The application of a decision rule for feed storage

THE APPLICATION OF A
DECISION RULE FOR FEED STORAGE

by

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This thesis has been approved on the date shown below:

Roger A. Selley — 25 July 1981

Roger A. Selley
Professor of Agricultural Economics

Date

To My Parents

and

Marge

Micah 7:8

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ABSTRACT

The major objective of this thesis was to determine the economic feasibility of grain storage for the consumer of grain. The decision to purchase storage facilities requires a long term commitment of capital. It is therefore important that the costs and returns of the various storage alternatives be carefully evaluated before the investment is made.

Investment costs were developed to determine the breakeven ownership cost of storage facilities. The breakeven analysis was applied to year around storage as insurance against shortages and advance purchases to reduce the cost of grain for later consumption. Advance purchases were discounted to give a present value cost and amortized to determine possible savings from storage. The results of advance purchases were then reviewed and compared as to their economic feasibility with the breakeven cost of storage. A method of determining expected cash prices was developed as part of the decision to make purchases in excess of consumption needs.

CHAPTER 1

INTRODUCTION

Farm storage and drying facilities have increased dramatically during the past few years (Skees et al. 1978). According to Flatis (1978) total U.S. grain storage capacity as of April 1, 1978, includes 9.9 billion bushels on-farm storage and almost 7 billion bushels commercial storage. Fifty-nine percent of the nation's grain storage capacity is on-farm storage. In Arizona only sixteen percent is on-farm storage.

Storage is holding an asset which means the cost of holding that asset must be assessed against the savings. The money tied up in the purchase of feed for future needs has a time value and it must be decided if the funds will receive a greater return than if invested elsewhere. The period studied witnessed the beginning of rapidly rising prices and interest rates. As a result, each stage of the production process has to be scrutinized and unnecessary expenses eliminated. The examination of feed storage is part of this process.

The economic feasibility studies concerning grain storage have primarily been completed in grain surplus areas. The emphasis has been on storage by the grain producer rather than the consumer (Malphrus and Boyleston, 1977). Cost and returns associated with on-farm storage has received extensive study. Skees et al (1978) evaluated the economic feasibility of storing corn, wheat, and soybeans on the farm. Two types of storage systems were analyzed: 1) A "representative" system, 2) A "recommended" system theoretically generated on the basis of engineering recommendations by the use of computer simulation model, "chase". The researchers felt the trend of on-farm storage was growing and could come to play an important role in the national grain policies. In a study of grain storage in Arizona, Angus and Stultz, (1963) compared costs and benefits resulting from on-farm storage through the use of grain storage budgets. The results advocated on-farm grain storage. This study all focused upon the producer of grain and not the consumer.

The storage of feed grain is a specialized aspect of the cycle of grain utilization. In another survey study, Schwabe (1977) concluded that on-farm milling with storage facilities was economically viable. Schwabe kept storage facilities at a minimum and assumed constant prices as being representative. The different storage systems and designs are discussed in detail by Bouland and Smith (1960). J.E. Bailey (1974) discussed almost all methods of storage: from on the ground practices which are feasible for temporary periods to the variety of bins that are currently available. Lammers (1979) studied the alternatives of on-farm storage and milling feed and the purchasing of commercially processed feed. In conclusion Lammers found on-farm storage of feed in conjunction with on-farm milling to be feasible. Economics of size existed such that the cost - savings increased with size and volume of the operation.

Deciding when to store requires the formulation of expected prices. Using the futures market as a predictor of cash prices, Dahl and Henneberry (1977), showed a relationship between the cash price and the futures price (the basis). Their study cautioned that using the basis and the futures market as part of the decision making process for predicting expected cash prices required extensive knowledge of the market. Helmuth's (1977) study explained in the futures market and presented a detailed description of the U.S. grain pricing mechanism. There is an abundance of literature explaining the terms and types of contracts that exist in futures trading.

This study will examine the economic feasibility of storing feed for consumption by selective purchases in excess of consumption needs. The selective purchases will be made based upon the results of a decision rule. Application of accounting procedures and cashflow analysis will examine the possible savings from storage of feed for the eight year period 1969-1976. The advance purchases of sorghum grain are made by the decision rule using the current cash prices of sorghum and the corn futures price as a predictor of the expected cash price.

The study begins with a breakeven analysis for the storage of grain in Chapter 2. A control model of price certainty and perfect knowledge is applied in Chapter 3 using the decision rule to make selective purchases, given the cost of owning and operating a facility. The results of the decision rule are computed by accounting procedures as to the feasibility of owning storage facilties for consumption needs. A notion of guaranteeing a months supply of storage is introduced from the beginning of the program and the savings from having a guaranteed storage facility is tested.

Chapter 4 evaluates the feasibility of storage by applying the decision rule in the market of imperfect knowledge. The decision rule involves comparing the current cash prices with expected prices based upon the futures prices of corn. Chapter 5 summarizes the results and suggests further study that is indicated.

CHAPTER 2

BREAKEVEN ANALYSIS DERIVATION AND COMPUTATION FOR FEED STORAGE

Breakeven analysis has played an important role for analysis in the non-agricultural commercial world. (Manes 1966) The business schools have developed various methods to measure production costs against revenues in relation to volume. The purpose of economic theory is to go further than the traditional acounting breakeven analysis in specifying not only a breakeven condition with respect to total costs, but also an "equilibrium" or maximum profit condition.

Setting

The case assumed here is a regular demand for the feed grain as in a poultry operation and can be projected over a set time period--say one year. Storage facilities are assumed to be in a position to receive grain in a semi truck and in some cases a railroad car.

The costs of storage are annual ownership costs and operating costs. The annual ownership costs are incurred irrespecive of the level use of the storage facilities. They include annual depreciation, interest on investment, annual repairs and insurance on facilities. In the short run a degree of fixity exists in the size of the storage facility and annual ownership costs; operating costs are incurred as a result of using the facilities and equipment to store grain and may vary with the amount of grain stored and the length of storage. They include additional man-hours, storing, and exporting grain, and inspecting stored grain. Other costs associated with variations in storage costs are energy, repair, maintenance and grain insurance.

The farmer contemplating on-farm storage storage facilities, or one wishing to expand existing facilities is using the longrun planning horizon and will have to analyse the probable costs and returns of a long term investment. The purpose of the breakeven analysis presented below is to provide a method to identify and compare the costs and returns for various size storage facilities. Part of the analysis is also applicable to the use of the existing facility.

