values have negative or near zero y intercepts and positive regression coefficients as shown in Figure 3. Very small beginning bases usually result in hedging losses while larger beginning bases result in larger hedging returns.

Cash speculation returned slightly larger average profits than hedging for most of the periods analyzed. However, the standard deviation for average cash speculation was generally 3 to 5 times larger than for

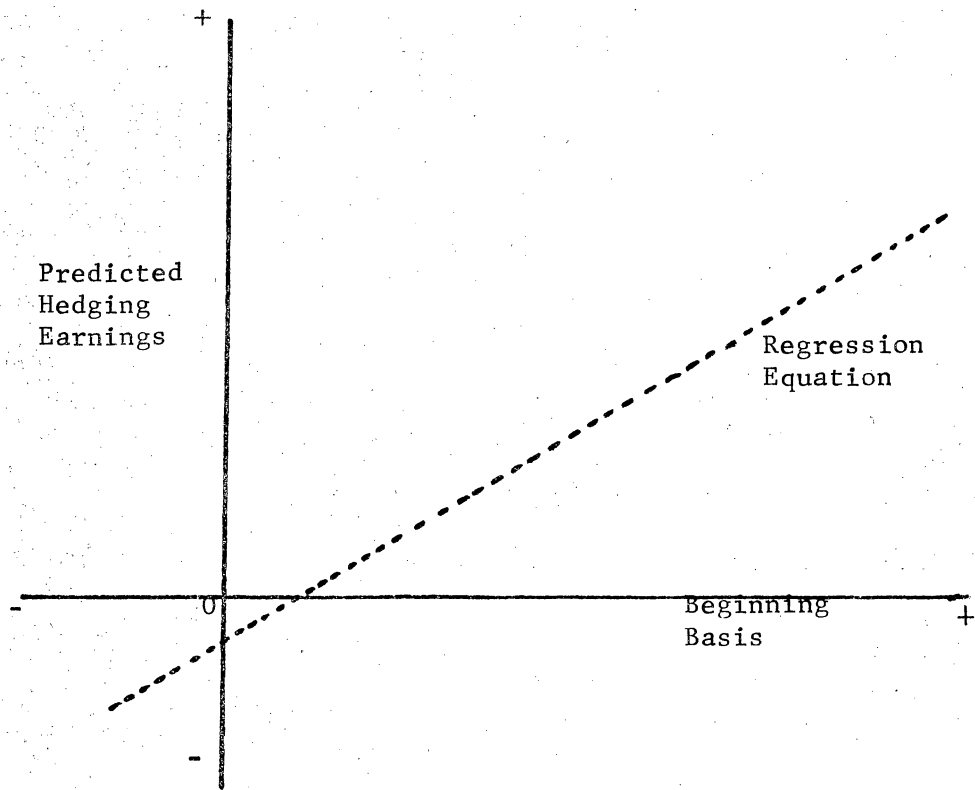


Figure 3. Regression Equation.

average hedging returns. Seldom did hedging losses occur while cash speculation for each period usually generated a loss for at least one year for the years analyzed.

Selective hedging based upon beginning basis increased average hedging returns by eliminating many of the unprofitable years. Only periods with highly reliable predictive equations can be used for selective hedging. The results of the analysis listed above show that hedgers need to be familiar with basis patterns at their own location. Hedging profits vary from one location to another and just because a given hedging period for one hedger in one part of the state is generally profitable, does not mean that an identical hedge placed in another part of the state will be equally as profitable. Hedges placed on October 19 and lifted on January 11 using the July contract averaged 8.68 cents per bushel at elevator A and 11.7 cents at elevator B (See Tables 2 and 3).

Uses of the Management Tool

The hedger needs to be familiar with basis patterns that are normal for his area and must be able to spot irregular basis movements that may be used to his advantage. The hedging analysis program may be used by farmers, elevator operators, grain merchants and processors as a management tool to study historical basis patterns and identify profitable hedging periods. Basis for each week for each contract may be printed as well as the average basis for all of the years included in the analysis. This information is available so the hedger can examine basis movements for all contracts for all years. Spread information is also included with the basis information. Spreads refer to the carrying charges between contracts and represents the cost of carrying grain from the near contract maturity date to the far contract maturity date. Close inspection of the historical spread information and the present futures market contract spreads will identify irregular carrying charges that may be used by the hedger to gain additional

Table 2. Results of Storage Hedging Analysis at Elevator A for Hedges Placed on October 19; 1965-1972.

