Detailed Description of Polysim

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Table of Contents

Table of Contents (Continued)

Detailed Description of POLYSIM

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Policy analysis is a systematic appraisal of the implications of pursuing specified policy options.[1] The degree of sophistication of an analysis can span from statements indicating only directional changes to complex modeling efforts that provide detailed quantitative estimates of policy impacts. The National Agricultural Policy Simulator (POLYSIM) was developed to provide additional analytical capability for estimating the impacts of alternative agricultural policies.

POLYSIM was initially developed at Oklahoma State University in 1972. It has since been expanded and refined through cooperative agreements with the Commodity Economics Division, Economic Research Service, U. S. Department of Agriculture.

The simulator is designed to provide low cost, quick, yet extensive, analyses of agricultural policy proposals and economic environments. POLYSIM is capable of addressing a wide spectrum of policy issues. Furthermore, the types of questions most often asked by lawmakers and policy administrators can be answered without modification of the simulator. The effect of instituting a specified domestic grain reserve program or changes in target prices, allotted acreages, loan rates or set aside acreages on prices and incomes of individual agricultural sector as well as net farm income, government costs, and consumer food expenditures can be analyzed with the model.

The purpose of this bulletin is to document the economic logic and the empirical relationships used in POLYSIM. As background a general discussion of the model is presented prior to the detailed relationships.

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[1]Viewed in a broader context, policy analysis may include identification of the goals, purposes and principles that guide an institution as well as analyses of alternative actions relating to policy issues.

OVERVIEW OF THE MODEL

POLYSIM was constructed differently from most simulation models to ensure compatability with other policy analyses of the ERS. The model makes full use of forecast data as a reference baseline. Included are the five-year baseline projections of commodity supplies, prices, and utilization made by ERS. Commodity specialists develop these projections using formal and informal forecasting models tempered with their own experienced judgments. The projections contain explicit assumptions concerning the rates of change in population, per capita incomes, consumer preferences, export demand, technology (including crop yields and livestock gains), and other supply and demand shifters. These projections also assume a specific set of Government farm programs.

In most policy analyses, the basic supply and demand shifters remain unchanged. It is the policy related shifts and indirect economic responses through the price mechanism that count in analyzing the impacts of alternative policy proposals. POLYSIM simulates the effects of policy specifications that differ from those assumed in the baseline while holding all other supply and demand shifters the same. The model thus focuses on the interaction of supply and demand responses that result from specified changes in policy variables.

Commodity supply and demand elasticities represent an important part of POLYSIM. The driving forces in the model are the initial and subsequent changes in commodity prices resulting from changes in policy conditions. The magnitude of impact is determined by direct and cross supply and demand elasticities. The elasticities used in the model were developed in stages. Initially, a comprehensive literature review was made to gather past estimates of the required elasticities. Secondly, many of the elasticities were reestimated, using more recent data. Finally, to make the model more useful to ERS, commodity specialists reviewed the estimates, which had been categorized by commodity groups. The final revised estimates are used as default values in the model, but users can change any of the elasticities if they have better or more recent information. (Appendix A contains a complete description of the elasticities used in POLYSIM.)

Commodities included in the model are feed grains, wheat, soybeans, cotton, cattle and calves, hogs, sheep and lambs, chicken, turkeys, eggs, and milk. As indicated earlier, the model is designed to simulate around a set of baseline conditions. Base estimates must be available for all years analyzed in the simulated time frame. To date, most applications have been for a time horizon of three to five years.

The user starts a simulation by changing one or more of the policy assumptions used in the base conditions; for example, by using a different series of loan rates. The simulation procedure traces through the effects on production, price, utilization, and farm income for each of the eleven commodity groups and on agriculture in the aggregate. Elasticities are used to calculate new values for the endogenous variables as deviations away from the base values. To simulate a change in an endogenous variable such as feed grain acreage, the percentage change between simulated and base estimates for the expected price variables is multiplied by direct and cross price elasticities. This operation results in a percentage change in feed grain acreage which is used to obtain a simulated value under the new policy assumptions.

The calculation procedure used by POLYSIM is similar to the hand calculations an analyst might use to estimate the impact of a change in an economic variable. Suppose a previous analysis indicated that farmers would plant 110 million acres of feed grains given the expected price for feed grains and other assumed conditions. If an analyst were asked to estimate a new feed grain acreage assuming a 10 percent increase in feed grain price (ceteris paribus), he probably would use an estimate of the elasticity of feed grain acreage with respect to feed grain price in his calculations. Specifically he would determine the percentage change in feed grain acreage by multiplying the elasticity of feed grain acreage wrt feed grain price (say .1) times the percent change in price, i.e., 10 percent X .1 = 1 percent. To obtain the new level of feed grain acreage he would convert the percentage change in acreage to a decimal (.01), add it to 1.0 and multiply the result (1.01) times the initial feed grain acreage of 110. The estimated acreage would be 1.01 X 110 = 111.1.

POLYSIM uses this general calculation approach as is illustrated in the following example relationships for feed grain acreage and cattle and calf production. The percentage change in the left-hand variable calculated by the model is the sum of products of the elasticities and percentage changes in the right-hand variables (from their baseline values). The resulting percentage change in the left-hand variable is added to

Percentage Change In	Elasticity	Due to Percentage Change In
Feed Grain Acreage (t)	.10	Expected feed grain price (t)
	—.03	Expected wheat price (t)
	—.06	Expected soybean price (t)
Cattle and Calf Production (t)	.11	Cattle and calf price (t-1)
	—.02	Hog price (t-1)
	—.01	Sheep and lamb price (t-1)
	—.05	Feed grain price (t-1)

1.0 and multiplied by its base value. Although not included in the example, each quantity equation has a geometrically distributed lag structure to allow multi-period response to price.

The relationships and response variables used in the model appear in Figure 1, which also indicates POLYSIM's complexity. Values for items in rectangles without asterisks are calculated by the model in a fashion similar to the above example while values for items in rectangles with asterisks are introduced exogenously. Many of the exogenous variables are policy instruments; others are included to make the model complete. POLYSIM is recursive in the sense that estimates for variables made during the year simulated may be used as casual variables for succeeding relationships in the same year and in later years.

The model provides estimates of acreage, yield, production, variable expenses, total supply, price, commercial domestic demand, exports, carryover, cash receipts, and government payments for each of the four crops. It also gives estimates of production, market price, and cash receipts for each of the seven livestock categories. Estimates for the various commodity variables are summed and added to exogenous data for commodities not included in the model—to develop aggregate estimates of production expenses, government payments, gross income and realized net income.[2]

The flow of the computer program for POLYSIM is diagrammed in Figure 2. The program uses baseline data which the computer reads and retrieves from disk storage. The program also needs user-supplied information, which includes the number of years to be simulated, the beginning year, farm program options; optional information on policy variable levels, such as target prices, loan rates, and set-aside; and information to be predetermined from outside analysis that differs from the baseline, such as, exports, yields, imports, and harvested acres. Further information about data input needs can be found in Richardson and Ray [1975a, 1975b].

The model begins simulating for the first year by calculating livestock production and prices. Production levels are calculated for cattle and calves, hogs, sheep and lambs, chicken, turkeys, eggs, and milk. The next step is to use this production information and the import and export demand to compute the amounts of livestock products available for domestic consumption. The last step in this part of the model is to calculate the percentage change in livestock product availability. By using farm level, direct and cross price flexibilities, the current year's price for each of the livestock products can be estimated.

[2]It is assumed that the impact of policy changes on the exogenous commodities is not sufficient to significantly affect the aggregate variables at the national level.

As shown in Figure 2, use of the seven-block series following the livestock calculations determines crop supplies and production costs for each crop. The next two blocks represent current crop-year price and demand. The final six blocks within the model's simulation loop treat producers' costs, receipts, and income. Government payments depend on which farm program the user is simulating. Included are possible support payments based on the assumed target prices, market prices, and loan rates, and set-aside payments calculated as the product of acreage set-aside and the rate of government payment per acre. All such payments are summed to determine total government payments for the farm program simulated. Aggregate or national estimates are made for total receipts, realized gross income; crop expenses; protein, feed, roughage, and nonfeed costs for livestock; total variable costs; total production costs; and realized net farm income.

Organization of the Bulletin

The remainder of this bulletin is separated into three sections. A complete documentation of the economic logic and the empirical relationships used in POLYSIM are presented in the following section. A second section describes the operation of POLYSIM including work organization, data input, and data output. The third section presents information on making POLYSIM a stochastic simulator.

THE POLYSIM MODEL

The model is described in this section in three parts or segments. The first segment describes the livestock production and consumption activities in the model. The second segment details the crop production and consumption portion of the model. The concluding segment describes the accounting identities for developing aggregate income estimates. Each segment contains a description of the equations used to estimate the output variables, as well as, a discussion of the farm policy provisions or variables that influence the output variables.

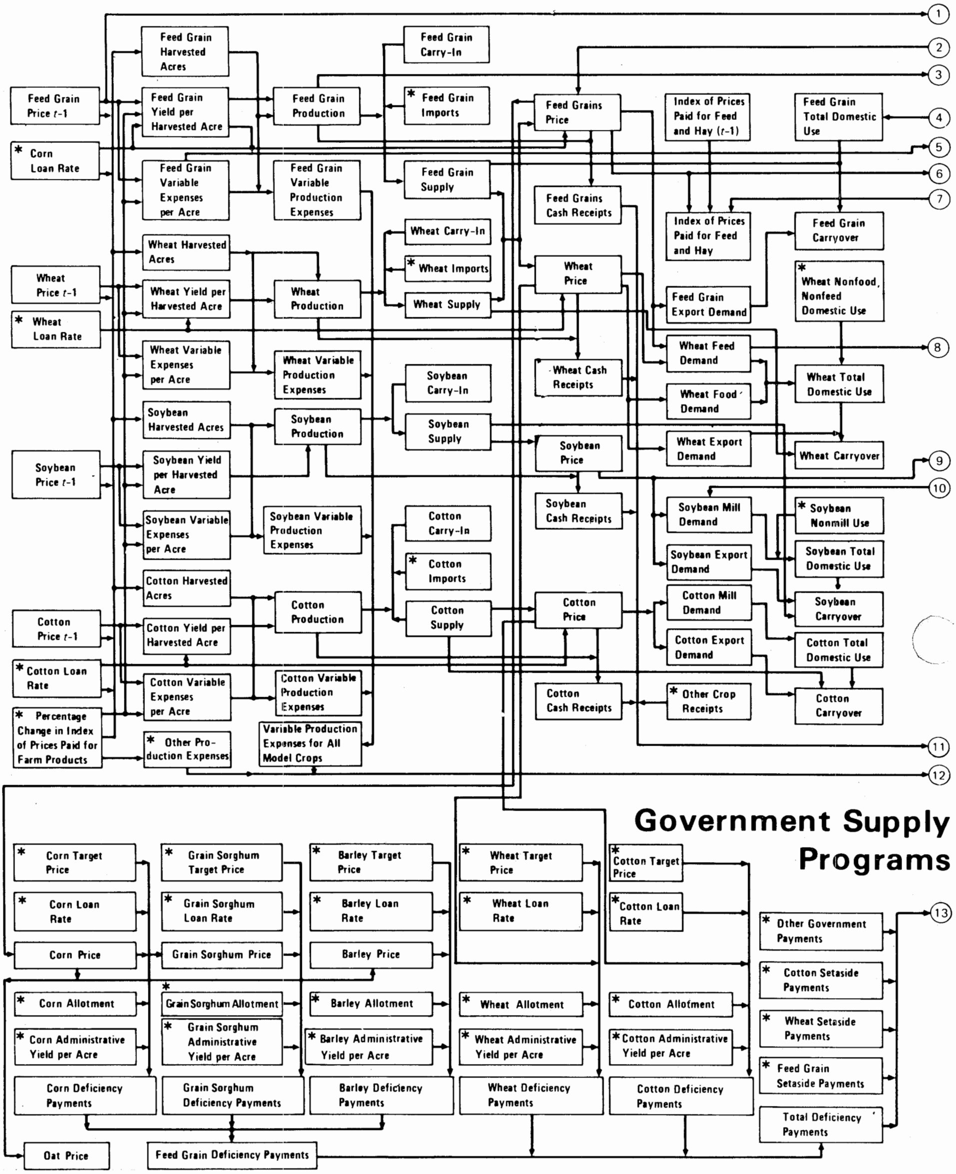
Livestock Production and Consumption

LIVESTOCK PRODUCTION

POLYSIM begins each simulation year by computing the level of production for each of the livestock categories. Production is measured in millions of pounds of carcass weight for cattle and calves, hogs, and sheep, and in millions of pounds of ready-to-cook weight for chickens and turkeys. Egg production is measured in millions of dozen and milk production is in terms of millions of pounds of milk equivalents.

SCHEMATIC DIAGRAM OF POLYSIM

Crops



Note: Dots on flow lines indicate lines connect.
Boxes with asterisk contain exogenous variables; Boxes without asterisk contain endogenous variables.

Figure 1.