Storage Costs

Storage will hopefully create a savings to the consumer of grain through timely purchases. There is also the satisfaction created by the security of "a bird in the hand is worth two in the bush". Income losses due to inadequate supplies may be avoided through storage.

Ownership Costs

An example of the initial investment is presented in Table 2.1. The example is a round galvanized steel-bolted storage bin. The various types and sizes of bin capacity would require a similar approach to computing investment cost (Bouland 1960). Grain

Table 2.1 Initial Investment for a Galvanized Steel Bolted Round Bin System, a Capacity of 7,202 Bushels.

	Price
A. Facilities [c]	
I. Steel round bin 21'x26'	5,700.00
II. Concrete Slab 21' Diameter; 5" thick includes support footings	520.00
Facilities Purchase Cost	6,220.00
B. Equipment [a]	
I. Screw conveyor, horizontal - - 6"x30'; includes support frames	980.00
Two systems	
a) Belt Drive Sheave	88.00
b) 2 h.p. motor; push botton with magnetic starter	252.00
II. Sporting	10.00
III. Hopper bin - - 2'x4'x2'	70.00
IV. Swivel Screw, Center-pivoting - 6'x10.5', includes drive assembly with gear box	265.00
a) 1.5 h.p. motor; push button with magnetic starter	114.00
Equipment purchase cost	779.00
Total Initial Investment	7,999.00

a) Includes 5% sales tax, erection and freight

b) The measurement of capacity of a storage facility is in bushels. Appendix Table A.3 has the conversion of volume measurement to weight.

c) Lammers (1979)

d) Lammers (1979)

storage capacity, types equipment for charging and discharging grain from storage can be found in the following publication: McKenzie B.A. et al "Planning Grain-Feed Handling". M.W.P.S 13, Midwest Planning Service, Iowa State University, Ames, Iowa, December 1968.

Annual ownership costs for a round galvanized bolted storage bin for feed grain with a 7,202 bushel capacity is found in Table 2.2. Annual ownership costs are developed from investment costs by the following calculations.

Depreciation

Depreciation is an accounting procedure in the prorating of the cost. The life of a round grainery is assumed to be twenty five years and the equipment to be seventeen years. Vosoloh (May 1976) used a 5% salvage value for facilities and equipment. A major component of ownership cost is the difference between the purchase cost and the salvage value which is defined as depreciation. A common method of spreading the depreciation over the useful life is the straight-lien method as follows: Average Annual Depreciation = $\frac{OC-SV}{N}$ where OC equals original cost, SV equals salvage and N equals number of useful life.

Table 2.2

a) Depreciation - 25 yrs. straight-line depreciation (Vosloh 1976) 5% salvage value.

b) Interest on investment - 8 1/2% on one half initial investment, salvage value and depreciation charge. Initial investment cost on following table.

c) Land sight valued @ 2,000.00 at 12% yr.

d) Insurance - initial investment multiplied by 5% for facilities and 1% for equipment (Lammers 1979).

e) Taxes - on sight improvement taxes on improvements - one half initial investment and salvage value multiplied by 18 percent to compute assessed value. Assessed value divided by 1.15 is net assessed, which is then multiplied by 9 percent to estimate tax bill (Lammers 1979).

f) Depreciation - 17 years straight-line depreciation (Vosloh 1976) 5% salvage value.

g) Property Tax - Full cash value multiplied by 18 percent times the tax rate set by the taxing authority and divided by 1.15 (Lammers 1979).

Table 2.2 Annual Ownership Costs of Round Storage Bin for Feed Grains for 7,202 Bushels of Storage Capacity.

A. Facilities	
1. Depreciation [a]	$ 236.00
2. Interest on Investment [b]	374.00
3. Insurance [d]	49.00
4. Taxes [e]	62.00
B. Equipment	
1. Depreciation [f]	99.00
C. Land	
1. Interest on land [c]	240.00
2. Property tax [g]	156.00
Annual Ownership Cost	$1,216.00
Annual ownership cost per unit of capacity.	.17

Interest

The funds used in the purchase of storage facilities have an opportunity cost. "The opportunity cost of a resource is the return the resource can earn when put to its best alternative use." (Doll 1978) Interest rates serve as a pricing mechanism for the time value of money and reflect an investors' time preference or opportunity cost of money. The method applied in this study, to find the average annual interest cost, is the "Arithmetic Average Method" as follows:

$$\text{Arithmetic Average Interest Cost} = \frac{\left(OC+SV+\frac{OC-SV}{N}\right) r}{2}$$

Where OC equals original cost, SV equals salvage value, N equals number of years of useful life and "r" equals annual interest rate. This method is based upon equal annual end of period principal payments and accounts for interest costs in the outstanding balance in each period (Selley 1979). A more common method applied to calculate the Average Annual Interest Cost is as follows: Average Annual Interest Cost = $\frac{(PC+SV)}{2}\, r$ where PC equals purchase cost, SV equals salvage value and "r" equals interest rate.

Investment

The results from the latter equation plus the Average Annual Depreciation will give the Average Annual Investment Cost. The Average Annual Investment cost does not take into account the time value of money. The Present Value method takes into account the time value of money when evaluating investment costs as follows: $\frac{PC - SV / (1+r)^n}{1 - 1 / (1+r)^n}$ where PC equals purchase cost, SV equals salvage value, "r" is the annual interest rate per conversion period and "n" is the number of conversion periods. The present value equals the future value divided by the conversion factor. By amortizing the investment flow, one will get an average annual cost of investment.

Insurance

Insurance cost for facilities and equipment is based on the initial investment costs. Insurance cost can either be calculated using the depreciation method or present value method. Average Insurance Cost by depreciation method is as follows: Total Accumulated Insurance / N where N is the number of periods the facility is to be insured. Average Annual Insurance using present value method discount the payments for each period by the following equation:

$$\frac{I_o /(1+r)^o + I_1/(1+r)^1 + - - + I_n(1+r)^n}{1 - 1/(1+r)^n}$$

where I equals the insurance premiums divided by the discount rate (1+r), where "r" equals interest rate on the exponent "n" is the time period related to insurance cost for that time period. In this study, insurance costs were computed at one percent for equipment and half a percent of facility investment cost.