STORAGE PERIOD	FUTURES CONTRACT	RETURNS TO HEDGING			BEGINNING BASIS			UPPER LIMIT	LOWER LIMIT	STAND DEV	RANGE OF LIMITS	REGRESSION EQUATION	R SQRD	B-E PT.
		AVE	MAX	MIN	AVE	MAX	MIN							
OCT 19-JAN 11	JULY	8.68	15.00	.88	27.96	32.38	21.62	12.50	4.86	5.20	7.64	Y= 15.73 + -.252X	.039	62.40
	CASH RESULTS	8.86	40.00	-12.00		2.89		20.85	-3.14	16.33	23.99			38.60
OCT 19-MAR 15	JULY	10.27	13.00	4.13	27.96	32.38	21.62	12.42	8.12	2.92	4.29	Y= 5.38 + .175X	.060	30.82
	CASH RESULTS	14.57	40.00	-6.00		1.96		24.82	4.33	13.95	20.49			29.28
OCT 19-MAY 2	JULY	13.04	15.75	10.12	27.96	32.38	21.62	14.69	11.38	2.26	3.32	Y= 1.57 + .410X	.554	-3.83
	CASH RESULTS	19.29	58.00	-14.00		1.86		35.72	2.85	22.38	32.87			30.31
OCT 19-JULY 11	JULY	15.95	19.50	8.50	27.96	32.38	21.62	18.80	13.09	3.88	5.71	Y= -5.39 + .763X	.648*	7.06
	CASH RESULTS	39.14	120.00	-14.00		1.68		70.54	7.75	42.75	62.79			31.97
OCT 19-JAN 11	MAY	9.27	13.88	2.00	27.14	31.25	21.00	12.44	6.10	4.31	6.33	Y= 10.18 + -.033X	.001	304.11
	CASH RESULTS	8.86	40.00	-12.00		3.09		20.85	-3.14	16.33	23.99			124.84
OCT 19-MAR 15	MAY	12.09	15.25	6.12	27.14	31.25	21.00	14.39	9.79	3.13	4.60	Y= -.73 + .472X	.373	1.56
	CASH RESULTS	14.57	40.00	-6.00		2.30		24.82	4.33	13.95	20.49			28.78
OCT 19-MAY 2	MAY	15.91	20.12	10.25	27.14	31.25	21.00	18.49	13.33	3.51	5.16	Y= -3.27 + .707X	.663*	4.62
	CASH RESULTS	19.29	58.00	-14.00		2.27		35.72	2.85	22.38	32.87			24.44
OCT 19-JAN 11	MCH	9.41	13.50	3.25	24.52	28.00	18.62	11.78	7.04	3.23	4.75	Y= 1.98 + .303X	.118	-6.54
	CASH RESULTS	8.86	40.00	-12.00		3.14		20.85	-3.14	16.33	23.99			13.26
OCT 19-MAR 15	MCH	12.80	17.00	7.25	24.52	28.00	18.62	15.44	10.16	3.60	5.28	Y= -5.92 + .764X	.606*	7.75
	CASH RESULTS	14.57	40.00	-6.00		2.44		24.82	4.33	13.95	20.49			21.50
OCT 19-JAN 11	JAN	8.27	13.50	2.62	20.52	24.00	14.87	11.09	5.45	3.84	5.63	Y= -11.27 + .952X	.707*	11.83
	CASH RESULTS	8.86	40.00	-12.00		2.76		20.85	-3.14	16.33	23.99			18.13

* Denotes R-squared values significant at the 90 percent level.

Table 3. Results of Storage Hedging Analysis at Elevator B for Hedges Placed on October 19; 1968-1972.