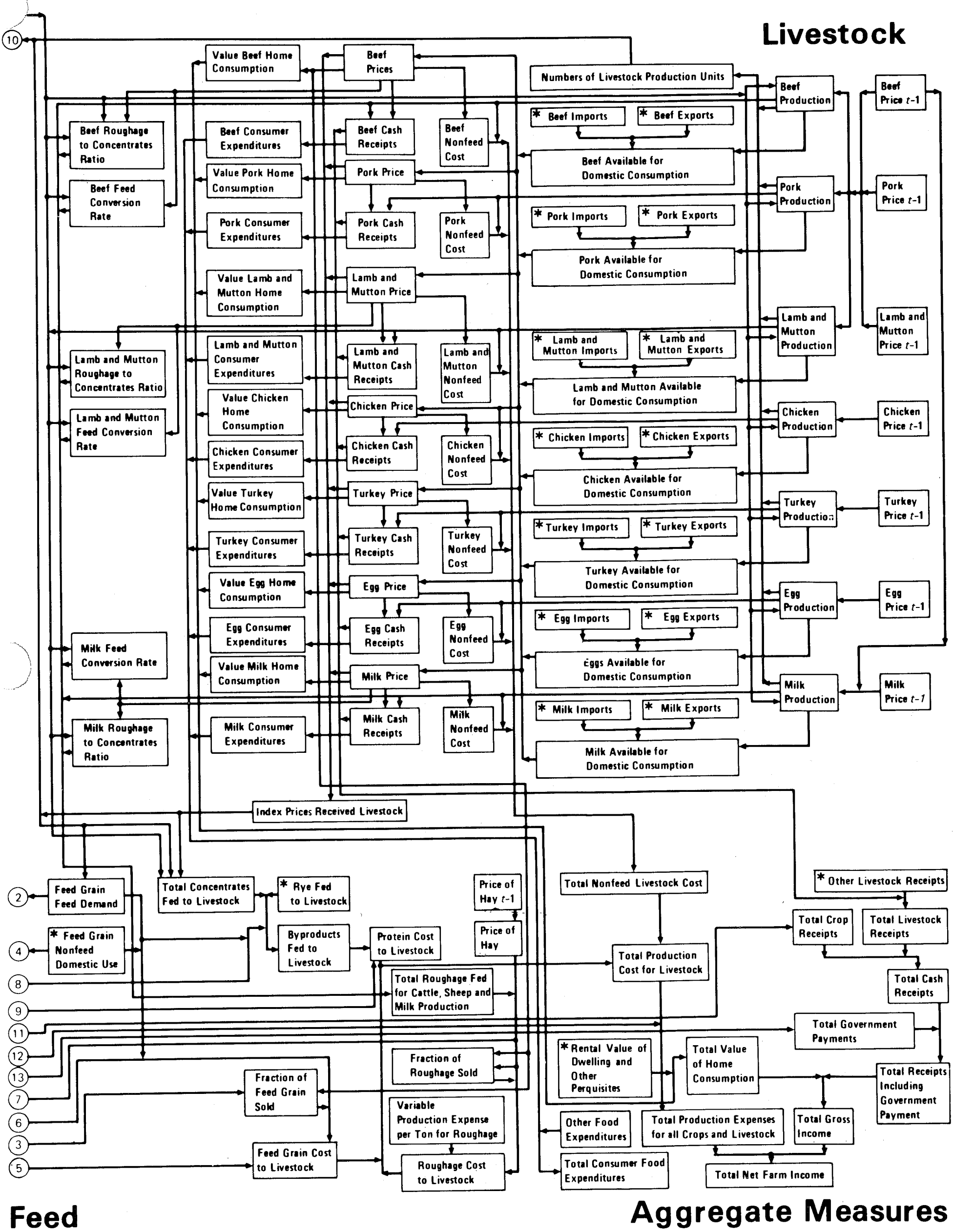
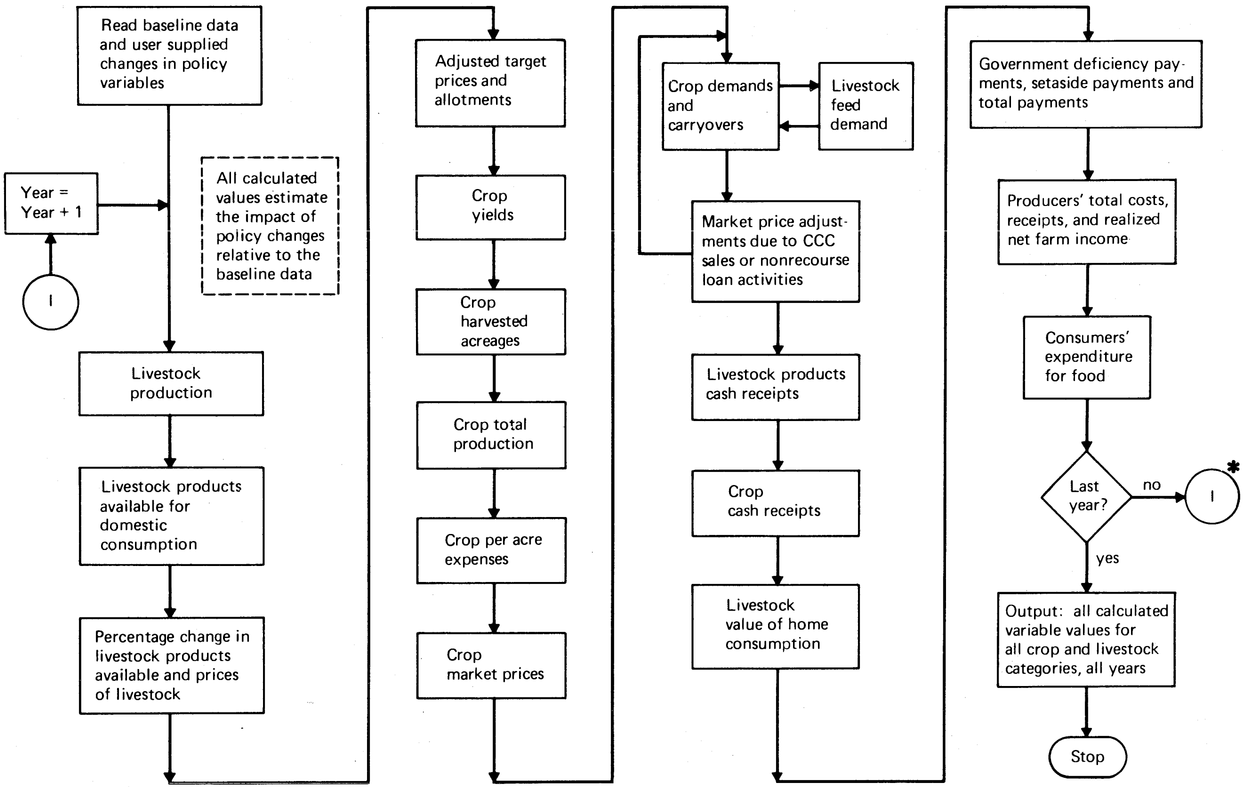


Figure 1. Continued.

Flow Chart of Computer Program for POLYSIM



* Note: The computer is instructed to return to the beginning of its program to simulate another year.

Figure 2

Following economic theory, the baseline value for each livestock group's production is adjusted up or down in response to changes in the expected price of the particular livestock group, and changes in expected price of feed. Specifically, the production of cattle and calves responds to expected changes in own price, hog price, milk price and the price of feed grains. Due to the time lag in the production process, previous year prices are used as the expected prices in determining production response. Hog and sheep production is dependent upon their own price, cattle and calf price and feed grain price. Broiler, turkey and egg production is a function of their own price and the price of feed grains. Milk production is a function of expected changes in own price, cattle and calf price and the feed grain price.

Livestock production values are computed by a single equation for each livestock category. The appropriate prices in the equation are related to the dependent variables (million pounds of production) through elasticities; the hog production equation (1) demonstrates the mechanics of associating the appropriate prices and elasticities.

$$\begin{aligned} &\text{Simulated Hog Prod. m. lbs.}_t = \text{Baseline Hog Prod. m. lbs.}_t * \Bigg[1.0 + \left\{ \text{elasticity hog prod. wrt hog price} * \text{\% change hog price from baseline}_{t-1} \right\} + \\ &\left\{ \text{elasticity hog prod. wrt cattle and calf price} * \text{\% change cattle and calf price from baseline}_{t-1} \right\} + \left\{ \text{elasticity of hog prod. wrt feed grain price} * \right. \\ &\left. \text{\% change feed grain price from baseline}_{t-1} \right\} \Bigg] + \left(1.0 - \text{long run adjustment factor} \right) * \left(\text{simulated hog prod.}_{t-1} - \text{baseline hog prod.}_{t-1} \right) \end{aligned} \qquad (1)$$

The interpretation of equation (1) is as follows. The estimated level of hog production is obtained by adjusting baseline hog production to reflect supply response from changes that may have occurred in lagged prices of hogs, cattle and calves and feed grains. The price changes are in terms of percent of baseline prices. The effect of each price change (say, price of hogs) on production is estimated as the product of the percentage change in price and the elasticity of hog production with respect to the price. The net first-year effect of all price changes on production is the sum of products of the percentage price changes and associated elasticities. This net first-year effect (expressed as a decimal) is added to one and multiplied times baseline hog production to obtain a new production level that is consistent with the prices. Since complete response to price change is not immediate but is distributed over a number of time periods, a geometrically distributed lag structure is also included. The level of hog production in year t will be influenced not only by changes in prices that occurred in t-1 but also in previous periods. The ratio of short-run to long-run elasticities is used to compute the Nerlovian adjustment coefficient for the distributed lag portion of the equation.

A numerical example may be helpful in understanding what takes place in equation (1).

$$15033.6 = 14700.0 * [1.0 + (0.30 * \frac{0.39 - 0.38}{0.38}) + (-0.04 * \frac{0.43 - 0.44}{0.44}) + (-0.25 * \frac{1.64 - 1.75}{1.75})] + (1.0 - 0.5) * (13380.0 - 13380.0)$$

In the example, hog price increases by one percent per pound from the baseline value of 38¢, cattle and calf price decreases one cent and corn price decreases eleven cents per bushel. The first year impact of these price changes is to adjust the baseline value for hog production up by 333.6 million pounds. If there are no price changes in the following year (t+1), the baseline production will be increased by 166.87 million pounds or (1.0 - 0.5)* (15033.6 - 14700.0), due to the lagged production response to the change in price in t.

The own and cross price elasticities for the livestock production equations are presented in Table 1. Each row of the table gives the default elasticities for the respective livestock production equation which follows the form of equation (1). For example, the cattle and calf production equation has an own supply elasticity of +.110, cross supply elasticities for hog price and sheep price of —.005 and —.001, respectively, and a supply elasticity with respect to feed grain price of —.050. The production equations for the red meat groups contain cross supply elasticities because of the possibility of substitution across these categories. On the other hand, the default cross elasticities of supply for the poultry categories are zero because the facilities and management for producing each poultry group is relatively specialized.

LIVESTOCK CONSUMPTION

The quantity of livestock available for domestic consumption is production plus imports minus exports. Imports and exports of livestock are exogenous to the system and as such, are held constant at baseline levels (unless livestock import or export programs are being investigated).[3] As the quantity of beef available for domestic consumption increases the price received by farmers for cattle and calves decreases, other things constant. For a disaggregated model, such as POLYSIM, it is not acceptable to compute prices for each livestock category without considering the

[3]It is assumed that ending year cold storage inventories are equal to beginning year inventories.

Table 1. Default Elasticities for Livestock Production.

Elasticity of	Cattle & Calf $Price_{t-1}$	Hog $Price_{t-1}$	Sheep $Price_{t-1}$	Chicken $Price_{t-1}$	Turkey $Price_{t-1}$	Egg $Price_{t-1}$	Milk $Price_{t-1}$	Feed Grain $Price_{t-1}$
Cattle & Calf $Production_t$	.110	—.005	—.001					—.070
	(.440)	(—.020)	(—.004)					(—.280)
Hog $Production_t$	—.040	.300	—.005					—.250
	(—.080)	(.600)	(—.010)					(—.500)
Sheep $Production_t$	—.010		.025					(—.040)
	(—.020)		(.050)					(—.080)
Chicken $Production_t$				.260				—.220
				(.364)				(—.358)
Turkey $Production_t$					.250			—.200
					(.425)			(—.340)
Egg $Production_t$						.100		—.060
						(.150)		(—.090)
Milk $Production_t$							.100	—.060
							(.250)	(—.150)

For the sources, see Appendix A, Section 1.
Long run elasticities are in parentheses beneath the respective short run elasticities.

other livestock categories. Economic theory and empirical findings [George and King, 1971; Brandow, 1961] indicate there is a significant cross price relationship between the major livestock categories. The Brandow and the George and King matrices of own and cross farm level price flexibilities for the seven major livestock categories are presented in Table 2. The matrix of price flexibilities provided by the Commodity Economics Division, ERS, USDA is also given in Table 2.