Taxes

Taxes like insurance will vary from area to area. It should be noted that the method of taxation can change from one legislative session to the next. In this study, taxes were based on assessed value, taking eighteen percent of one half the initial investment, divided by 1.15. This gave the net assessed value, which was multiplied by nine percent to estimate the tax bill. Average Annual Taxes can be calculated using the Depreciation method and the Present Value Method. The Depreciation Method is as follows: Total Accumulated Taxes / N where "N" is the number of periods of taxation. Calculating the taxes by the Present Value Method involves the taxation for the number of taxed periods and each period is discounted and summed then divided by the uniform series present value over "n" at interest rate ("r"). The Average Annual taxes by the Present Value Method will then be as follows:

$$\frac{T_1 /(1+r)^1 + T_2 /(1+r)^2 + \ldots + T_n/(1+r)^n}{1 - \frac{1/(1+r)^n}{r}}$$

Taxes were split into improvements and the sight itself.

Land

The average annual cost of land is the interest cost on the land. Since land in this case is not depreciated, the average annual cost of land is calculated by the Present Value Method--this is represented by the interest rate per period. The interest rate is usually stated at an annual rate and the method of payment is flexible.

Repairs

Finding the Average Annual Repairs accurately is next to impossible. Repairs normally increase over the life of the machine. Stresses to machinery do occur and repairs can be abnormally large one year and nil the following. From the point of view of accuracy for the life of the machinery, the present value method of calculating repair costs are more accurate than the other methods used in calculating Average Annual repairs. The Average Annual Repair calculated by the present value method is as follows:

$$\frac{R_1/(1+r)^1 + R_2/(1+r)^2 + \quad + R_n/(1+r)^n}{\frac{1 - 1/(1+r)^n}{r}}$$

where "R" is equal to the repair costs, "n" is the number of periods and "r" is equal to the interest rate. The Average Annual Repairs by the Depreciation Method is as follows: Total Accumulated Repairs / N where "N" equals the number of periods.

Table 2.2 illustrates the Annual Ownership Costs developed for a 7,202 bushel bin. The data is developed from Table 2.1. The facilities in Table 2.2 refer to the storage structure which is built to hold the grain for storage (including the concrete floor). The equipment is the necessary machinery used to convey the grain in and out of storage. Table 2.3 is an example of Average Annual Ownership Cost for Various Sizes of Round Bin Storage.

Operating Costs

Operating costs are costs that vary with the quantity stored and or the time stored. With the high energy costs, refer to McKenzie et al pp. 48-52 as an aid in the locating of the most efficient use and type of system to actuate grain.

Operating costs will differ from one area to another. The underlying assumptions for computing operating costs are similar, however, drying costs have been excluded since most grains are purchased at moisture levels within storable allowances (Welchert, 1978, pp. 43-77). There are some operation costs associated with discharging grain to and from storage. Degree of mechanization will influence the moving cost which includes the labor, equipment repair and energy costs.

Table 2.3 Average Annual Ownership Cost of Various Round Bin Storage for Milo.

Storage Capacity In Bushels	7,202	15,114	20,304	27,120	43,950	83,932	174,850
Storage Capacity In Tons	202	423	570	760	1,231	2,350	4,896
Cost: Facilities							
Depreciation of Investment	$236	508	584	730	1,130	2,078	4,312
Interest on Investment	374	739	833	1,013	1,543	2,722	5,488
Interest on Land	240	240	240	240	240	240	240
Insurance on Facility	49	91	91	121	182	309	636
Tax on Land	156	156	207	207	207	207	207
Tax on Improvement	62	122	138	168	256	451	909
Cost: Equipment							
Depreciation	99	136	137	137	184	197	385
Total Ownership Cost	1,216	1,992	2,230	2,616	3,742	6,204	12,177
Annual Ownership Cost per Unit of Capacity	.17	.13	.11	.10	.09	.07	.07

The remaining operating costs are associated with the time period that the grain is held in storage. These costs include labor, utilities and supplies involved in maintenance of the grain, including inspections, turning and aeration of the grain, minor repairs and possible treatment for insect damage and rodent control. Other operating costs include insurance and interest on stored grain.

Insurance on grain in stock is computed at the rate of $2.50 per $100; based upon an "all risk" insurance policy (Pan American Insurance Co. 1979). As stated earlier, the use of owner capital involves an opportunity cost and income foregone from investing those funds in an alternative production process. In the example, the assumption is that forty percent of the capital for grain storage is owner supplied and will receive a passbook cost of 6 1/2%. The remaining sixty percent is borrowed funds and costs the going rate of 8 1/2% per year.

The electrical rates were determined from Tucson gas and electric rates of 1979; according to rate number 10 and service charge 12.8 as follows:

0 - 100 KWH	.00080 CTS/KWH
101 - 400 KWH	.07025 CTS/KWH
401 - 3000 KWH	.06316 CTS/KWH

A tax of 4.1% was assessed on electric usage. The size of storage facilities will dictate the horsepower of the electrical motors to be used. The example in the study uses two horsepower and one and a half horsepower motors to transfer grain in and out of storage facilities. Eight man hours per week were allotted to transfer grain and maintain the grain and facilities. The larger the facilities and more often grain is transfered then the allotted time will have to be increased. A wage rate was set at $4.00 per hour with F.I.C.A. set at 5.85% and workman's compensation at 10.15% of salary (Poppe 1977).

Table 2.4 is an example of operating costs and how they are developed for a round 7,202 bushel galvanized steel bin. The annual costs and ownership costs can be estimated using Tables 2.1--2.4 from budgets and income statement. Table 2.4 illustrates a method to collect "field data". With the data classified, breakeven analysis computations and feasibility of grain storage can be pursued relative to size and type of facility. In this study grain shrinkage has been ignored. Since the purchasing department will be charging the production department for grain weighed in and purchased. Grain costs per hour can be calculated when grain is moved in or out; other cost of grain handling such as treatment are per bushel.

Breakeven

The breakeven point will be where the cost of storage will be equal to purchase price of grain on an as-need basis. The breakeven analysis is simple and convenient. It might lead to erroneous answers, especially if there are significant differences in the time patterns of cash flows associated with the alternatives; such as ownership versus

Table 2.4 Worksheet - Operational Cost per Unit for Grain Storage, Bin Capacity and Needs, for a One Year Period.