STORAGE PERIOD	FUTURES CONTRACT	RETURNS TO HEDGING			BEGINNING BASIS			UPPER LIMIT	LOWER LIMIT	STAND DEV	RANGE OF LIMITS	REGRESSION EQUATION	R SQRD	B-E PT.
		AVE	MAX	MIN	AVE	MAX	MIN							
OCT 19-JAN 11	JLY	11.70	26.25	1.00	28.65	34.25	23.00	20.55	2.86	9.28	17.69	Y= -25.30 + 1.292X	.345	19.59
	CASH RESULTS	23.60	99.00	-7.00		3.90		64.43	-17.23	42.82	81.66			24.24
OCT 19-MAR 15	JLY	20.05	54.37	5.63	28.65	34.25	23.00	38.67	1.43	19.53	37.23	Y= -15.50 + 1.241X	.072	12.49
	CASH RESULTS	65.00	267.00	7.00		3.82		172.82	-42.82	113.08	215.64			20.95
OCT 19-MAY 2	JLY	28.03	75.62	13.00	28.65	34.25	23.00	53.59	2.46	26.81	51.12	Y= -16.88 + 1.567X	.061	10.77
	CASH RESULTS	104.60	436.00	4.00		4.00		281.57	-72.37	185.61	353.94			19.70
OCT 19-JULY 11	JLY	-3.55	18.50	-77.13	28.65	34.25	23.00	35.81	-42.91	41.28	78.73	Y= 20.66 + -.845X	.007	24.45
	CASH RESULTS	94.60	325.00	24.00		-.37		217.66	-28.46	129.07	246.12			1.98
OCT 19-JAN 11	MAY	10.45	15.13	3.00	27.62	33.25	22.25	15.14	5.77	4.91	9.37	Y= -17.19 + 1.001X	.719	17.18
	CASH RESULTS	23.60	99.00	-7.00		3.48		64.43	-17.23	42.82	81.66			23.17
OCT 19-MAR 15	MAY	13.25	18.50	8.75	27.62	33.25	22.25	17.02	9.48	3.96	7.55	Y= -2.60 + .574X	.365	4.54
	CASH RESULTS	65.00	267.00	7.00		2.52		172.82	-42.82	113.08	215.64			22.83
OCT 19-MAY 2	MAY	19.25	25.12	16.13	27.62	33.25	22.25	23.04	15.46	3.97	7.58	Y= .78 + .669X	.491	-1.17
	CASH RESULTS	104.60	436.00	4.00		2.75		281.57	-72.37	185.61	353.94			19.77
OCT 19-JAN 11	MCH	9.17	15.62	4.50	24.77	29.87	20.00	13.50	4.84	4.54	8.66	Y= -12.88 + .890X	.582	14.47
	CASH RESULTS	23.60	99.00	-7.00		3.06		64.43	-17.23	42.82	81.66			21.21
OCT 19-MAR 15	MCH	9.47	18.62	-12.75	24.77	29.87	20.00	21.72	-2.77	12.84	24.49	Y= -.95 + .420X	.016	2.22
	CASH RESULTS	65.00	267.00	7.00		1.80		172.82	-42.82	113.08	215.64			27.22
OCT 19-JAN 11	JAN	8.03	16.13	-1.13	20.60	26.00	16.00	14.23	1.82	6.51	12.41	Y= -9.16 + .834X	.268	10.98
	CASH RESULTS	23.60	99.00	-7.00		2.68		64.43	-17.23	42.82	81.66			18.17

profits. For example, if the average spread between the January and March contracts on November 2 is 4.23 cents according to historical standards (see Table 4) and presently the spread is 6 cents, the hedger may be inclined to hedge with the March contract. A spread of less than 4.23 cents may induce the hedger to use the January contract with the possibility of later shifting the hedge if normal carrying charges prevail or lifting the hedge in January if normal or favorable carrying charges do not occur. Average basis plots in graphical form allow the hedger to easily identify basis movements from the first week of the storage year to contract maturity.

Hedging profits depend on the narrowing of basis. The basis at the time when the hedge was lifted is subtracted from the beginning basis yielding gross hedging profits. The program determines average gross hedging profits for those periods selected for analysis by the user. Additional hedging information for each period as shown in Figure 2 is also printed. The maximum and minimum hedging returns for all years analyzed is also displayed to show the range of hedging returns. The average, minimum and maximum beginning basis for the hedging period is also printed. The beginning basis information helps the hedger compare historical basis to the basis he interpreted as a good possibility of returning greater than normal hedging returns.