Livestock prices are computed using one of the price flexibility matrices and computed percentage changes in the quantity available for domestic consumption from their respective baseline values. The user must specify which of the farm level price flexibility matrices in Table 2 is to be used.[4]

In computing cattle and calf price, the first row of the selected price flexibility matrix is multiplied times the percentage change in the quantity available for domestic consumption for the corresponding commodity. The seven multiplication products are summed, added to 1.0, and the result is multiplied times the baseline cattle and calf price. Equation (2) displays the computation procedure.

$$\begin{aligned}\text{Simulated cattle and calf price}_t = {} & \text{Baseline cattle and calf price}_t * \Big[1.0 + \big(\text{own price flexibility for cattle and calves} * \text{\% change in cattle \& calves available from baseline}_t\big) \\ & + \big(\text{cross price flexibility for hogs} * \text{\% change in hogs available from baseline}_t\big) + \big(\text{cross price flexibility for sheep} * \text{\% change in sheep available from baseline}_t\big) \\ & + \big(\text{cross price flexibility for chicken} * \text{\% change in chicken available from baseline}_t\big) + \big(\text{cross price flexibility for turkey} * \text{\% change in turkey available from baseline}_t\big) \\ & + \big(\text{cross price flexibility for eggs} * \text{\% change in eggs available from baseline}_t\big) + \big(\text{cross price flexibility for milk} * \text{\% change in milk available from baseline}_t\big)\Big] \qquad (2)\end{aligned}$$

An equation similar to (2) is used to calculate the price received by farmers for each of the remaining six livestock categories. The percentage changes in quantities of all seven commodities are used for all price equations along with the appropriate row of the selected matrix. For example, if the Brandow matrix is selected (Table 2), the hog price equation would use —0.4180, the cross price flexibility of hog price to the quantity

[4]The CED matrix was developed by commodity analysts in CED, USDA to reflect the influence of grass fed beef on the market. The matrix is a hybrid of the Brandow matrix, the George and King matrix, and new coefficients for the cattle price flexibility wrt cattle available and for the chicken price flexibility wrt cattle availability.

Table 2. Three Sets of Demand Equations for Livestock and Livestock Products at the Farm Level, Expressing Prices as a Function of Quantity

Logs of Prices of	Cattle[2]	Hogs[2]	Sheep and Lambs[2]	Chickens[2]	Turkeys[2]	Eggs[3]	Milk[4]
			BRANDOW MATRIX[1] — Logarithm of Quantities of:				
Cattle[5]	—1.5862	—.2787	—.0363	—.1458	—.0248	—.0245	—.0283
Hogs[5]	—.4180	—2.3269	—.0478	—.1929	—.0331	—.0351	—.0407
Sheep and Lambs[5]	—.5026	—.4460	—.4832	—.1917	—.0317	—.0212	—.0243
Chickens[5]	—.4750	—.4205	—.0450	—1.4907	—.1375	—.0301	—.0347
Turkeys[5]	—.3112	—.2757	—.0295	—.5364	—1.1332	—.0265	—.0307
Eggs[6]	—.1018	—.0856	—.0068	—.0348	—.0087	—3.5000	—.0648
Milk[7]	—.0506	—.1189	—.0033	—.0172	—.0043	—.0230	—2.6390
			GEORGE AND KING MATRIX[1] — Logarithm of Quantities of:				
Cattle[5]	—2.3946	—.9051	—.0746	—.2716	—.0268	—.0270	—.0271
Hogs[5]	—.7184	—4.7626	—.1231	—.2774	—.0296	—.0693	—.0696
Sheep and Lambs[5]	—.5845	—.6916	—.6673	—.3299	—.0303	—.0420	—.0422
Chickens[5]	—.9064	—.9825	—.0936	—1.8671	—.1011	—.0471	—.0472
Turkeys[5]	—.4315	—.5858	—.0416	—.5120	—.7962	—.0207	—.2708
Eggs[6]	—.2683	—.4699	—.0262	—.0926	—.0163	—4.3350	—.4316
Milk[7]	—.0884	—.1313	—.0089	—.0282	—.0060	—.1750	—3.1801
			CED LIVESTOCK MATRIX[1] — Logarithm of Quantities of:				
Cattle[5]	—1.6446	—.9051	—.0746	—.2715	—.0268	—.0269	—.0271
Hogs[5]	—.7184	—2.3269	—.0478	—.1929	—.0331	—.0351	—.0407
Sheep and Lambs[5]	—.5026	—.4460	—.4832	—.1917	—.0317	—.0212	—.0243
Chickens[5]	—.7750	—.4205	—.0450	—1.4907	—.1375	—.0301	—.0347
Turkeys[5]	—.4612	—.2757	—.0295	—.5364	—1.1312	—.0265	—.0307
Eggs[6]	—.2684	—.4699	—.0262	—.0826	—.0164	—4.3350	—.4316
Milk[7]	—.0885	—.1313	—.0089	—.0282	—.0060	—.1750	—3.1801

[1]Source: For the sources, see Appendix A, Section 2.
[2]Million pounds slaughtered.
[3]Million dozen sold.
[4]Million hundred weight sold.
[5]Dollars per pound.
[6]Dollars per dozen.
[7]Dollars per hundredweight.

of beef available, —2.3269, the own price flexibility of hog price, and so on.

Estimated livestock prices for period t are used to compute livestock cash receipts in period t and the livestock demand for feed grains in t. These t period prices are also used to estimate livestock production in the following period (t+1). The livestock cash receipts equations are discussed in a later section.

INDICES OF THE LIVESTOCK SECTOR

POLYSIM provides estimates of the total number of livestock production units (grain-consuming animal units) and the index of prices received for livestock products as well as production and price estimates for the seven major livestock categories. Livestock production units is an index series relating the number of livestock and poultry fed on farms during a given year to the feeding requirements of each major livestock category, in terms of different grains, high protein feeds and roughages [USDA, 1970]. Grain consuming animal units are of particular interest in the POLYSIM model.

The baseline level of livestock production units is modified if production in any of the seven livestock categories is different from their respective baseline levels. The factors which are applied to the difference between the baseline and calculated production levels are the same as those used by the USDA to construct the baseline livestock production units series [USDA, 1975]. Equation 3 illustrates the computation procedure.

$$
\begin{aligned}
\text{Calculated livestock production units}_t = {} & \text{Baseline livestock production units}_t \\
& + \left\{ \left(\text{calculated beef production}_t - \text{baseline beef production}_t \right) * \text{beef weight in livestock production units} \right\} \\
& + \left\{ \left(\text{calculated hog production}_t - \text{baseline hog production}_t \right) * \text{hog weight in livestock production units} \right\} \\
& + \left\{ \left(\text{calculated sheep production}_t - \text{baseline sheep production}_t \right) * \text{sheep weight in livestock production units} \right\} + \cdots\cdots \\
& + \left\{ \left(\text{calculated milk production}_t - \text{baseline milk production}_t \right) * \text{milk production weight in livestock production units} \right\}
\end{aligned}
\qquad (3)
$$

The index of prices received for livestock and livestock products is calculated in the model as an adjustment in the baseline index number for changes in the calculated prices received for livestock from their respective baseline values (4).

$$\text{Calculated index of prices received for livestock}_t = \text{Baseline index of prices received for livestock}_t * \left[1.0 + \left(\text{cattle and calves weight in the index} * \text{\% change in cattle and calves price from baseline}_t\right) + \left(\text{hogs weight in the index} * \text{\% change in hog price from baseline}_t\right) + \ldots\ldots + \left(\text{milk prices weight in the index} * \text{\% change in milk price from baseline}_t\right)\right] \tag{4}$$

The sum of the weighted percentage changes in livestock prices is multiplied by the baseline index number to get a calculated index number. The baseline index number implicitly contains the baseline prices received for each of the seven livestock categories and prices received for all other livestock products. By assuming that the prices of all other livestock products remain fixed at their baseline levels, the calculated index number need only be adjusted for relative changes in the prices of the seven livestock categories in the model. The weights for the individual livestock categories are used in (4) to appropriately weight the change in prices.

Crop Production and Utilization

CROP PRODUCTION

The crop production section of POLYSIM includes equations for estimating harvested acreage, yield, and variable production expense per harvested acre for each of the four crops in the model (feed grains, wheat, soybeans, and cotton). Crop production is computed as the product of yield and harvested acreage. Feed grain production is in terms of million tons, while wheat and soybeans are in terms of million bushels. Cotton production is measured in millions of net bales.

Harvested Acreage

To estimate the harvested acreage for each crop, the baseline harvested acreage value is adjusted for farmer response to changes in expected crop prices from their respective baseline levels. Percentage changes in crop price and prices of the other three crops are weighted by the direct and cross supply elasticities to arrive at the percentage adjustment in the base acreage value. An example of the calculation approach is given by equation (5) for feed grain harvested acreage.

$$\begin{aligned}&\text{Simulated feed grain harvested acreage m. acres}_t = \text{Baseline feed grain harvested acreage m. acres}_t * \Bigg[1.0 + \left(\text{elasticity of fg acreage wrt fg price}\right) * \\ &\left(\text{\% change fg price from baseline}_{t-1}\right) + \left(\text{elasticity of fg acreage wrt wheat price}\right) * \left(\text{\% change wheat price from baseline}_{t-1}\right) + \left(\text{elasticity of fg acreage wrt soybean price}\right) * \\ &\left(\text{\% change soybean price from baseline}_{t-1}\right) + \left(\text{elasticity of fg acreage wrt cotton price}\right) * \left(\text{\% change cotton price from baseline}_{t-1}\right)\Bigg] + \\ &\left(1.0 - \text{long run adjustment factor}\right) * \left(\text{calculated fg acreage}_{t-1} - \text{baseline fg acreage}_{t-1}\right)\end{aligned} \quad (5)$$

Equations similar to (5) are used to estimate harvested acreage for wheat, soybeans, and cotton. Lagged crop prices are used as expected price in the acreage equations. If the current year loan rate is greater than the previous year's crop price and the loan rate has been provided by the user, the loan rate is used as the expected price in equation (5) for the calculation of harvested acreage. As will be seen in following sections, the user provided loan rate also serves as the expected price if it is greater than lagged crop price in the yield and per acre variable production expense equations. This practice has been adopted because if loan rates exceed the previous year crop price the loan rate is the marginal value of output for planting and input use decisions. This feature allows the user to simulate the impacts of loan rates which exceed the expected market price on crop acreage, production and income.

Including the price of other crops in the harvested acreage equation (5) allows substitution of one crop for another in response to changes in relative prices. Assuming a homogeneous acreage response function of degree zero, an equal increase in the expected price of all crops and input prices should have no effect on the mix of crops grown; while a change in the expected price of only one crop would, of course, affect the crop mix. The elasticities used in the four acreage equations (5) approximate homogenity of degree zero (Table 3). The own acreage elasticity for feed grains is .10 in the short run and .15 in the long run while the cross elasticities with respect to wheat, soybeans, and cotton prices are —.03, —.06, and —.01, respectively (Table 3).

Acreage Set-Aside

Adjustments to acreage levels for simulating land diversion or set-aside are made before computing acreage response to change in relative crop prices. The procedure for accounting for set-aside is different from

Table 3. Direct and Cross Acreage, Yield, and Supply Elasticities.

	Feed Grains Price_{t-1}	Wheat Price_{t-1}	Soybean Price_{t-1}	Cotton Price_{t-1}
Soybean acreage	—.15 (—.187)	—.02 (—.024)	.25 (.312)	—.03 (—.037)
Feed grains acreage	.10 (.15)	—.03 (—.045)	—.06 (—.09)	—.01 (—.015)
Wheat acreage	—.03 (—.06)	.10 (.20)	—.02 (—.04)	—.01 (—.02)
Cotton acreage	—.05 (—.10)	—.01 (—.02)	—.10 (—.20)	.30 (.60)
Feed grain yield	.10 (.20)			
Wheat yield		.05 (.10)		
Soybean yield			.10 (.20)	
Cotton yield				.15 (.20)

For the sources, see Appendix A, Section 3.
Long run elasticities are in parentheses beneath the respective short run elasticity.

the normal calculation approach used by POLYSIM. If the general POLYSIM calculation approach were used, a mathematical formulation to account for changes in set-aside from the level assumed in the baseline would appear at the end of equation (5). However, farmer adjustment in acreage as a result of set-aside programs is made completely during the crop year. There is no multi-year distributed lag in crop acreage response to set-aside. Hence, if the set-aside computation were tacked onto equation (5) which includes a distributed lag structure, set-aside announced in year t would affect acreage in year t+1 even though the government enacted no set-aside program for year t+1. To get around this problem, the baseline harvested acreage is modified so as to include the effect of the user specified level of set-aside. This acreage value becomes the "new" baseline acreage which is used in equation (5) to compute harvested acreage.