Per Unit Costs		COST
1. Labor wages (Hours per unit * wage rate per hr.)		.0118
2. F.I.C.A. and Workmans's Compensation	+	.0019
3. Total labor cost of grain transfer per unit	=	.0137
4. Energy cost hours per unit * worked per month		.0008
5. Total cost per unit of transfer per month		.0145
6. Number of units stored per year		
7. Total cost of transfer for year (5 * 6)		
8. Monthly cost per bin	=	.0059
9. Labor inspection, pest control, "turning" grain	=	.0059
10. F.I.C.A. and Workman's Compensation	+	.0009
11. Total labor cost of maintenance per unit per month	=	.0068
12. Repair, servicing of equipment and facilities per unit per month		.0025
13. Energy cost, lights, ventilation and turning grain		.0008
14. Grain insurance per unit per month at average price per unit		.0058
15. Total maintenance cost per unit per month	=	.0159
16. Total operating cost per unit per month (5+15)	=	.0304
17. Number of months facility is used per year	=	
18. Operating cost per year (15 * 16)	=	
19. Capacity of storage	=	7,202
20. Number of units stored per year	=	
21. Cost of operating storage per year (20 * 18)	=	

leasing of storage or extension of time period. Comparisons need to be based on present values of the projected cash flow streams.

The annual cost of feed procurement with no excess storage available is the annual units consumed times the average purchase price. If additional storage is to be profitable, the net annual cost of feed procurement must decrease. The annual cost of feed procurement with the purchase of excess storage includes the following: The annual units consumed multiplied by the Average Price per unit. The average price will include the price of advance purchases. The advance units purchased will be added into the above. The cost of operating the storage facility will include the interest charge on borrowed funds for making advance purchases. The operating cost per unit stored per month is found by refering back to Table 2.4. The operating cost for the facility is multiplied by the average months of storage. This cost figure is added to the annual ownership per unit of storage capacity for the storage facility. That is the storage capacity above consumption needs. The total cost of feed procurement is the net annual cost with storage. This is illustrated in Table 2.5.

The breakeven cost per unit of storage per period can be calculated algebraically by the following, where Annual cost without storage equals Annual cost with storage. A breakeven occurs where the net feed procurement costs are the same with and without storage.

Table 2.5 Annual Net Cost of Feed Procurement with Storage Available for Advance Purchases.

1. Annual units consumed

2 * Average purchase price per unit with advance purchases

3 + Annual units purchased in advance

4 * Average months stored

5 * Operating cost per unit stored per month

6 + Units of excess storage capacity

7 * Annual ownership cost per unit storage capacity

8 = Net annual cost of feed procurement with storage available for advance purchases

Solving for the breakeven annual ownership cost of excess storage capacity results in:

Breakeven Annual ownership cost per unit storage capacity =

$$\frac{\text{Annual Income Gain} - \left[\text{Annual Units}\right] \circ \left[\text{Net change in Price Per Unit}\right]}{\text{Units of Excess Storage Capacity.}}$$

Where the net change in the price per unit is the difference between the average purchase price of grain per unit and the operating cost per unit stored times units stored per units consumed. When the operating cost is greater than reduction in the purchase price the result is an increase in the net procurement cost. Table 2.6 presents the breakeven annual ownership cost of storage for a variety of circumstances.

The annual units consumed are in the top left column. Various expected income gains from storage are shown for each level of annual consumption. The lower portion of Table 2.6 (part B) is the net price changes and breakeven ownership cost per unit of storage relative to the above annual income gain and feed consumption.

The following examples will help clarify the use of Table 2.6. First consider the purchase of additional storage that are kept full whenever possible to provide insurance against running short of feed and are to be fed annually. Assume it is expected that $600 additional profits can be realized with one additional month of storage capacity and that storage will involve a $.05 per ton operating expense. Referring to Table 2.6A, read down the column of budgeted needs to 3,000 tons and across to the third column to $600. Locate the

Table 2.6 Breakeven Analysis of Ownership Cost of Storage.

A. Storage Consumption Need/Unit of Time — Annual Income Gain with Additional Storage

Storage Consumption Need/Unit of Time	Annual Income Gain with Additional Storage										
1000	0	100	200	300	400	500	600	700	800	900	1000
2000	0	200	400	600	800	1000	1200	1400	1600	1800	2000
3000	0	300	600	900	1200	1500	1800	2100	2400	2700	3000
4000	0	400	800	1200	1600	2000	2400	2800	3200	3600	4000
5000	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
6000	0	600	1200	1800	2400	3000	3600	4200	4800	5400	6000
7000	0	700	1400	2100	2800	3500	4200	4900	5600	6300	7000
8000	0	800	160	2400	3200	4000	4800	5600	6400	7200	8000
9000	0	900	1800	2700	3600	4500	5400	6300	7200	8100	9000
10,000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000

B. Net Savings Per/Unit/t — Annual Ownership Cost Per Unit - Months of Additional Storage Capacity

	Net Savings Per/Unit/t	Annual Ownership Cost Per Unit - Months of Additional Storage Capacity									
-.10	1.20	2.40	3.60	4.80	6.00	8.2	8.40	9.60	10.80	12.00	13.20
-.09	1.08	2.28	3.48	4.68	5.88	7.08	8.28	9.48	10.68	11.88	13.08
-.08	.96	2.16	3.36	4.56	5.76	6.96	8.16	9.36	10.56	11.76	12.96
-.07	.84	2.04	3.24	4.44	5.64	6.84	8.04	9.24	10.44	11.64	12.84
-.06	.72	1.92	3.12	4.32	5.52	6.72	7.92	9.12	10.32	11.52	12.72
-.05	.60	1.80	3.00	4.20	5.40	6.60	7.80	9.00	10.20	11.40	12.60
-.04	.48	1.68	2.88	4.08	5.28	6.48	7.68	8.88	10.08	11.28	12.48
-.03	.36	1.56	2.76	3.96	5.16	6.36	7.56	8.76	9.96	11.16	12.36
-.02	.24	1.44	2.64	3.84	5.04	6.24	7.44	8.64	9.84	11.04	12.24
-.01	+.12	1.32	2.52	3.72	4.92	6.12	7.32	8.52	9.72	10.92	12.12
0.00	0.00	1.20	2.40	3.60	4.80	6.00	7.20	8.40	9.60	10.80	12.00
+.01	-.12	1.08	2.28	3.48	4.68	5.88	7.08	8.28	9.48	10.68	11.88
+.02	-.24	.96	2.16	3.36	4.56	5.76	6.96	8.16	9.36	10.56	11.76
+.03	-.36	.84	2.04	3.24	4.44	5.64	6.84	8.04	9.24	10.44	11.64
+.04	-.48	.72	1.92	3.12	4.32	5.52	6.72	7.92	9.12	10.32	11.52
+.05	-.60	.60	1.80	3.00	4.20	5.40	6.60	7.80	9.00	10.20	11.40
+.06	-.72	.48	1.68	2.88	4.08	5.28	6.48	7.68	8.88	10.08	11.28
+.07	-.84	.36	1.56	2.76	3.96	5.16	6.36	7.56	8.76	9.96	11.16
+.08	-.96	.24	1.44	2.64	3.84	5.04	6.24	7.44	8.64	9.84	11.04
+.09	-1.08	.12	1.32	2.52	3.72	4.92	6.12	7.32	8.52	9.72	10.92
+.10	-1.20	0.00	1.20	2.40	3.60	4.80	6.00	7.20	8.40	9.60	10.80