The standard deviation, upper and lower limit of a 90 percent confidence interval, and the range of the confidence interval for average hedging returns indicate to the hedger the reliability of the average returns. A small standard deviation and subsequent small range of the confidence limits enable the hedger to feel more assured that the average hedging returns for this period are consistent year after year. A positive lower

Table 4. Average Basis and Spread Data at Elevator A, 1965-1972.

PERIOD	DATE	AVERAGE BASIS FOR ALL YEARS							SPREAD DATA					
		NOV	JAN	MAR	MAY	JULY	Aug	SEP	JAN-MAR	JAN-MAY	JAN-JULY	MAR-MAY	MAR-JULY	MAY-JULY
1	OCT 5	19.22	23.60	27.95	31.02	32.02	27.47	15.40	4.35	7.43	8.43	3.08	4.04	1.00
2	OCT 12	20.92	25.12	29.00	31.97	33.05	29.47	16.05	3.87	6.85	7.93	2.98	4.05	1.08
3	OCT 19	20.70	24.60	28.77	31.62	32.65	28.80	15.30	4.16	7.03	8.05	2.65	3.88	1.03
4	OCT 26	19.30	23.50	28.03	31.20	32.20	28.52	14.22	4.55	7.70	8.70	3.15	4.15	1.00
5	NOV 2	18.97	22.67	26.90	30.05	31.07	27.62	13.12	4.23	7.38	8.40	3.15	4.18	1.03
6	NOV 9	18.32	21.47	25.67	29.30	30.57	27.27	12.67	4.20	7.82	9.10	3.62	4.90	1.28
7	NOV 16	18.82	20.32	23.85	27.12	28.57	25.35	11.00	3.52	6.80	8.23	3.28	4.73	1.45
8	NOV 23	0.00	17.47	21.15	24.50	26.17	23.35	9.50	3.64	7.03	8.70	3.35	5.02	1.67
9	NOV 30	0.00	16.52	20.72	24.20	25.72	22.57	10.10	4.20	7.67	9.20	3.47	5.00	1.52
10	DEC 7	0.00	13.72	18.05	21.55	23.10	19.72	6.65	4.33	7.82	9.37	3.50	5.05	1.55
11	DEC 14	0.00	13.45	17.32	20.43	22.25	19.55	5.90	3.88	6.25	8.80	3.08	4.93	1.85
12	DEC 21	0.00	12.62	16.62	18.05	18.85	15.82	5.03	3.80	5.22	5.83	1.42	2.03	1.60
13	DEC 28	0.00	11.42	15.90	18.17	19.07	15.82	4.25	4.08	6.35	7.25	2.26	3.18	1.90
14	JAN 4	0.00	11.97	15.35	17.22	17.32	13.60	-1.58	3.38	5.25	5.35	1.87	1.98	1.10
15	JAN 11	0.00	11.57	14.60	16.17	15.95	12.45	-1.98	3.03	4.60	4.38	1.57	1.55	-1.22
16	JAN 18	0.00	11.72	13.92	15.52	12.67	9.05	-7.30	2.20	1.00	1.15	-1.40	-1.05	-1.65
17	JAN 25	0.00	9.38	13.22	11.70	10.67	6.77	-7.53	3.65	2.32	1.50	-1.53	-2.55	-1.82
18	FEB 1	0.00	0.00	11.72	9.80	8.17	3.40	-12.58	0.00	0.00	0.00	-1.93	-3.55	-1.62
19	FEB 8	0.00	0.00	10.97	9.57	7.85	3.05	-15.88	0.00	0.00	0.00	-1.40	-3.12	-1.73
20	FEB 15	0.00	0.00	10.62	8.82	6.17	1.02	-22.18	0.00	0.00	0.00	-1.60	-4.45	-2.65
21	FEB 22	0.00	0.00	11.80	7.75	2.07	-4.15	-26.73	0.00	0.00	0.00	-4.05	-9.72	-5.67
22	MAR 1	0.00	0.00	11.12	8.92	4.40	-3.03	-30.73	0.00	0.00	0.00	-2.20	-6.72	-4.52