The computational procedure is to first add the set-aside that was assumed in the original baseline to the original baseline value of harvested acreage and then subtract the set-aside specified by the user. Historically, however, not all acreage declared as set-aside would have been harvested even without the set-aside program. Some acreages in flood prone areas, on unproductive hilltops or in fallow are designated as set-aside areas. This slippage, or lack of complete effectiveness of set-aside in reducing harvested acreage, is taken into account in the computations. The rate of slippage, or percent slippage converted to a decimal, is user controlled. Equation (6) demonstrates the procedure for modifying baseline feed grain harvested acreage for set-aside. Similar relationships are included for wheat and cotton.

$$\text{Calculated harvested acreage for } fg_t = \text{Baseline harvested acreage for } fg_t + \left\{ \text{baseline acreage set-aside for } fg_t * \left(1.0 - \text{baseline fg slippage rate}_t\right) \right\} - \left\{ \text{user supplied acreage set-aside for } fg_t * \left(1.0 - \text{user supplied fg slippage rate}_t\right) \right\} \qquad (6)$$

Yield Per Harvested Acre

Yield per harvested acre is measured in tons for feed grains, bushels for wheat and soybeans, and pounds of lint for cotton. Each crop yield is estimated by adjusting the baseline value for yield up or down, in response to differences in the expected crop price from the baseline price. If the expected price is higher than the baseline price, more inputs, such as fertilizer, will be applied per acre which will increase yield per harvested acre. The four yield equations are of the form shown in equation (7) for feed grain yield. Lagged crop price is used as the expected price. (When the user provided loan rate in t is greater than lagged crop price, the loan rate is used as the expected price.) The distributed lag adjustment coefficient is included in each equation to allow multi-period adjustment in yields to a price change.

$$\text{Simulated fg yield ton/acre}_t = \text{Baseline fg yield ton/acre}_t * \left[1.0 + \left(\text{elasticity of fg yield wrt fg price} * \text{\% change fg price from baseline}_{t-1}\right) + \left(\text{elasticity of fg yield wrt cost of production} * \text{\% change in prices paid for inputs from baseline}_{t-1}\right)\right] + \left(1.0 - \text{long run adjustment factor}\right) * \left(\text{calculated yield}_{t-1} - \text{baseline yield}_{t-1}\right) \qquad (7)$$

The baseline is developed assuming a specific rate of increase in input prices. By including the input price variable in the yield equation, the crop yields can respond to modifications of the inflation rate for inputs from the baseline rate of inflation. The default elasticity of yield with respect to the cost of production is —.10 for all four crops. The yield equation could be expanded to incorporate the relationship between yield and the number of harvested acreage for a particular crop, if the response parameters were available.

The default own yield elasticities for the crops in the model are in Table 3. The short run yield elasticity for feed grains is .10 and its long run elasticity is .20 (Table 3). For a detailed discussion of the source of these parameters, see Appendix A, Section 3.

Production

Once harvested acreage and yield per harvested acre have been estimated, the total production for the crop is simply the product of the acreage and yield. For feed grains the equation for total production is (8). The total production equation for wheat, soybeans, and cotton follow the same general form as equation (8).

$$\begin{matrix}\text{Simulated fg} \\ \text{production} \\ \text{m. ton}_t\end{matrix} = \begin{matrix}\text{Simulated} \\ \text{fg acreage} \\ \text{m. acres}_t\end{matrix} * \begin{matrix}\text{Simulated} \\ \text{fg yield} \\ \text{ton/acre}_t\end{matrix} \qquad (8)$$

Supply

The total supply of a particular crop is the sum of production, imports and stocks on hand at the beginning of the crop year. Total crop production comes from equation (8), imports are exogenous and the value of stocks on hand for time period t, are the ending year stocks in time period t-1 or the carryin for period t. For feed grains the total supply equation is (9).
The total supply for the other three crops in the model follow the same form as equation (9).

$$\begin{matrix}\text{Simulated} \\ \text{fg supply} \\ \text{m. tons t}\end{matrix} = \begin{matrix}\text{Simulated fg} \\ \text{production} \\ \text{m. tons t}\end{matrix} + \begin{matrix}\text{Exogenous} \\ \text{fg imports} \\ \text{m. tons t}\end{matrix} + \begin{matrix}\text{Carryin} \\ \text{of fg} \\ \text{m. tons t}\end{matrix} \qquad (9)$$

Crop Production Expense

The final set of equations in the crop production section of the model calculate the variable production expense per harvested acre. As the per unit prices of inputs increase, the cost of a given level of input usage per acre increases. Economic theory suggests that the quantity of inputs used per acre is inversely related to the price of the input and positively related to the price of the output. The variable expense per acre relationships allow for changes in per acre expense due to input response to changing crop prices as well as for the change in outlay per unit from changes in input price. The feed grain variable production expense equation (10) is typical of the equation used for all four crops in the model.

$$\begin{pmatrix}\text{Simulated fg}\\ \text{variable prod}\\ \text{expense/acre}_t\end{pmatrix} = \begin{pmatrix}\text{Baseline fg}\\ \text{variable prod}\\ \text{expense/acre}_t\end{pmatrix} * \left[1.0 + \begin{pmatrix}\text{elasticity of fg}\\ \text{expense per acre}\\ \text{wrt fg price}\end{pmatrix} * \begin{pmatrix}\text{\% change fg}\\ \text{price from}\\ \text{baseline}_{t-1}\end{pmatrix} + \begin{pmatrix}\text{elasticity of fg}\\ \text{expense per acre}\\ \text{wrt prices paid}\end{pmatrix} * \begin{pmatrix}\text{\% change prices}\\ \text{paid from}\\ \text{baseline}_{t-1}\end{pmatrix}\right] + \left(1.0 - \begin{matrix}\text{adjustment}\\ \text{coefficient}\end{matrix}\right) * \begin{pmatrix}\text{simulated fg}\\ \text{variable prod}\\ \text{expense/acre}_{t-1}\end{pmatrix} - \begin{pmatrix}\text{baseline fg}\\ \text{variable prod}\\ \text{expense/acre}_{t-1}\end{pmatrix} \quad (10)$$

The lagged crop prices are used as the expected prices for equation (10). (When the loan rate is greater than lagged crop price, the loan rate is used as the expected price.) A distributed lag adjustment coefficient is used in equation (10) to allow for multi-period adjustments to changes in prices. Equation (10) can be expanded to include the relationship between the number of harvested acres and the level of production expenses when the parameters become available.

The own elasticities of variable per acre production expense for the crops in POLYSIM are presented in Table 4. The elasticity of crop expense per acre with respect to the prices paid index is also presented in Table 4. The sources of these elasticities are discussed in Appendix A, Section 3.

Total variable production expense for each of the model crops is calculated as the product of the number of harvested acres and variables production expense per acre. The feed grain equation for total variable production expense (11) is typical of the four crop equations in the model.

$$\begin{matrix}\text{Simulated fg}\\ \text{total variable}\\ \text{prod expense}_t\end{matrix} = \begin{matrix}\text{Simulated}\\ \text{fg harvested}\\ \text{acreage}_t\end{matrix} * \begin{matrix}\text{Simulated fg}\\ \text{variable prod}\\ \text{expense/acre}_t\end{matrix} \quad (11)$$

CROP PRICES

Following Wold [1960, 1964], POLYSIM uses a recursive interpretation of supply, price and demand determination for agricultural crops. As has been discussed in earlier sections, current year production is a function of previous year prices and applicable federal farm policy provisions. After the current year crop has been produced, supply is essentially perfectly inelastic. Current year price is determined by the intersection of the perfectly inelastic supply curve and the expected demand curve. The quantity demanded is then a function of the crop price.

Table 4. Elasticity of Variable Production Expense For Model Crops.

Elasticity of variable production expense$_t$	Feed Grain Price$_t$	Wheat Price$_t$	Soybean Price$_t$	Cotton Price$_t$	Index of Prices Paid$_{t-1}$
Feed grains wrt	0.100				1.00
	(0.225)				(1.50)
Wheat wrt		0.050			1.00
		(0.150)			(1.50)
Soybeans wrt			0.100		1.00
			(0.225)		(1.50)
Cotton wrt				0.150	1.00
				(0.225)	(1.50)

For the sources refer to Appendix A, Section 3.
Long run elasticities are in parentheses beneath the respective short run elasticity.

If the estimated crop supply is the same as the baseline crop supply the estimated price will be the same as the baseline price. If, on the other hand, estimated supply varies from the baseline supply, that is, there is a shift in the perfectly inelastic supply curve, the baseline price must be adjusted to reflect the new intersection of the supply and expected demand curves. The adjustment to the baseline price is computed as the product of the percentage change in supply from the baseline level and the inverse of the demand elasticity or price flexibility for the crop.

The expected demand includes, of course, export demand as well as various domestic demands. In POLYSIM the baseline total demand is the expected demand. Given the prominance of sharp shifts in export demand in recent years, the price relationships are specified to allow the user to predetermine export demand and therefore shift the expected demand curve. Hence, a set of terms is included in the crop price equations to account for shifts in expected demand.

The feed grain price equation (12)is typical of the price equations for the model crops.

$$\begin{aligned}\text{Calculated fg price \$/ton}_t = {} & \text{Baseline fg price \$/ton}_t * \Bigg[1.0 + \text{price flexibility of feed grains} * \Bigg\{\Bigg(\Big(\text{simulated feed grain supply}_t \\ & - \text{baseline feed grain supply}_t\Big) - \Big(\text{expected feed grain demand}_t - \text{baseline feed grain demand}_t\Big)\Bigg) \div \text{baseline feed grain supply}_t\Bigg\}\Bigg]\end{aligned} \quad (12)$$

Feed grain price is in \$ per ton units, wheat and soybeans are in \$ per bushel units, and cotton is in \$ per pound units. The default price flexibilities for the model crops are in Table 5.

Table 5. Own Price Flexibility Schedules for Feed Grains, Wheat, Soybeans and Cotton.

Feed Grains	Own Price Flexibility
relative coverage[1] $<$ 0.05	—6.00
0.05 $\geq$ relative coverage $<$ 0.10	—4.00
0.10 $\geq$ relative coverage $<$ 0.20	—3.50
0.20 $\geq$ relative coverage $<$ 0.30	—2.00
0.30 $\leq$ relative coverage	—1.00
Wheat	
relative coverage $<$ 0.10	—6.00
0.10 $\geq$ relative coverage $<$ 0.15	—4.00
0.15 $\geq$ relative coverage $<$ 0.20	—3.00
0.20 $\geq$ relative coverage $<$ 0.30	—2.40
0.30 $\geq$ relative coverage $<$ 0.50	—2.00
0.50 $\geq$ relative coverage $<$ 0.60	—1.50
0.60 $\geq$ relative coverage	—1.00
Soybeans	
relative coverage $<$ 0.033	—6.00
0.033 $\geq$ relative coverage $<$ 0.066	—4.00
0.100 $\geq$ relative coverage $<$ 0.150	—2.50
0.150 $\geq$ relative coverage $<$ 0.200	—2.00
0.200 $\geq$ relative coverage	—1.75
Cotton	
relative coverage $<$ 0.15	—5.00
0.15 $\geq$ relative coverage $<$ 0.20	—4.00
0.20 $\geq$ relative coverage $<$ 0.25	—3.00
0.25 $\geq$ relative coverage $<$ 0.35	—2.25
0.35 $\geq$ relative coverage $<$ 0.55	—1.75
0.55 $\geq$ relative coverage	—1.00

For the sources, see Appendix A, Section 4.

[1]Relative coverage is the expected ending year carryover expressed as a percent of expected total utilization. In the model, relative coverage =

$$\frac{\text{calculated supply}_t - (\text{baseline or expected demands}_t)}{\text{baseline or expected demands}_t}$$

so as the fraction gets small the ending year carryover is small relative to demands and vice versa.

The estimated per bushel prices for the separate feed grains, corn, grain sorghum, barley and oats are computed from estimated feed grain price. Corn price is calculated by equation (13).

$$\begin{aligned}\text{Calculated corn price \$/bu.}_t = {} & \text{Calculated fg price \$/ton}_t \div \Bigg[35.714 * \Bigg\{\left(\text{percent of corn in feed grains}\right) + \left(\text{percent of grain sorghum in feed grains} * \text{grain sorghum nutrient equivalence to corn}\right) \\ & + \left(\text{percent of barley in feed grains} * \text{barley nutrient equivalence to corn}\right) + \left(\text{percent of oats in feed grains} * \text{oats nutrient equivalence to corn}\right)\Bigg\}\Bigg]\end{aligned} \tag{13}$$

To obtain equation (13), the relationship used by the USDA to compute feed grain price based on the prices, corn nutrient equivalences, the mix of the four separate grains was solved in terms of corn price. The constant 35.714 converts bushels to tons. The same proportional relationships between the baseline corn price and the baseline prices of grain sorghum, barley, and oats are used to compute the estimated prices for each of the minor feed grains. An equation similar to the oat price equation (14) is used to estimate the price for barley and grain sorghum.

$$\text{Calculated oat price \$/bu.}_t = \frac{\text{Baseline oat price \$/bu.}_t}{\text{Baseline corn price \$/bu.}_t} * \text{Calculated corn price \$/bu.}_t \tag{14}$$

Generally the prices differ by the feeding value of oats, barley, and grain sorghum relative to corn.