net price increase (loss from storage) of $.05 in Part B and read across to the third column, where the breakeven annual ownership cost is shown as $1.80 per unit (ton). Therefore, if the annual ownership costs are below $1.80, it would be profitable to purchase additional storage capacity. In the above example, assume two months of storage capacity would be required to realize an annual savings of $600. The breakeven cost for the table is again $1.80 but now it is for two months storage. The breakeven cost per ton will be $1.80 divided by 2 = $.90 per ton. If storage costs are greater than $.90 per ton (unit) then the additional two months storage will not be feasible.

Alternatively consider the use of excess storage to present the timely purchase of feed and thereby reduce the average purchase price by the example below. Selective purchases can be made as a result of distress sales or the results of a forecasting decision, where the feed grain market has been reviewed and current cash price is less than the expected cash price. When selective purchases for grain storage are made to minimize cost of feed grain and cover the annual ownership cost (per unit) of storage, then the net change in per unit price becomes an average annual savings (or loss) per unit of purchase price of feed grain.

Referring to Table 2.6 part B and the first two columns only. Assuming the annual ownership cost per unit is $.17 per unit (re-Table 2.2) and storage capacity is for one month. The Annual Ownership cost of storage per unit is in column two between $.12 and $.24. Reading across to column one, grain purchased for storage on the average will have to be \$.015 below current market price to breakeven on the annual ownership cost. Assumming the same breakeven of \$.17 but now two months storage is available. The breakeven cost per unit will be \$.17 divided by 2 which equals \$.085 per unit. As long as storage costs are less than or equal to \$.085 per unit then storage will be economically feasible with selective purchases.

The computation of a breakeven is a simplified process with the use of a hand held programmable calculator. A program was developed for a Hewlett Packard 65 as an aid to computation of breakeven costs for feed storage (see Appendix Table A.1). The equations for breakeven cost of storage are below with formulea in the Appendix Table A.2. One of the five unknowns can be calculated by one of the equations below given the other variables.

1. Breakeven Annual Income Gain with Storage.

$$= \text{Annual Units required for annual consumption} \cdot \text{Net Change in Price per unit} + \left[\begin{array}{l}\text{months of}\\ \text{storage capacity}\end{array}\right] \circ \left[\begin{array}{l}\text{Annual ownership}\\ \text{Cost per of}\\ \text{storage capacity}\end{array}\right]$$

2. Breakeven Net Change in Price per Unit.

$$= \left[\frac{\text{Annual Income Grain with Additional Storage}}{\text{Annual Units required for annual consumption}}\right] - \underline{\left[\begin{array}{l}\text{Annual Ownership Cost}\\ \text{per unit of}\\ \text{Storage Capacity}\end{array}\right]} \circ \underline{\left[\begin{array}{l}\text{Months of}\\ \text{Storage Capacity}\end{array}\right]}$$

3. Breakeven Months of Annual Storage Capacity.

$$= \frac{\begin{bmatrix}\text{Annual Income} \\ \text{Gain with} \\ \text{Additional Storage}\end{bmatrix} - \begin{bmatrix}\text{Annual Units} \\ \text{required for annual} \\ \text{consumption}\end{bmatrix} \cdot \begin{bmatrix}\text{Net Change in} \\ \text{price per} \\ \text{unit}\end{bmatrix}}{\begin{bmatrix}\text{Annual units} \\ \text{required for Annual} \\ \text{consumption}\end{bmatrix} \cdot \begin{bmatrix}\text{Annual Ownership} \\ \text{Cost per unit} \\ \text{of Storage Capacity}\end{bmatrix}}$$

The Annual units required for annual consumption is budgeted for the forthcoming year; the months of storage costs equals the units of storage divided by the units of consumption per month.

All capital budgeting programs require an investment analysis to be made of the various alternatives. The investment choice in the case study has been grain storage. The economic criteria collected will enable the capital budgeting process to accept or reject the investment under study.

Chapter 3

APPLICATION OF A DECISION RULE FOR ADVANCE PURCHASES UNDER PRICE CERTAINTY

An evaluation is made in this chapter of purchasing feed in advance of consumption needs. The determination of when to purchase and how much to purchase is completed by the application of a decision rule under the assumption of price certainty (perfect knowledge of futures prices). A case study is reported for a feeding operation where monthly purchases of grain sorghum are made by a purchasing department to meet the monthly consumption needs of a production department. Varying storage capacities to be achieved by increasing storage capacity thereby permitting an increase in advance purchases in an endeavor to minimize feed cost. The decision rule used involves comparing the future value of the current cash price to future cash prices. Any one of the subsequent months can cause the decision rule to signal the purchase of feed in excess of consumption needs. Mathematically the decision rule is to purchase for future needs if: (current price + margin) $(1+r)^m <$ expected price in 'm' months. The interest rate, "r" reflects the investors' time preference for money. The compound interest factor $(1+r)^m$ expresses the current price in terms of an equivalent amount after compounding for "m" months at the interest rate "r". A margin is added to the current cash price to cover the cost of maintaining the stored grain and the risk involved in owning and storing grain. No purchases in excess of consumption needs are made when the future value of the current cash price plus margin is equal to or greater than the cash price in subsequent months. When the cash price at any one of the future months is greater than the future value of the current cash price plus the required margin, the purchasing department will purchase feed in excess of consumption needs. Prices used in the case study are midmonth cash sorghum prices as reported by the Arizona Crop and Livestock Reporting Service for the years 1969 to 1977 (Mayes et al). The data used in the decision rule each month includes the current price and the price for the following eleven months. Each thirty days, the decision rule was used to review the future cash prices for the following eleven months.