23	MAR 8	0.00	0.00	11.55	9.70	3.02	-3.95	-34.30	0.00	0.00	0.00	-1.65	-6.53	-4.69
24	MAR 15	0.00	0.00	11.90	10.97	5.20	-1.75	-30.30	0.00	0.00	0.00	-1.93	-6.70	-5.77
25	MAR 22	0.00	0.00	19.96	7.85	4.40	-2.25	-26.15	0.00	0.00	0.00	-12.11	-15.56	-3.45
26	MAR 29	0.00	0.00	0.00	6.03	1.87	-6.03	-27.53	0.00	0.00	0.00	0.00	0.00	-4.15
27	APR 4	0.00	0.00	0.00	5.77	4.67	-2.20	-21.93	0.00	0.00	0.00	0.00	0.00	-1.10
28	APR 11	0.00	0.00	0.00	6.37	2.42	-4.70	-29.23	0.00	0.00	0.00	0.00	0.00	-3.55
29	APR 18	0.00	0.00	0.00	5.05	2.47	-4.45	-31.50	0.00	0.00	0.00	0.00	0.00	-2.57
30	APR 25	0.00	0.00	0.00	5.85	1.57	-4.25	-33.36	0.00	0.00	0.00	0.00	0.00	-3.68
31	MAY 2	0.00	0.00	0.00	6.57	-1.16	-3.25	-40.30	0.00	0.00	0.00	0.00	0.00	-7.75
32	MAY 9	0.00	0.00	0.00	17.65	-2.10	-11.35	-46.44	0.00	0.00	0.00	0.00	0.00	-19.75
33	MAY 16	0.00	0.00	0.00	3.25	-3.83	-17.78	-56.06	0.00	0.00	0.00	0.00	0.00	-7.12
34	MAY 23	0.00	0.00	0.00	0.00	-1.65	-15.78	-65.33	0.00	0.00	0.00	0.00	0.00	0.00
35	MAY 30	0.00	0.00	0.00	0.00	-5.87	-20.40	-62.08	0.00	0.00	0.00	0.00	0.00	0.00
36	JUN 6	0.00	0.00	0.00	0.00	-7.73	-10.15	-54.68	0.00	0.00	0.00	0.00	0.00	0.00
37	JUN 13	0.00	0.00	0.00	0.00	12.32	1.45	-44.35	0.00	0.00	0.00	0.00	0.00	0.00
38	JUN 20	0.00	0.00	0.00	0.00	14.82	-3.75	-52.62	0.00	0.00	0.00	0.00	0.00	0.00
39	JUN 27	0.00	0.00	0.00	0.00	30.42	22.45	-12.25	0.00	0.00	0.00	0.00	0.00	0.00
40	JUL 4	0.00	0.00	0.00	0.00	34.42	44.72	9.65	0.00	0.00	0.00	0.00	0.00	0.00
41	JUL 11	0.00	0.00	0.00	0.00	40.80	35.30	18.35	0.00	0.00	0.00	0.00	0.00	0.00
42	JUL 18	0.00	0.00	0.00	0.00	41.43	22.72	-2.55	0.00	0.00	0.00	0.00	0.00	0.00
43	JUL 25	0.00	0.00	0.00	0.00	15.30	28.47	-4.25	0.00	0.00	0.00	0.00	0.00	0.00
44	AUG 1	0.00	0.00	0.00	0.00	0.00	42.30	9.67	0.00	0.00	0.00	0.00	0.00	0.00
45	AUG 8	0.00	0.00	0.00	0.00	0.00	25.65	-1.45	0.00	0.00	0.00	0.00	0.00	0.00
46	AUG 15	0.00	0.00	0.00	0.00	0.00	16.02	-17.78	0.00	0.00	0.00	0.00	0.00	0.00
47	AUG 22	0.00	0.00	0.00	0.00	0.00	19.08	-1.25	0.00	0.00	0.00	0.00	0.00	0.00
48	AUG 29	0.00	0.00	0.00	0.00	0.00	0.00	-2.35	0.00	0.00	0.00	0.00	0.00	0.00
49	SEP 5	0.00	0.00	0.00	0.00	0.00	0.00	12.90	0.00	0.00	0.00	0.00	0.00	0.00
50	SEP 12	0.00	0.00	0.00	0.00	0.00	0.00	17.02	0.00	0.00	0.00	0.00	0.00	0.00
51	SEP 19	0.00	0.00	0.00	0.00	0.00	0.00	6.75	0.00	0.00	0.00	0.00	0.00	0.00
52	SEP 26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

confidence interval indicates that 90 percent of the time the hedging returns will be above zero.