Government Price Supports

Non-recourse Commodity Credit Corporation (CCC) loans and direct government grain purchases have been part of farm program legislation since the 1930's. At the user's option, POLYSIM will simulate the support of crop prices at levels specified by the user. (Coding the "Farm Policy Card" for activating price supports is described in the POLYSIM User's Manual [Richardson and Ray, 1975a].) The crop price is calculated as usual based on the prevailing supply and demand conditions by equation (12). Price support action is taken only if the estimated price is less than the support price or loan rate. When the market price is less than the support price (or loan rate), the model computes the quantity of grain or fiber that must be diverted from the market to raise the average market price to the loan rate.

A typical equation for computing the quantity of grain that must be put under CCC loan or diverted from the market to support the market price with the loan rate is illustrated in equation (15).

$$\begin{array}{l}\text{Quantity of}\\ \text{wheat in CCC}\\ \text{loan program}\end{array} = \begin{array}{l}\text{Calculated}\\ \text{supply of}\\ \text{wheat}_t\end{array} * \left[\left(1.0 - \frac{\text{New wheat price}_t}{\text{calculated wheat market price}_t}\right) \div \begin{array}{l}\text{wheat own}\\ \text{price}\\ \text{flexibility}\end{array}\right] \tag{15}$$

The formulation in the inner parentheses computes the percentage increase in the market price that is required to reach the support price or loan rate. The percent increase in price (with sign changed) is divided by the price flexibility of demand for crop to compute the percent reduction in supply that would make the market clear at the higher market price. This computation is equivalent to multiplying the percent change in price times the overall elasticity of demand for the crop. Hence, the equation determines the length of movement up the demand curve or equivalently the leftward shift in the perfectly inelastic short run supply curve that would result in the market price being equal to the loan rate.[5] The calculated reduction in supply is the quantity of stocks that must be diverted from the market. The market price is set equal to the support price and the model proceeds to the crop demands section.

The CCC has always had some provision for releasing accumulated stocks in the market when the average market price exceeded the loan rate by a certain percentage. In the model, CCC loans are released to the market when the average market price, calculated by equation (12), is 50 percent greater than the loan rate. Stocks owned by the CCC are released to the market when market price exceeds loan rates by 75 percent. (Other release policies have been programmed by user specified options and are described in the POLYSIM User's Manual [Richardson and Ray, 1975a].) The quantity of stocks released by the CCC (in loan or owned by the government) are calculated by equation (16).

Equation (16) calculates the amount of stocks that the CCC can release without lowering the average market price below the release price. The average market price for the crop is set equal to the release price and the quantity of stocks held by the CCC in loan or owned are reduced by

[5]The program can be easily modified so market price is increased to user specified percentage of the support rate based on an assumed participation rate A substitute set of subroutines are also available that estimates equanities in CCC loan, quantities redeemed and quantities added to government stock. Variable length of CCC loans are allowed with this approach. An application of this set of computations can be found in [Erickson, Ray, and Richardson, 1976].

$$\text{Quantity of wheat stocks to release from CCC stocks}_t = \text{Calculated wheat supply}_t * \left[\left(1.0 - \frac{\text{wheat release price}_t}{\text{calculated wheat market price}_t}\right) \div \text{wheat own price flexibility}\right] \quad (16)$$

the amount of the stock release. The model then proceeds to the domestic demand equations with the revised market price for the particular crop.

The costs to the Commodity Credit Corporation for holding stocks of grains and cotton are calculated by the model. The total costs for holding government owned stocks include the interest charge for the average value of stocks held, the in and out charge for entering the market, the storage cost for physical storage of a commodity, and the net profit or loss from the release of stocks. The total costs to the government for holding CCC loans is zero since the farmer who owns the commodity pays the storage costs, and in and out charge, the interest and stands to make a profit or loss.

CROP DEMANDS

As indicated earlier the structure of agricultural crop supply, price and demand tend to be recursive in nature. Ceteris paribus supply is a function of previous year price, price is determined by the level of supply relative to expected demand and actual quantity demanded is a function of price (and other variables). Hence a simplified causation diagram would appear as:

$$\text{Price}_{t-1} \longrightarrow \text{Quantity Supplied}_t \longrightarrow \text{Price}_t \longrightarrow \text{Quantity Demanded}_t$$

In general, the domestic and export crop demand equations use changes in current year price from the baseline price and elasticities of demand to compute new quantities demanded. In the equations that follow this approach, it is assumed that demand shifters (population, per capita incomes, etc.) are unchanged from those implicit in the baseline demand quantities.

However, in the case of livestock feed demands, the price of livestock, substitute feed prices and other demand shifters determined within the agricultural economy do not necessarily remain at levels implicit in the baseline. Hence, the various livestock feed demand relationships are structured to include the impact of changes in demand shifters as well as the feed's own price. These relationships for estimating livestock feed demands are presented first. The domestic and export demand relationships which assume no changes in the demand shifters from the baseline follow the subsections on feed demand.

Feed Grain Feed Demands

Domestic demands for feed grains and by-products (protein) as livestock feed are calculated as a derived demand based on livestock production, livestock prices and the price of feed grains and soybean meal. The procedure is a multi-step method that is repeated for each of the seven livestock categories in the model and results in values for feed grains demanded by each livestock group. The equations follow the structure reported by Richardson and Ray [1977].

The five equations used to estimate feed grain demand for hogs are presented here to illustrate the procedure. The first step is to calculate the concentrate feed conversion rate, defined as the pounds of concentrates fed per pound of liveweight production.[6] The baseline concentrate feed conversion rate (equation 17) is adjusted up or down depending upon changes in the own livestock price and the price of feed grains and soybean meal.[7]

$$\begin{pmatrix}\text{Calculated concen-}\\ \text{trate feed conver-}\\ \text{sion rate for hogs}_t\end{pmatrix} = \begin{pmatrix}\text{Baseline feed}\\ \text{conversion}\\ \text{rate for hogs}_t\end{pmatrix} * \left[1.0 + \begin{pmatrix}\text{elasticity of feed}\\ \text{conversion rate}\\ \text{wrt hog price}\end{pmatrix} * \begin{pmatrix}\text{\% change hog}\\ \text{price from}\\ \text{baseline}_t\end{pmatrix} + \begin{pmatrix}\text{elasticity of feed}\\ \text{conversion rate}\\ \text{wrt fg price}\end{pmatrix} * \begin{pmatrix}\text{\% change fg}\\ \text{price from}\\ \text{baseline}_t\end{pmatrix}\right] \quad (17)$$

If the simulated price of hogs is higher than the baseline value, the concentrate feed conversion rate will increase whereas if the feed grain or soybean meal prices are higher than their baseline value the feed conversion rate will decrease. The price elasticities for concentrate feed conversion rates in (17), for the livestock categories in POLYSIM are in Table 6.

The second step is to compute the quantity of concentrates demanded that is consistent with the calculated feed conversion rates and the calculated livestock production. Multiplying the concentrate feed conversion

[6]Concentrates fed to livestock and poultry includes corn, sorghum, barley, oats, wheat, rye, oilseed meal, animal protein feeds, and other by-product feeds. For POLYSIM, wheat has been subtracted out of concentrates feed and is treated as a separate domestic demand for wheat.

[7]Soybean meal price is estimated in the model by the following equation:

$$PSM_t = -27.5326 + 5.9245\ PSB_t + 0.6597\ PCM_t + 0.5484\ LSPU_t$$

	PSB	PCM	LSPU
Student t	2.00	4.12	3.46
Elasticity	0.208	0.617	0.473

$F = 250.8 \quad R^2 = 0.98 \quad S.E. = 5.83 \quad D = 2.17 \quad \bar{Y} = 80.4$

where: SM is price of soybean meal ($/ton), PSB is price of soybeans ($/bu.), PCM is price of cottonseed meal ($/ton) and LSPU is number of livestock production units (millions), for years 1950-1974, less 1972.

Table 6. Elasticity of Concentrate Feed Conversion Rate and Elasticity of Percent of Feed Grains in Concentrates Fed for Each of the Livestock Categories in the Model.

Elasticity of Feed Conversion $Ratio_t$ for:	Own Livestock $Price_t$	Feed Grain $Price_t$	Soybean Meal $Price_t$
Cattle and Calves wrt	0.894	—0.834	
Hogs wrt	0.132	—0.051	
Sheep and Lambs wrt	0.566	—0.222	
Checkens wrt	0.180	—0.180	
Turkeys wrt	0.197	—0.069	
Eggs wrt	0.153	—0.122	0.069
Milk wrt	0.080	—0.080	
Elasticity of Percent of Feed Grains in Concentrates Fed_t for:	**Own Livestock $Price_t$**	**Feed Grain $Price_t$**	**Soybean Meal $Price_t$**
Cattle and Calves wrt		—0.114	0.087
Hogs wrt	0.099	—0.092	0.071
Sheep and Lambs wrt	0.230	—0.009	0.220
Chicken wrt	0.133	—0.002	0.037
Turkeys wrt	0.097	—0.099	0.118
Eggs wrt	0.007	—0.106	
Milk wrt	0.005	—0.078	0.042

For the sources, see Appendix A, Section 5.

rate (pounds of feed per pound of production) by the calculated livestock production (millions of pounds) results in the total concentrates demanded by each livestock category. The total concentrates equation for hogs (18) is typical for the other meat animal categories and differs from the milk and egg equations in that meat production is in carcass weight and must be converted to a liveweight basis.

$$\text{Calculated total concentrates fed to hogs m. tons}_t = \left\{\left(\text{Calculated hog production m. lbs. carcass wt.}_t \div \text{Factor to convert hog carcass wt. to liveweight}\right) * \left\{\text{Calculated feed conversion rate for hogs}_t\right\} \div 2000.0\right. \quad (18)$$

The total concentrates demanded in (18) is a function of own and cross livestock prices lagged one period in the production equations, current own livestock prices in the feed conversion rate, as well as, the current prices of feed grains and soybean meal. Hence, the underlying relationships cause total concentrates demanded to be a derived demand of the livestock industry.

The third step is to estimate the percent of feed grains in the concentrates fed for each of the livestock groups. This set of seven equations is typified by equation (19) for hogs.

$$\text{Calculated percent of fg in concentrates fed to hogs}_t = \text{Baseline percent of fg in concentrates fed to hogs}_t * \Big[1.0 + \left(\text{elasticity of \% fg concentrates fed to hogs wrt hog price}_t * \text{\% change hog price from baseline}_t\right) + \left(\text{elasticity of \% fg in concentrates fed to hogs wrt fg price}_t * \text{\% change fg price from baseline}_t\right)\Big] \quad (19)$$

The amount of feed grains in concentrates fed, as a percentage, decreases as the own livestock price increases and decreases when the feed grain price increases. The default elasticities used in equation (19) for the separate livestock categories are presented in Table 6.

The final step is to separate total concentrates demanded by each livestock category into feed grains and by-product feeds (high protein). This is handled by an equation similar to (20) and (21) for each of the livestock categories. Equation (20) computes the derived demand for feed grains by hogs by multiplying the calculated total concentrates fed to hogs by the percent of feed grains in concentrates fed to hogs.

$$\text{Calculated fg demanded by hogs m. tons}_t = \text{Calculated total concentrates fed to hogs m. tons}_t * \text{Calculated percent of fg in concentrates fed to hogs}_t \quad (20)$$

Feed grain demand is estimated for each livestock category in the same manner. Total feed grain feed demand is computed as the sum of the calculated feed grain demands in equation (19) over the seven livestock categories. The resulting feed grain demand is a derived demand for feed grains based on the livestock production and the simulated livestock and feed prices.

By-Product Feed Demands

The total by-product demand for each livestock category is calculated by equation (21); it is simply the difference between total concentrates demanded and feed grains demanded.[8] Since the equation is similar for all livestock categories the equation for hogs is presented here.

[8]By-product feeds include protein feeds, animal proteins, grain protein feeds, and other by-product feeds. High protein feeds are oilseed meal, such as soybean meal and cottonseed meal. Animal proteins are meat, fish, and milk by-products and grain protein feeds are by-product of millers and distillers.

The total by-product demand is the sum of the individual livestock categories' demand, computed by equation (21).

$$\text{Calculated by-product demand by hogs m. tons}_t = \text{Calculated total concentrates fed to hogs m. tons}_t * \left(1.0 - \text{Calculated \% of fg in concentrates fed to hogs}_t\right) \quad (21)$$

Domestic Demands for Other Model Crops

Wheat, soybeans, and cotton domestic demands consist of the following: wheat food demand, wheat feed demand, soybean mill demand and cotton mill demand. Other domestic demand for each of the four crops (seed demand, residual, etc.) are considered exogenous.