When the cash price for a month is equal to or less than the prices of the subsequent eleven months, then the storage department will purchase grain only for immediate consumption needs. If the storage department has feed in inventory when the decision rule signals no purchase, the production department consumes the grain in the inventory. Otherwise, grain will be purchased to meet that month's consumption needs. If the decision is to purchase grain in excess of consumption needs, purchases are made to use up to the available storage capacity. In any case, the production department pays the purchasing department for the grain at the current cash price plus one month's interest.

Cash accounting method have been used in this case study rather than the accural method. Cash accounting is not confined to a fiscal year and measures the flow of cash funds as soon as the transfer occurs. Cash flows account for borrowing and debt repayments associated with the investment which in this cash is the purchase and consumption of feed. The monthly cash operating income generated by the purchasing department is represented by:

cash flow = consumption * cash price * (1+r) + consumption* operating cost (1+r/2) - purchases + cash price (1+r) - inventory * operating cost * (1+r/2) - debt* r.

The inflow of cash is the value of the feed that the production department will consume (purchase) from the purchasing department at the current price plus storage (operating) cost. The operating costs are assumed to be spread evenly over the month hence the production department is charged interest on one half the monthly operating cost of storing feed that is consumed that month. The production department pays this sum irrespective of whether consumption is from storage or from purchases that month. Consumption needs are purchased at the beginning of each thirty day period but paid for at the end of thirty days. The purchasing department charges the production department interest in the same manner that the purchasing department would be charged interest by its suppliers. The remainder of the components in the cash flow equation are cash out-flows. The outflows include the cost of purchases made at the beginning of the month plus interest for the month. The operating cost will be incurred for the amount of feed in storage plus interest. Again, the operating cost of storage is assumed to be spread evenly over the month. Whenever the net cash flow is negative, the purchasing department accumulates a debt. If the purchasing department has a positive net cash flow, the debt is reduced. If the debt is positive it is assumed the purchasing department will have to pay interest at the rate "r" on the outstanding debt. If funds are accumulated as a a result of positive monthly cash operating incomes (cash flows) and the outstanding debt becomes negative, it is assumed that the purchasing department earns funds to the rest of the operation at the current interest rate. The debt is updated monthly by the following equation:

Debt = Debt - Cashflow

Table 3.1 shows the accumulated net savings over the consumption period (January 1, 1969 - December 31, 1976), calculated as follows:

Net savings = closing inventory * (closing inventory value)

- closing debt.

The savings is a result of profitable (cost reducng) advance purchases of feed. Since the monthly consumption needs were assumed to be one unit, the per unit savings is determined by amortizing the savings into an average monthly savings as in Table 3.2. The average monthly (per unit) savings is computed by the following:

$$\text{Average Savings per unit consumed} = -\text{Debt} + \text{Closing Inventory} * \text{Closing Inventory Value} \quad \frac{(1+r)^n}{r} * \text{Units consumed per month.}$$

Dividing the average savings per unit consumed by the number of months of additional storage results in the savings per unit of additional storage capacity as in Table 3.3. The best performance (1.33 cents

Table 3.1 Accumulated (Future Value of) Savings in Meeting One Unit (Bushel) Monthly Consumption Needs, January 1, 1969 to December 31, 1976.

Profit Margin / Storage	0	.1	.2	.3	.4	.5	.6	.7	.8
1	2.0912	2.125	1.5527	1.3076	1.3147	1.10	.4116	.3839	.3579
2	3,8089	3.904	3.1794	2.6884	2.7275	2.3492	1.1967	.7955	.7504
3	5,0471	5.6131	4.7416	4.0481	4.1143	3.7863	1.8623	1.5806	1.1720

Table 3.2 Average Savings (Dollars) per Unit (Bushel) Consumed.

Profit Margin / Storage	0	.1	.2	.3	.4	.5	.6	.7	.8
1	.0131	.0133	.0097	.0082	.0082	.0069	.0026	.0024	.0022
2	.0238	.0244	.0199	.0168	.0171	.0147	.0075	.005	.0048
3	.0316	.0351	.0296	.0253	.0257	.0237	.0116	.0099	.0073

Table 3.3 Average Savings (Dollars) per Unit (Bushels) Consumed per Unit (Bushel) Additional Storage Capacity.

Profit Margin / Storage	0	.1	.2	.3	.4	.5	.6	.7	.8
1	.0131	.0133	.0097	.0082	.0082	.0069	.0026	.0024	.0022
2	.0119	.0122	.0100	.0084	.0086	.0074	.0038	.0025	.0024
3	.0105	.0117	.0099	.0084	.0086	.0079	.0039	.0033	.0024

savings per bushel) was realized where a profit margin of 0.1 and one unit of additional storage were used. Referring to Table 2.6 the breakeven annual ownership cost per unit of storage for a 1 cent savings per bushel is 12 cents. The breakeven annual ownership cost per unit of storage for a 2 cent savings per bushel is 24 cents. Interpolating, the breakeven annual ownership cost per unit of storage for 1.33 cent savings per bushel is 16 cents which is slightly below the cost of storage using a 7202 bushel bin (see Table 2.3).

Under the condition of perfect knowledge of prices, the results from the decision rule show that the storage of feed in excess of consumption needs are unprofitable if selective purchases are made at the market price. Distress sales, however, could permit the purchase of feed at prices below the market price and would increase the per unit savings and lower the breakeven annual ownership cost.

Also, the decision rule is not perfect. An exact minimization of procurement costs would require the use of dynamic programming or a similar algorithm. The use of a dynamic programming would have increased the per unit savings and reduced the breakeven average annual ownership cost.

CHAPTER 4

APPLICATION OF A DECISION RULE FOR ADVANCE PURCHASES UNDER PRICE UNCERTAINTY

Feed prices now are assumed to be unknown to the decision maker and expectations will have to be formulated. An identical case situation is assumed as in the previous chapter.

Price predictions are developed by market analyists and other forecasters using considerable information and experience and in some instances complex models. The futures market acts as an exchange for information on predicted prices. There is a sorghum futures market but it is very lightly traded. The futures market for corn, however, is quite active. Since prices of futures contract commodities can be compared with the same or similar (substitute) commodities (Dahl, 1977) and corn and grain sorghum are close substitutes, the corn futures will be used to formulate expected prices. The corn futures data used was the closing corn futures price from the Chicago Board of Trade for the third Wednesday of each month from January 1969 to December 1976. There are five contract months in a corn crop year. The corn crop year is from October 1 to September 30, and the contract months are December, March, May, July and September. A contract month is a month which a contract matures and in which delivery is to be met in accordance with the regulations of negotiating a futures contract.