The regression equation and associated R-squared value are probably the two most important pieces of output to the hedger. The regression equation is a predictor of hedging earnings (dependent variable) based upon the beginning basis (independent variable) and the R-squared value indicates the amount of the variation in hedging earnings that is explained solely by the beginning basis. R-squared values range from 0 to 1 with a value of 1 meaning perfect correlation between the independent and dependent variable. A regression equation with an R-squared value of .808 means that 80.8 percent of the variation in hedging earnings is explained by beginning basis while 19.2 percent is caused by other factors. The hedger can use the regression equation to predict hedging earnings by simply substituting the beginning basis for x and solving for y. For example, the regression equation for the October 19-January 11 period using the January contract is $y = 11.27 + .952x$ (Table 2), and if the present basis is 20 cents; x is replaced with 20 and the equation is solved for y. Solving the equation yields 7.77 cents which represents the predicted gross hedging earnings. The relatively high R-squared value of .707 allows the hedger to be confident that this prediction is reliable.

The program also solves the predictive equation for two break-even points. The first value represents the beginning basis needed to break even with no hedging costs. That is, y is set to zero and the equation is solved for x. The break-even cost of the regression equation listed above is 11.83 cents (Table 2). The second value represents the beginning basis required to break even with a variable monthly hedging cost specified by the user on the control card. Suppose the user specifies a cost of 2 cents per month

for the 3 month hedging period. The total storage cost of 6 cents is substituted for y and the same equation is solved yielding a break-even point of 18.13 cents for 2 cents per month hedging costs.

The program also computes the average monthly hedging return so the hedger can compare total returns to monthly returns. A farmer who owns storage and therefore has very low variable costs is primarily interested in total earnings while the farmer who rents storage encounters only variable costs and may be more concerned about high monthly earnings rather than total earnings.

Cash speculation analysis is also computed and printed so the hedger can compare the two storage options. The average, maximum and minimum cash returns are printed along with the standard deviation, upper and lower limit of a 90 percent confidence interval, and range of limits for average cash returns. This allows the hedger to compare both estimated average returns along with the reliability of both estimates.

Presently the hedging program is set up to be used in batch processing at a central computer facility. However, the program needs only slight modification for remote terminal access. The futures price input may be loaded at the central facility or entered via the remote terminal such as a teletype. The control card information is minimal and could also be entered via the teletype at time of execution. The output formats would need to be changed to conform to the terminal's output restrictions.

Extension field personnel and other interested staff could access the program anywhere with the use of a teletype and present telephone communications lines for demonstration purposes or for interested farmers who want to analyze their own potential hedging returns. Presently Purdue University has an editing routine that allows remote terminal users to edit

and modify programs and data that has been entered at the terminal or is already stored on a random access device. This routine would help the agent and/or user modify the program and data to fit his own needs and desires.

The hedging program is capable of use by anyone who wants to analyze hedging returns for a specified location. Input is minimal and the output may be modified to suit the user.

Summary

The Indiana soybean hedging analysis showed that hedging does reduce price fluctuation risk and substantial hedging profits can be earned by placing hedges at the appropriate times. Basis is widest during the peak of harvest and quick profits can be turned around the first of the year or large total profits can be earned by holding the hedge into the late spring or early summer. Greater average earnings can be earned by using selective hedging based on beginning basis. Cash speculation results in slightly higher average profits but the variation of cash returns is much greater than the hedging earnings variations.

Adoption of this tool for storage hedging analysis as part of an extension program could make this program readily available to all people interested in analyzing hedging potentials. Historical data analyzed and presented by the program can be compared to the present market situation to detect potentially profitable hedging opportunities.

REFERENCE

- (1) Gerke, Darrell L., "Analysis of Soybean Storage Hedging Returns In Selected Indiana Regions", unpublished M.S. Thesis, Purdue University, 1974.