The domestic food demand of wheat is a function of wheat price and demand shifters, such as the level and distribution of disposable income and population. The influence of the demand shifter variables are embodied in the baseline domestic wheat food demand level. Changes in domestic farm policy will not significantly effect the level of population or values of other demand shifter variables. Hence, only the impact of a change in the price of wheat resulting from a change in policy or different yield and export projections are of importance. The domestic wheat food demand (22) is estimated as a derivation away from the baseline value resulting from changes in wheat price from its baseline.

$$\text{Calculated domestic wheat food demand m. bu.}_t = \text{Baseline domestic wheat food demand m. bu.}_t * \left[1.0 + \left(\text{elasticity of wheat food demand wrt own price}\right) * \left(\text{\% change of wheat price from baseline}_t\right)\right] + \left(1.0 - \text{long run adjustment factor}\right) - \left(\text{calculated wheat food demand}_{t-1} - \text{baseline wheat food demand}_{t-1}\right) \quad (22)$$

The distributed lag adjustment coefficient is included in (22) to allow domestic wheat food demand to have a multi-period adjustment to changes in wheat price. The default short run elasticities of wheat food demand with respect to own price are —.10 in the short run and —0.20 in the long run (Table 7).

Wheat Feed Demand. The domestic demand for wheat as livestock feed is a function of wheat price and feed grain price. When the price of wheat gets close to the price of corn wheat will be substituted for corn at the margin. Wheat feed demand is estimated with equation (23). A downward adjustment in feed grains fed to livestock, baseline on wheat's feeding equivalent relative to corn, is made whenever the wheat price gets within 12 percent of corn price. (On a corn equivalent feed

$$\text{Calculated wheat feed demand m. bu.}_t = \text{Baseline wheat feed demand m. bu.}_t * \Big[1.0 + \Big(\text{elasticity of wheat feed demand wrt own price}\Big) * \Big(\text{\% change in wheat price from baseline}_t\Big) + \Big(\text{elasticity or wheat feed demand wrt fg price} * \text{\% change in fg price from baseline}_t\Big)\Big] + \Big(1.0 - \text{long run adjustment factor}\Big) * \Big(\text{calculated wheat feed demand}_{t-1} - \text{baseline wheat feed demand}_{t-1}\Big) \quad (23)$$

unit basis wheat is 12 percent more valuable as a livestock feed than corn.)

Table 7. Domestic and Export Demand Elasticities for the Model Crops.

	Feed Grain Price_t	Wheat Price_t	Soybean Price_t	Cotton Price_t
Wheat Domestic				
Food Demand_t wrt		—0.100 (—0.200)		
Feed Demand_t wrt		—0.300 (—0.600)		
Soybean Domestic Mill Demand_t wrt			—0.350 (—0.700)	
Cotton Domestic Mill Demand_t wrt				—0.100 —(0.150)
Feed grain export demand_t wrt	—0.500 (—1.500)			
Wheat export demand_t wrt		—0.500 (—1.500)		
Soybean export demand_t wrt			—0.650 (—1.950)	
Cotton export demand_t wrt				—0.500 (—1.500)

For the sources, refer to Appendix A, Section 4.
Long-run elasticities are in parentheses beneath the respective short run elasticity.

Soybean Mill Demand. Soybean domestic mill demand is a function of the price of soybeans, the number of grain consuming livestock production units, mill capacities, prices of substitute protein sources and vegetable oils, population, and disposable incomes. All of these factors influencing demand are embodied in the baseline value for soybean mill demand. In a farm policy analysis where the demand shifters such as income, population, and mill capacity are not altered, changes in mill demand for soybeans from its base value are largely dependent on soybean price and the level of livestock production. The soybean mill demand equation in POLYSIM allows the baseline soybean mill demand ,as specified in equation (24) to respond to soybean price and the number of livestock production units.

$$
\begin{aligned}
\begin{pmatrix}\text{Calculated}\\ \text{soybean mill}\\ \text{demand m. bu.}_t\end{pmatrix} = {} & \begin{pmatrix}\text{Baseline}\\ \text{soybean mill}\\ \text{demand m. bu.}_t\end{pmatrix} * \left[1.0 + \begin{pmatrix}\text{elasticity of}\\ \text{soybean mill demand}\\ \text{wrt own price}\end{pmatrix} * \begin{pmatrix}\text{\% change in}\\ \text{soybean price}\\ \text{from baseline}_t\end{pmatrix} + \begin{pmatrix}\text{elasticity of soybean mill}\\ \text{demand wrt no. of livestock}\\ \text{production units}\end{pmatrix} * \begin{pmatrix}\text{\% change in no. of}\\ \text{livestock production}\\ \text{units from baseline}_t\end{pmatrix}\right] \\
& + \begin{pmatrix}1.0 - \text{long run adjustment factor}\end{pmatrix} * \begin{pmatrix}\text{calculated}\\ \text{soybean mill}\\ \text{demand m. bu.}_{t-1}\end{pmatrix} - \begin{pmatrix}\text{baseline}\\ \text{soybean mill}\\ \text{demand m. bu.}_{t-1}\end{pmatrix}
\end{aligned} \qquad (24)
$$

The distributed lag adjustment factor is included in (24) to allow the domestic soybean mill demand to have a multi-period adjustment to changes in soybean price. The demand elasticities for (24) are presented in Table 7.

Cotton Mill Demand. Cotton domestic demand is made up entirely of mill demand. Mill demand for cotton is a function of cotton price, disposable incomes, population and the price of synthetic fibers. The baseline value for mill demand embodies all of these factors and, since farm policy only influences cotton price to any great degree, changes in mill demand from its baseline value are largely a function of cotton price. The cotton mill demand equation (25) adjusts the baseline cotton mill demand up or down as cotton price varies its baseline value.

$$
\begin{aligned}
\begin{pmatrix}\text{Calculated cotton}\\ \text{mill demand}\\ \text{m. net bales}_t\end{pmatrix} = {} & \begin{pmatrix}\text{Baseline cotton}\\ \text{mill demand}\\ \text{m. net bales}_t\end{pmatrix} * \left[1.0 + \begin{pmatrix}\text{elasticity of cotton}\\ \text{mill demand wrt}\\ \text{own price}\end{pmatrix} * \begin{pmatrix}\text{\% change in}\\ \text{cotton price}\\ \text{from baseline}_t\end{pmatrix}\right] \\
& + \begin{pmatrix}1.0 - \text{long run adjustment factor}\end{pmatrix} * \begin{pmatrix}\text{calculated cotton mill demand}_{t-1} - \text{baseline cotton mill demand}_{t-1}\end{pmatrix}
\end{aligned} \qquad (25)
$$

The distributed lag factor in (25) allows the cotton mill demand to have multi-period adjustments to changes in cotton price. The default elasticity of demand for cotton at the mill wrt own price is —0.10 (Table 7).

Total domestic demands are calculated for each of the model crops (feed grains, wheat, soybeans, and cotton) as the sum of the endogenous demands and an exogenous other demand component. Total feed grain domestic demand is the sum of domestic feed demand and feed grains used for other than feed uses (food, seed and industrial). Wheat domestic demand is the sum of domestic food and feed demand and the exogenous component of seed and industrial uses. Soybean total domestic utilization is the sum of mill demand for crushing and the exogenous demand for seed. Cotton total domestic demand consists only of domestic mill consumption.

Export Demands. Foreign demands for feed grains, wheat, soybeans, and cotton are dependent upon the domestic price, the foreign supply, population and income of importing countries and other variables. The baseline values for crop exports are developed with specific assumptions pertaining to these variables. When a farm policy is analyzed which changes only the domestic prices, it can be modeled by adjusting the baseline export value for changes in the price from the baseline. However, if the base assumptions pertaining to foreign supply are changed the analyst can provide a new export value that has been determined outside the system. The model would set exports at the prespecified level and compute the crop's price taking into account the shift in the demand curve.

The feed grain export equation (26) typifies the export equations used for each of the four crops.

$$\text{Calculated fg export m. tons}_t = \text{Baseline fg export m. tons}_t * \left[1.0 + \left(\begin{matrix}\text{elasticity of}\\ \text{fg export wrt}\\ \text{own price}\end{matrix}\right) * \left(\begin{matrix}\text{\% change fg}\\ \text{price from}\\ \text{baseline}_t\end{matrix}\right)\right]$$

$$+ \left(1.0 - \begin{matrix}\text{long run}\\ \text{adjustment}\\ \text{factor}\end{matrix}\right) * \left(\text{calculated fg export}_{t-1} - \text{baseline fg export}_{t-1}\right) \qquad (26)$$

The distributed lag adjustment coefficient in (26) allows crop exports to have a multi-year response to changes in price. The export price elasticities for feed grains are reported in Table 7 along with the export elasticities for wheat, soybeans, and cotton.

Total Utilization and Carryovers

For each crop the model calculates the total utilization for each time period as the sum of total domestic demands and export demands.

Total carryover or ending year stocks is the difference between total supply and total utilization including increases in government stocks.

Accounting Identities

Crop and livestock cash receipts and the expenses for producing crops and livestock are simulated with a series of identity relationships. Also, identities are used to compute totals for production expenses, government payments and aggregate farm income.

CROP CASH RECEIPTS

Simulated cash receipts for each crop and livestock category are computed by adjusting the baseline cash receipts for the commodity for changes in price and production. Cash receipts are not generally equal to price times production (value of production). Farmers do not market all of the annual production of grain. Crop and livestock farmers feed part or all of their home-grown grain to their livestock. Changes in farmer stored grain also influence the amount of grain sold for cash. In estimaking cash receipts, the proportion of production sold for cash is implicitly assumed to be the same as in the baseline. The feed grain cash receipts equation (27) is typical of the equations used for the four crops in the model.

$$\text{Simulated fg cash receipts m. \$}_t = \left\{ \left(\frac{\text{simulated fg price}_t}{\text{baseline fg price}_t} * \frac{\text{simulated fg production}_t}{\text{baseline fg production}_t} * \text{baseline fg cash receipts}_t \right) * 0.35 \right\} + \left\{ \left(\frac{\text{simulated fg price}_{t-1}}{\text{baseline fg price}_{t-1}} * \frac{\text{simulated fg production}_{t-1}}{\text{baseline fg production}_{t-1}} * \text{baseline fg cash receipts}_{t-1} \right) * 0.65 \right\} \quad (27)$$

The parameters 0.35 and 0.65 in (27) are weights to convert crop year cash receipts for feed grains to a calendar year basis. The default parameters for converting to wheat cash receipts to a calendar year are 0.65 and 0.35. The parameters for soybeans are 0.35 and 0.65 and 0.55 and 0.45 for cotton. The parameter values were suggested by the Farm Income Group, NEAD, USDA, and can be changed by the user in the UPDATE program [Richardson and Ray, 1975b]. As can be seen in equation (27), the baseline cash receipts are adjusted by the ratio of the simulated and baseline prices and the ratio of the simulated and baseline production levels. If there are no changes in price or production, the ratios reduce to ones and cash receipts are unchanged from the baseline.

Total cash receipts for all crops is computed as the sum of simulated cash receipts for the four major crops (feed grains, wheat, soybeans, and cotton), plus cash receipts for non-model crops. Since cash receipts for non-model crops are exogenous in the model, the baseline value is used in all analyses unless side calculations have indicated the new level for the variable, then it is read in as data.

LIVESTOCK CASH RECEIPTS

Cash receipts for each of the seven livestock categories are estimated by adjusting the baseline cash receipts for proportional changes in the estimated price and production relative to their respective baseline values. The cash receipts for each livestock category are estimated with an equation similar to the following equation (28) for hogs:

$$\text{Simulated hog cash receipts m. \$}_t = \text{Baseline cash receipts for hogs}_t * \frac{\text{Simulated hog price}_t}{\text{Baseline hog price}_t} * \frac{\text{Simulated hog production}_t}{\text{Baseline hog production}_t} \qquad (28)$$

Livestock production and price levels are simulated on a calendar year basis so no marketing year to calendar conversion is required for livestock cash receipts.

Cash receipts for livestock other than the seven major categories are exogenous. Total cash receipts for all livestock is the sum of the estimated cash receipts for the seven livestock categories plus the exogenous cash receipts for other livestock.

Total cash receipts for crops and livestock are the sum of cash receipts for all crops and all livestock. Total cash receipts are on a calendar year basis and reflect the changes in prices and production of the endogenous crops and livestock categories from their baseline values. To simulate total realized gross farm income, values are needed for the value of non-money income and government payments.

REALIZED NON-MONEY INCOME

The baseline value of home consumption of each livestock category is adjusted for changes in the price of the commodity. The equation for the value of home consumption of hogs (29) is similar to those used for the other livestock categories.

$$\text{Simulated value of home consumption for hogs}_t = \text{Baseline value of home consumption for hogs}_t * \frac{\text{Simulated hog price}_t}{\text{Baseline hog price}_t} \qquad (29)$$

It is assumed that the quantity of each type of livestock consumed on the farm is constant and only its value changes with a change in price. In reality, some change in quantity consumed would also occur with a price change. Since the demand for livestock products consumed on the farm is probably highly inelastic, the assumption is not very restrictive.

The value of prerequisites other than livestock consumed on the farm (rental value of dwellings, crops, firewood, and other income) is exogenous. Total realized non-money income is the sum of the value of home consumption for each of the major livestock categories plus the value of other farm perquisites.