Historically and in principle there is a difference between the futures price at contract maturity and the cash price. The difference between the cash prices and the futures price at contract maturity reflects the local supply-demand conditions and the direction of flow of the commodity (Helmuth 1977). The difference in the cash and futures prices is called the basis. The basis can be either positive or negative. A negative basis occurs when the futures price is less than the cash price.

An interpretation of the futures price at time "t" is that it is an expected price formulated at time "t" for deliveries to be made to a contract delivery point during the contract month. Therefore, for a non-delivery point, the futures price minus the expected basis for that (non-delivery) point provides a predicted contract month price for the commodity. The expected basis could be formulated as a simple mean of historical basis data. However, it seems desirable to use current information to estimate the basis since the basis changes from year to year due to changes in market conditions. Therefore, the expected basis is formulated here as the basis for the respective contract for the previous year. It has been adjusted for any changes that have been taken place within the last year in the basis for the contract that most recently expired as explained below.

The expected basis for the current contract in time period 't' is therefore calculated as follows:

Current Basis_{t-1} * Previous Basis_t / Previous Basis_{t-1}.

The expected price at time "t" for the commodity for a particular contract month is equal to the future price for that contract month minus the expected basis. The basis is updated when the current month is a contract month. The decision rule reviews the future five contract months from the current month ignoring the non-contract months. Execution of the decision rule is preceeded by checking whether the current month is a contract month or a non-contract month. If the current is a contract month, the basis is updated in order to compute an updated expected basis.

After checking the status of the current month and when necessary updating the basis, the decision rule was then applied as in Chapter Three. The objective was again to minimize feed costs through advance purchases of feed: comparing the compounded value of the current cash price to expected prices.

The cash prices used in this cash study were the same as in Chapter Three. Every thirty days, the decision rule reviews the future prices for the following five contract months.

When the cash price for a month is equal to or less than the expected prices of the subsequent five contract months, the storage department has feed in inventory when the decision rule signals no purchase, the production department consumes the inventory; otherwise, grain will be purchased only to that month's consumption needs. If the decision is to purchase grain in excess of consumption needs, purchases are made to use up the available storage capacity. Purchases in excess of consumption needs are made when the compounded value of the current cash price plus margin is less than the expected value of the current cash prices plus required margins.

The monthly cash operating income generated by the purchasing department is calculated as in Chapter Three where: Cash flow = Consumption * cash price * (1+r) + consumption * operating cost (1+r/2) - purchases * cash Price (1+r) - inventory * operating cost * (1+r/2) - debt * r. The inflow of cash is the value of the feed that the production department will consume from the purchasing department at the current cash price plus storage operating cost on monthly consumption.

Table 4.1 shows the accumulated net dissavings over the consumption needs are assumed to be one unit, the per unit dissavings is determined by amortizing the net savings. The average monthly (per unit) dissavings is illustrated in Table 4.2. The average monthly per unit dissavings is computed as follows:

$$\text{Average Dissavings per unit consumed} = \frac{-\text{Debt} + \text{Closing Inventory} * \text{Closing Inventory Value}}{\frac{(1+r)^n - 1}{r} * \text{units consumed per month.}}$$

Dividing the average savings by the number of months of additional storage results in the savings per unit of additional storage capacity in Table 4.3. The best performance (0.82 loss per bushel) was realized with a margin of $.50 when one unit of additional storage was used per month. Referring to Table 2.6, the breakeven annual ownership cost per unit of storage for a one cent loss per bushel is a negative twelve cents. Interpolating, the breakeven annual ownership cost per unit of

Table 4.1 Accumulated Net (Savings) For January 1969 to December 1976.

Profit Margin / Storage	0	.1	.2	.3	.4	.5	.6	.7	.8
1	-3.3251	-2.9798	-2.0071	-2.4671	-1.7285	-1.3188	-1.3188	-1.822	-1.822
2	-7.2359	7.3959	-4.8563	-5.5390	-4.1383	-3.1932	-3.1932	-2.9201	-2.9201
3	-11.6680	-11.8189	-7.8361	-8.7733	-6.5446	-5.289	-5.2890	-4.8793	-4.8793

Table 4.2 Average Monthly Dissavings (per unit) Consumed for the Time Period.

Profit Margin / Storage	0	.1	.2	.3	.4	.5	.6	.7	.8
1	-.0208	-.0186	-.0126	-.0154	-.0108	-.0082	-.0082	-.0114	-.0114
2	-.0452	-.0462	-.0304	-.0346	-.0259	-.02	-.02	-.0183	-.0283
3	-.0730	.0739	.0490	.0549	-.0409	-.0331	-.0331	-.0305	.0305

Table 4.3 Average Savings per Unit Consumed per Unit Additional Storage Capacity.

Profit Margin / Storage	0	.1	.2	.3	.4	.5	.6	.7	.8
1	-.0208	-.0186	-.0126	-.0154	-.0108	-.0082	-.0082	-.0114	-.0114
2	-.0226	-.0231	-.0152	-.0173	-.013	-.01	-.01	-.0092	-.0092
3	-.0243	-.0246	-.0163	-.0183	-.0136	-.011	-.011	-.0102	-.0102

storage for 0.82 cents loss per bushel is a negative ten cents. The ownership of storage facilities will have to be subsidized entirely plus an additional 10 cents per unit of storage in order to store grain.

Under the condition of price uncertainty, the results from the decision rule showed that the storage of feed in excess of consumption needs is unprofitable. Distress sales and special contracts, however, could permit the purchase of feed at prices below the market price and allow a per unit savings. Further analysis is required to see if it is possible to develop a more reliable method of formulating expected cash prices.

CHAPTER 5

SUMMARY AND CONCLUSION

The objective of this study was to determine the economic feasibility of advance purchases of feed. Ownership costs and costs of operating a storage facility were calculated and tabulated for budget generation and analysis. Cost of erecting a specific facility was calculated from work by Lammers (1979).