GOVERNMENT PAYMENTS

Payments for acreage set-aside and deficiency payments, when applicable, are computed separately for each of the model crops. Set-aside payments are calculated for feed grains, wheat, and cotton with relationships similar to equation (30); which is presented in terms of feed grains.

$$\text{Simulated fg set-aside payments m. tons}_t = \text{Set-aside acreage for fg m. ac.}_t * \text{Set-aside payment per acre for fg \$/ac.}_t \qquad (30)$$

The set-aside levels and payment rates default to baseline levels unless specified by the user. Per acre payment rates may be zero, if set-aside is required for eligibility for other provisions in farm legislation.

Deficiency payments are income support payments paid to farmers and originated with the Agricultural Consumer Protection Act of 1973 and are provided for in the Food and Agricultural Act of 1977. Payments are made only when the average crop price (for the first five months of the marketing year) is less than the target price. Deficiency payments are calculated by the model for corn, grain sorghum, barley, wheat and cotton.

The procedure for determining the deficiency payment for each of the five crops is similar and is presented here for the case of corn. The first step is to determine the deficiency payment rate. By law, the payment rate is the lesser value of 1) the difference between target price and average market price, and, 2) the difference between target price and loan rate (31).

$$\text{Corn deficiency payment rate}_t = \text{The Lesser Of} \begin{cases} \text{Corn target price}_t - \text{Corn average market price}_t \\ \text{OR} \\ \text{Corn target price}_t - \text{Corn loan rate}_t \end{cases} \qquad (31)$$

The total deficiency payment is the product of the deficiency payment rate, the program acreage, the farm program yield, and the fraction of farmers participating in the program (32).

$$\text{Corn deficiency payment}_t = \text{Corn deficiency payment rate}_t * \text{Corn program acreage}_t * \text{Corn farm program yield}_t * \text{Fraction of corn farmers in program}_t \quad (32)$$

The baseline values for target price, loan rate, program acreage, farm program yield, and fraction of farmers in the program are used in (32) to determine deficiency payments unless the user provides alternative values. Deficiency payments for corn, grain sorghum, barley, wheat, and cotton are summed to obtain total government deficiency payments paid to farmers.

The Food and Agricultural Act of 1977 states the value of the target prices for corn, grain sorghum, barley, wheat, and cotton for 1978 and a procedure for adjusting these values over time, based on changes in the variable cost of production (or total production costs excluding land and general overhead costs). The procedure is the same for all crops in the model and is demonstrated here for corn (33).

$$\text{Corn target price}_t = \text{Corn target price}_{t-1} + \text{Variable cost of production}_{t-1} - \text{Variable cost of production}_{t-2} \quad (33)$$

As indicated by equation (33), the target price is increased over the previous year's level if there is an increase in the variable cost of production.

AGGREGATE PRODUCTION EXPENSES

Total variable production expense for the individual model crops (feed grains, wheat, soybeans, and cotton) is calculated by equation (11) which was presented earlier. Total variable production expense for the model crops is the sum of the expense levels for the four crops.

The total variable production expense for producing livestock is calculated as the sum of feed and non-feed variable costs. Feed costs are disaggregated into the following feed types: protein feed grains, wheat, and roughage. Protein feed costs are calculated in equation (34) based on by-product feeds fed to all livestock which was computed earlier in the model.

$$\text{Protein feed costs to livestock}_t = \text{Simulated by-product feed demands}_t * \text{Soybean meal price}_t \quad (34)$$

In assigning a cost to the livestock sector for protein feed, all by-product feeds (soybean meal, cottonseed meal, animal proteins, grain protein feeds and other by-product feeds) are costed out using the price of soybean meal.

Feed grain feed cost for producing all livestock is the cost of feed grains fed to livestock on the farm where it is grown plus the cost of feed grains purchased and fed to livestock (35).

$$\text{Fg feed costs to livestock}_t = \left\{ \text{calculated fg fed to livestock}_t * \text{fraction of fg sold}_t * \text{price of feed grains}_t \right\} + \left\{ \text{calculated fg fed to livestock}_t * \left(1.0 - \text{fraction of fg sold}_t \right) * \frac{\text{fg variable cost of production}_t}{\text{fg yield per acre}_t} \right\} \quad (35)$$

The portion of feed grains fed to livestock on the farm where it is raised is valued at its variable production cost per bushel while the portion that is purchased and then fed to livestock is valued at the average market price. The user may reprogram to value home-grown grain to include a portion of fixed costs by increasing variable cost by a specified percentage, say 25 percent.

The cost of wheat fed to all livestock categories is the market value of wheat times the quantity of wheat fed to livestock (36).

$$\text{Wheat feed costs to livestock}_t = \text{Calculated wheat fed to livestock}_t * \text{Calculated average wheat price}_t \quad (36)$$

It is assumed that all wheat fed to livestock is purchased in the market. Hence, the wheat feed costs are not separated into two costing components.

Total roughage cost for all livestock production is computed as the sum of the cost of roughage fed to livestock on the farm where it is grown and the cost of roughage purchased and fed to livestock (37).

$$\text{Roughage feed costs for livestock}_t = \left\{ \text{roughage fed to livestock}_t * \text{fraction of roughage purchased}_t * \text{price of hay}_t \right\} + \left\{ \text{roughage fed to livestock}_t * \left(1.0 - \text{fraction of roughage purchased}_t \right) * \text{variable production cost of roughage}_t \right\} \quad (37)$$

The portion of roughage that is purchased is costed out to the livestock sector at the market price for hay. The portion fed to livestock on the farm where it is grown is valued at the variable cost of producing hay.

Non-feed variable production expenses for livestock include salt, mineral supplements, and veterinarian expenses. As the price of livestock increases and the marginal value product of livestock output increases, farmers are willing to spend more for non-feed costs. The non-feed cost in terms of dollars per unit is computed for each livestock category by relationships similar to equation (38), which is demonstrated here for hogs.

$$\text{Simulated non-feed cost of hog production}_t = \text{Baseline non-feed cost of hog production}_t * \left[1.0 + \left(\text{elasticity of non-feed cost for hogs wrt own price} * \text{\% change in hog price from baseline}_t\right)\right] \tag{38}$$

The baseline non-feed cost ($/unit of production) is adjusted slightly upward for increases in the own livestock price from its baseline level and slightly downward when the own livestock price is less than the baseline. The default non-feed expense per unit elasticities are presented in Table 8. Total non-feed costs for livestock production (39) is the sum of the seven livestock production levels times their respective non-feed costs per unit of production.

$$\begin{aligned}\text{Total non-feed costs for livestock}_t = {} & \left(\text{cattle and calf production}_t * \text{non-feed costs of cattle and calves}_t\right) + \left(\text{hog production}_t * \text{non-feed costs for hogs}_t\right) \\ & + \left(\text{sheep production}_t * \text{non-feed costs of sheep}_t\right) + \left(\text{chicken production}_t * \text{non-feed costs for chickens}_t\right) \\ & + \left(\text{turkey production}_t * \text{non-feed costs for turkeys}_t\right) + \left(\text{egg production}_t * \text{non-feed costs for eggs}_t\right) \\ & + \left(\text{milk production}_t * \text{non-feed costs for milk}_t\right)\end{aligned} \tag{39}$$

Total variable production expenses for livestock production is the sum of feed grains feed costs, protein costs, roughage costs, and non-feed variable production costs.

Total variable production costs for model crops and livestock is the sum of total variable production costs for the four crops and the seven

Table 8. Elasticity of Non-Feed Costs for Livestock Production in the Model.

Elasticity of Non-Feed Cost For	Own Livestock $Price_t$
Cattle and $Calves_t$ wrt	0.100
$Hogs_t$ wrt	0.020
Sheep and $Lambs_t$ wrt	0.005
$Chickens_t$ wrt	0.001
$Turkeys_t$ wrt	0.001
$Eggs_t$ wrt	0.001
Milk $Cows_t$ wrt	0.001

For the sources, see Appendix A, Section 5.

livestock categories, less double accounting of feed grains, soybeans, and wheat. "Double accounting" equations compute the portion of crop production expenses that was counted as feed expense for livestock. In the case of feed grains, the double counting adjustment is computed as the product of the variable production expense for producing a ton of feed grains and the tonnage of feed grains fed to livestock (equation (40)).

$$\text{Fg double accounting adjustment}_t = \frac{\text{Fg variable production expense per acre}_t}{\text{Yield per acre}_t} * \text{Fg fed to livestock}_t \qquad (40)$$

The double accounting adjustment is calculated similarly for the other grain crops.

Total farm production expense is the sum of variable production expenses for all model crops and livestock (adjusted for double accounting), the production costs of other livestock and crops not included in the model and total fixed costs of production. The total fixed costs and production expenses for other livestock and crops are exogenous to the model.

AGGREGATE NET FARM INCOME

Several measures of aggregate farm income and government payments are computed by the model. Total market and government receipts is the sum of total cash receipts for all crops and livestock and total government payments. Total government payments to farmers is the sum of set-aside payments for all crops, total deficiency payments for all model crops, and other direct government payments to farmers (wool growers, bee keepers, disaster payments, sugar program, etc.). Realized gross farm income is the sum of total market and government receipts and total realized non-money income. Realized net farm income is the difference between realized gross farm income and total farm production expenses.

POLYSIM DATA RETRIVAL AND DISPLAY OF RESULTS

The purpose of this section is to describe the organization and procedures for the data input-output operations of the model. The flow diagram for POLYSIM is presented in Figure 2 and is discussed in the Overview of the Model section. A source listing of the model is presented in Appendix B. Data input and output operations are designed to use alpha-numeric data stored on disk so as to minimize card input and formating. Another consideration in program organization was to make the program as flexible as possible so additional farm policy options could be added and output for these options could be printed without substantial modification of the model.

Data Input Requirements

Three subroutines handle data input for the model. The first input subroutine (INT1) reads table titles and headings from disk storage and assembles them in arrays for printing output tables. The table titles and headings are stored on disk so both POLYSIM and UPDATE can use the same output tables and to minimize the number of formats which add to program length and compiling time. This subroutine also reads the Label Cards provided by the user [Richardson and Ray, 1975a]. Label Cards allow the user to print out the values of new variables that have been programmed into the model.

The second input subroutine (INITIAL) reads user provided Core Data Cards. The Core Data Cards contain information on the farm program options to be used, the type of output the user desires, the years to be simulated, and the title of the simulation. This subroutine also reads the following data sets from disk storage: the baseline endogenous data, the baseline exogenous data, the default elasticities, and the user specified livestock price flexibility matrix. Finally, the farm policy options specified by the user are set-up for inclusion in the simulation process.

The third input subroutine (INT2) reads the Optional Data Cards provided by the user [Richardson and Ray, 1975a]. The user supplied values for policy variables, predetermined endogenous variables and new elasticities are stored in the appropriate arrays for use in the simulation loop of the model. At the users option, the new elasticities may be stored on disk to become permanent default elasticities. Otherwise the elasticities are used for the particular simulation and then replaced by default values. The user supplied predetermined and exogenous variable values are used only for the one simulation. The printed output for this subroutine is the Title Page, which includes the user specified simulation name, the farm policy options selected by the user and card images, if any, of Elasticity Data Cards, Policy Data Cards, and Predetermined Data Cards. Error messages informing the user of improper card order or misaligned data are printed by each of the three input subroutines.

The first input subroutine (INT1) is called only once each time the model is run, the other input subroutines are called once for each simulation. Calling the latter subroutines for each simulation ensures the use of the same set of baseline data for each simulation and that calculated values from preceding simulations are not used inadvertently.

Output Modes

Three subroutines are used to assemble and print simulation results for the deterministic model. The first subroutine (TAB1) produces no printed output, but calculates statistics for measuring the change in the simulated endogenous variables from the baseline. The percentage change of the value for the last year simulated relative to the corresponding baseline value is computed first. Secondly, the subroutine computes the percentage change in the simulated endogenous values from their corresponding baseline values over the full period simulated, usually five years.

The second subroutine (TAB2) prints twenty separate tables that contain simulated results for about 180 variables in the model. (Due to the use of disk storage for table titles and labels, only seven formats are needed to print these output tables.) Each table displays variable data for the two years preceding the first year simulated, the simulated values for all years simulated, and the percentage change statistics calculated in subroutine TAB1. The variables printed are the following: the supply and utilization variables for the model crops and livestock categories, the farm program variables, and the aggregate values for total receipts and expenses.

The third output subroutine (TAB3) prints summary tables of selected variables in the model. Both the baseline and simulated values for each year simulated are printed for key variables, such as: crop acreage, crop and livestock production and prices, total cash receipts, total government payments, realized gross farm income, farm production expenses and realized net farm income. Additional variable values, designated by the user through the use of Label Cards, are printed by this subroutine. The results for each simulation can be stored on disk in a user specified location for later access by an optional table writer program [Richardson and Ray, 1975a].