The emphasis was on round steel bolted bins with flat concrete floors. The types of storage facilities available are numerous and their cost of construction owning and operating will vary. Worksheets were developed for comparison and analysis by individual operators. The method of budget analysis for an actual operation is similar. The results from the study are pre-tax returns. Income-tax deferments and tax-brackets will influence results for the individual. The method applied to the selective purchasing of feed for storage and later consumption showed storage to be unprofitable given the ownership and operating costs considered. As the bin size increases, annual ownership cost-per-unit per month decreases and with perfect knowledge, storage would be feasible. In the case of imperfect knowledge, no savings were realized from selective purchases of grain in excess of consumption needs.

This study is not comprehensive and allows for further research and investigation. The decision rule as applied neglected to use the non-contract months in predicting expected cash prices. The decision rule reviews eleven months to the future and sometimes the decision to buy was made too soon. A dynamic optimizing cost strategy was not used and would further improve the decision rule, also, models for forecasting commodity which could be incorporated in the formulation of expected prices.

There are other alternatives which require further investigation. Existing storage facilities may be leased by grain consumers. A feed operation could lease storage facilities and store so that feed consumption will be uninterupted.

Feed can be purchased on contract for a number of loads of feed for a period to fill consumption needs and be delivered so that the seller will be storing the feed grain at the convenience of the grain consumer. This is a common practice by the feed-milling companies and larger feedlots which consume several railcars of grain a week.

APPENDIX

Table A.1 The Program for an H.P. 65 Programmable Calculator for the Breakeven Analysis for the Unknown Variable.

Income Gain W/S	Annual Ownership -Even Cost	Net Price /Unit	Months of Storage	Initialize
A	B	C	D	E

The steps of computation:

STEP	Instructions	Input data /units	Key	Output Data Units
1	Enter program			
2	Initialize		E	
	When ever a different variable is to be computed the E key should be pressed to clear irrelevant data to the variable to be computed			
3	Enter known data as shown below to find unknown variable			
	Income Gain-Units	# Amount STO 1		
	Annual Ownership Cost/Unit	# Amount STO 2		
	Net Change in Price	# Amount STO 3		
	Months of Storage-Units	# Amount STO 4		
	Annual Needs Budgeted Units	# Amount STO 5		

TABLE A.1--Continued

STEP	Instructions	Input data /units	Key	Output Data Units
4	The unknown variable is calculated by pressing the key associated with it - given the data to the other four variables		0	
	A. = Income gain w/ storage		A	#
	B. = Annual ownership cost		B	#
	C. = Net price per unit		C	#
	D. = Months of storage		d	#
5	To add new data to a variable enter manually and calculate as above			
	A program listing is in Appendix Table A.3			

Example.

Given: Income gain = $ 800.00
Net price/unit = .10 ct
Months of storage = 2.00
Annual budgeted needs = 4000.00

Find: Annual ownership costs =
from Table IV.

Switch calculator on Enter data.

Enter program.
Initilize

Enter data

Press B

Results will be .60 cts. This is the annual breakeven ownerhip cost to store grain with the given variables. Answer can be found by use of Table 2.6.

TABLE A.1--Continued

Step	Instructions	Input Data /Units	Key	Output Data
	Example.			
	Given: Income gain	= $ 800.00		
	Months storage	1.00		
	Annual budget need	8000.00		
	Annual ownership cost	1.08		
	Find: Net price that will be the limit for firm to buy grain for storage.			
	Procedure.			
	Switch on. Press E.			
	Enter. Manually known data figures.			
	Enter. Program.			
	Press C.			
	Result: $.01^{ct}$ if the net price is greater than $.01^{ct}$/ton then the firm will find storage infeasible.			

Table A.2 Worksheets and Formulea for Breakeven Analysis.

I. Breakeven Income Gain w/ Storage.

1.	Months storage		____
2.	x Annual ownership cost	x	____
3.	=	=	____
4.	12		____
5.	x Change in net price/unit		____
6.	=	=	____
7.	6 + 3	=	____
8.	- 12		____
9.	x		____
10.	Annual budgeted needs - units. Breakeven income gain w/ storage		____

II. Breakeven Annual Ownership Cost/Unit.

1.	Annual budged needs		____
2.	x in net price per unit	x	____
3.	-	-	____
4.	+ Income gain w/ storage	+	____
5.	x	x	____
6.	12		____
7.			____
8.	Annual budgeted needs		____
9.	x Months of storage capacity		____
10.			____
11.	7 - 10 Breakeven annual ownership cost		____

III. Breakeven Change In Net Price/Unit.

1.	Income gain w/ storage		____
2.	- Annual budgeted needs	-	____
3.	= Income gain per unit of feed budget	=	____
4.	Annual ownership cost		____
5.	x Months of storage capacity	x	____
6.			____
7.	- 12	-	____
8.	-	-	____
9.	From line 3		____
10.	Breakeven change in price/unit		____

TABLE A.2--Continued

IV. Breakeven Purchase Price w/ Storage.

1. Price of grain w/o storage		______
2. - Operating cost per unit		______
3. - Change in net price/unit		______
4. = Breakeven price w/ storage/unit	=	______

V. Breakeven Price of Feed w/o storage.

1. Price of grain w/ storage		______
2. + Change in net price/unit	+	______
3. + Operating cost/unit		______
4. = Breakeven price of feed w/o storage	=	______

VI. Breakeven Months of Storage Capacity/YR.

1. Annual budgeted needs		______
2. x Change in net price/unit	x	______
3. - Total price of feed budgeted	-	______
4. Income gain w/ storage		______
5. x 12		______
6.	=	______
7. Annual budged needs		______
8. x Annual ownership costs		______
9. - Total ownership cost of grain	=	______
6 - 9 Breakeven months of storage capacity / yr.		______

Table A.3 Program Listing of Breakeven Analysis of Grain Storage.

#	STO	RCL	LBL	C	X
STO	6	3	C	LBL	RCL
1	RCL	X	RCL	D	9
#	3	1	4	RCL	-
STO	12	+	RCL	5	R/S
2	X	12	2	RCL	GTO
#	RCL	X	X	2	D
STO	6	STO	12	X	LBL
3	+	7	-	STO	E
#	RCL	RCL	STO	9	f
STO	5	5	8	RCL	REG
4	X	RCL	RCL	5	R/S
#	ENTER	4	1	RCL	f
STO	12	X	RCL	3	STK
5	-	g	RCL	X	
LBL	R/S	1/X	5	1	
A	GTO	RCL	-	CHS	
RCL	A	7	RCL	X	
4	LBL	X	8	RCL	
RCL	B	R/S	-	1	
2	RCL	GTO	R/S	+	
X	5	B	GTO	12	

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