POLYSIM AS A STOCHASTIC SIMULATOR

Stochastic simulation techniques have been used by agricultural economists for quite some time. Anderson [1974] provides a review of literature of stochastic simulation applications in agricultural economics. The primary advantage of stochastic simulation is that it provides the researcher a means of experimentally estimating the probability distribution for key output variables given parameters of uncertainty about variables that drive the system. The process of mathematically deriving probability distributions for output variables is quite complicated and may be impossible in large models. However, stochastic simulation techniques provide a fast and reliable means of empirically estimating the probability distributions for the endogenous variables.

Experimental probability distributions are especially useful in addressing questions concerning the probability of an output variable taking on a value that is above (or below) some critical value. In farm policy analysis the experimental probability distribution allows researchers the opportunity to answer probabilistic questions concerning the prices received by farmers, the level of government payments, the levels of stocks held by the CCC, the level of realized net farm income, etc. Specifically, a policy maker may be interested in the probability of government payments exceeding $3 billion or the probability of net farm income being in the range of $20 to $26 billion under a given set of farm program parameters and a specified distribution for crop yields and exports.

Procedure for Making POLYSIM Stochastic

A deterministic model can be made stochastic by drawing values for selected variables from probability distributions that represent the randomness of those variables. The impact of the drawn values on the model endogenous variables are estimated with the simulator. By repeating the process a large number of times and recording the values of the output variables, experimental probability distributions are developed for the endogenous variables in the model.

Of the variables in POLYSIM, crop yields and exports are considered to be most dependent on stochastic factors. Domestic crop yields are influenced, in part, by the stochastic nature of weather in the United States. Similarly, crop export demands are influenced by the stochastic nature of weather on crop yields in the rest of the world. Crop yields for the four model crops directly influence the level of crop supply and thus the crop prices. Export demands influence the expected demands for the crops and thus the crop prices and domestic demands. The crop prices in turn affect the level of production and profitability of the livestock enterprises. All of these effects stemming from variances in yields and exports trace a set of values for farm incomes, government expenditures and consumer expenditures for food.

Operationally random deviates about baseline crop yields and export demands are drawn for each of the four model crops and inputed to the rest of the model. The yield equations (7) and the export demand equations (26) are bypassed when the model is run stochastically. Random deviates for the four yields and four exports are sequentially drawn as each year (of the, say, five year period) is simulated. The process is repeated a relatively large number of times (say 300) to obtain sample data for estimating probability distributions for the endogenous variables in the model.

The user of a stochastic simulator must specify the nature of the probability distributions for the "driving variables" of the system. The distributions of the variables themselves or of the variables after detrending will not often conform exactly to any of the common types of distributions. The researcher uses information on the past behavior of the variable and his judgment concerning the most realistic type of distribution that is appropriate for the analysis. Most stochastic simulation studies have used the normal probability distribution. The normal distribution is often indicated in analyzing detrended data of biologically based variables. The normal is relatively easy to use since the distribution is completely identified by the mean and the standard deviation.

Also, the triangular probability distribution has been used in a number of stochastic simulation models [Taylor and North, 1976; Reutlinger, 1976; Sprow, 1967; Richardson and Mapp, 1976]. In contrast to the normal, the triangular distribution has a finite minimum and maximum. The triangular distribution is completely described by three values: the minimum, the mode, and the maximum. Also, the triangular probability density function may be skewed in either direction from the mode, indicating a higher probability of a high (low) value over that of a low (high) value.

Alternative subroutines are available for POLYSIM that allow the user to specify the probability distribution that best suits the problem being considered. Subroutine, RYLDEX, calculates random values for yields and exports that are independent and normally distributed. RCOEXY is a subroutine for drawing appropriately correlated random values for yields and exports from normal distributions. Subroutine, TRIRAN, selects independent and triangularly distributed random numbers for yields and exports. Subroutine, CURAN, draws random yields and exports from user specified cumulative probability distributions. On more than one occasion these subroutines have been used together, for example using TRIRAN to generate random yields and exports for the first year simulated and using RCOEXY for the remaining years simulated. (Listings for these subroutines are in Appendix C.)

The subroutine, RYLDEX, uses the pseudo random number generator, GAUSS [Marsoglias and Bray, 1964] for drawing standard normal deviates. The subroutine contains eight equations for obtaining random values of crop yield and export demand for each of the model crops. The equation structure is the same for all crop yields and exports and is demonstrated here for feed grain yields (41).

$$\text{Random fg yield}_t = \text{Baseline fg yield}_t + \text{Fg yield standard deviation} * \text{Random standard normal deviation} \quad (41)$$

The baseline yields and export levels (41) for each year are used as the mean for the random variables. The user must provide the standard deviations for the eight independent yield export demand distributions. Values for the random standard normal deviate (41) are obtained from on-line subroutine GAUSS.

Subroutine, RCOEXY, is used when the researcher assumes that the normally distributed yields for the crops are correlated and that the normally distributed exports for the four crops are correlated. Appropriately correlated random values are obtained by using random standard normal deviates from GAUSS and the transformed variance-covariance matrixes for yields and exports. A procedure for transforming the covariance matrix so that appropriately correlated events can be generated is described by Clements, Mapp and Eidman [1971]. The covariance matrices are transformed by a computer program originally written by Spence [1976] and modified by the authors to test and store the transformed matrices on disk. The first time the RCOEXY subroutine is called, it reads the matrices from disk storage, for use in the simulator. Subroutine CORNEY is similar to RCOEXY, but it is used when the user wants the eight normally distributed yields and exports to be correlated as a set.

Subroutine, TRIRAN, generates random values of yields and exports for the individual model crops. The random values are independent across the crops. The user can specify the probability distributions in one of two ways. The first method is to specify the minimum, mode, and maximum values for each crop, for each of the years to be simulated. The second method is to specify the minimum and maximum values as percentages of the mode and let the mode be the baseline value for each year simulated. (In the latter case, the minimum could be set at 90 percent of the mode and the maximum could be set at 115 percent of the mode for feed grain yield while other percentages can be used for the other crops.)

The user can use any particular probability distribution by providing the distribution in the CURAN subroutine. A cumulative distribution is segmented in one to ten segments by designating the appropriate end points and probabilities and then is used by the model to simulate random values for independent yields and exports. This subroutine, as well as, the others described above are presented in Appendix C.

Output for the Stochastic Model

Data management becomes a challenge in large stochastic simulation models. A stochastic simulation with POLYSIM for a five year period, replicated 300 times, generates about 500,000 numbers. It is impractical to print or visually analyze this much raw data. Raw data of output variables generated in stochastic runs are organized and stored on disk with subroutine STORE. Auxillary programs are used to analyze the data.

One function of the STORE subroutine is to compute the sum of each endogenous variable for each year over all iterations. After the last iteration the variable sums are divided by the number of iterations (say, 300) to obtain the average simulated value for all endogenous variables for each year. These average values are printed in the usual POLYSIM tables with the same output subroutines (TAB1, TAB2, TAB3) as in a deterministic run. The standard tables containing variable means are the only printed variable output from POLYSIM, per se.

The other function of STORE, is to store simulated values for selected variables on disk for later analysis. This storage of data is performed at the end of each iteration or replication in a stochastic analysis. The user may select up to 100 model variables for storage and subsequent statistical analysis. The file numbers B or EXOG [see Richardson and Ray, 1975a] for the selected files are stored on disk by program AGSTORE and are used by STORE in writing the selected files on disk. (A description of AGSTORE and other programs used by the stochastic simulator is in Appendix C.) The values for the stored variables may be analyzed by auxiliary programs AGSTAT1 or AGSTAT2. AGSTAT1 computes and prints the mean, minimum, maximum, variance, and the coefficient of variation for each selected variable for each year simulated. These same statistics also are computed using data for all years for each variable. In the case of a 300 iteration stochastic simulation over a five year period, the annual statistics for each of the selected variables would be based on 300 observations while the statistics computed for all years taken together would be based on 1500 observations. AGSTAT2 provides the same statistics as in AGSTAT1 but in addition prints a frequency distribution (experimental discrete probability distributions) for each of the selected variables for each year and for the full time period of the simulation.

POLYSIM VALIDATION

There are many different views concerning validation of economic models. These different views tend to be separated into three methodological positions—rationalism, empiricism, and positive economics [Naylor, 1971]. Rationalism holds that models are based upon postulates that are of unquestionable truth and that the problem of validation is then reduced to a problem of finding the basic underlying assumptions in the modeled system. Empiricism holds that observation is the primary source and ultimate judge of knowledge and rejects those postulates and assumptions that cannot be empirically verified. Positive economics holds that the validity of a model rests on the model's ability to predict the dependent variables and not on the validity of the basic assumptions. Economists who have faced the validation problem tend to follow a middle of the road approach that recognizes benefits of predictability, empirical relationships, and logical assumptions.

Naylor's [1971] multistage validation approach is one accepted method of validating simulation models. The first stage calls for the formulation of a set of postulates describing the system. This includes specification of components, selection of variables and functional form for the relationships in the model. Stage two calls for a validation of the tentative hypotheses outlined as postulates in stage one. Naylor suggests using econometric tests and deductive reasoning to validate the basic postulates. Stage three calls for testing the model's ability to predict the behavior of the system. The use that the model is to be put to, generally dictates the type of testing one should use. When a model is to be used for descriptive analysis its tracking of historical values can be used as a guide in testing the model. Models built for prescriptive analysis cannot use historical record as a direct check of their validity, rather the validity of the model must rest upon its predictions.

Stage One of Validation

The validation of the National Agricultural Policy Simulator (POLYSIM) was begun at the inception of the model and has been a continuing part of the model's development. POLYSIM was developed to provide analyses of alternative farm policy scenarios, using a recognized baseline data set provided by the Commodity Economics Division of USDA. Realizing that validation of any model is difficult at best, an effort was made to begin the validation process as POLYSIM was constructed.

In the initial stage the basic postulates of the model were developed. This involved formally stating the relationships within and between the crop and livestock sectors based on economic theory and knowledge of sectors involved. Attention was given to specifying these functions so that they were consistent with observed and recorded experience.

Stage Two of Validation

The second stage of development and validation involved empirical testing of the basic postulates. The basic postulates in POLYSIM were tested by searching the literature for published research that reported empirical functions similar to those postulated for the model. Following this search, commodity specialists in the Economic Research Service of the U. S. Department of Agriculture reviewed the specified equations and suggested revisions in the variables that appear in the relationships. This procedure was a theoretical and empirical validation of the equations specified in stage one of the model's development. When published documentation was not available the functions were estimated with econometric techniques and subjected to empirical tests. Those functions which proved to be unsatisfactory were replaced.

Parameters for the functional relationships in the model (elasticities) were collected from numerous sources in the literature. These elasticities were then carefully evaluated by a number of agricultural economists including commodity specialists of the USDA. The most widely accepted value for each of the elasticities, given the current environment of agriculture, was then adopted. In this manner the elasticities used in POLYSIM have been subjected to several empirical and subjective tests. They were tested empirically by the researchers who originally reported them and have been subjected to repeated testing by additional published research efforts and subjective judgments of commodity specialists. The elasticities were then tested for their theoretical validity and logical consistency when used in the overall macro model. This phase of the validation is an ongoing effort by the people who use the model.

Stage Three of Validation

Stage three of the validation procedure calls for testing the models ability to predict the behavior of the system. Since POLYSIM is a policy analysis model this is quite difficult; however, various tests of the model have been and are being made. One of the earliest validation tests was an evaluation of projected scenarios for given changes in crop production, export demands, and farm policy variables. Following the general approach of a Turing Test [Van Horne, 1971] the simulated outputs were evaluated for theoretical soundness and agreement with independent parallel research in the area. Corrections in the model specification were made when errors in logic were detected by this testing procedure.

A sensitivity analysis of the model has been conducted to determine the model's sensitivity to stochastic changes in crop yields and exports. Alternative variance covariance matrices for selected random yields and exports were used to test the model's ability to handle widely fluctuating endogenous variables. This testing has tended to demonstrate the model's ability to regain stability after repeated stochastic shocks.

Comparison of past POLYSIM predictions to observed phenomena as a validation test is rather difficult because the predictions either have been on a "What if. . . " nature or there has not been a sufficient lapse of time for a complete evaluation. In view of this problem, validation of the model must rest upon the first two stages of validation and a test of the model's ability to track a recent historical period. Since the model requires a baseline, a baseline developed in 1973 was used to simulate endogenous variables for years 1973 through 1977. The exogenous shifts in export demand and crop yields were read into the model. The predicted value for the endogenous variables from POLYSIM were compared to the published actual values for 1973, 1974, 1975, and 1976 and preliminary 1977 values. Other historical values provided as exogenous data for the simulation include: other crop and livestock cash receipts, other production expenses, target prices and loan rates, government payments for miscellaneous farm programs, and the change in the index of prices paid for input items above the value implicit in the baseline data.[7]

Several statistics for comparing the actual and the predicted values are reported for the major endogenous variables in the model (Table 9). The statistics reported are: mean of actual data, mean absolute percent simulation error, Root-Mean-Square percent simulation error and the Theil Inequality Coefficient (U). (Formulas for these statistics are included in a footnote of Table 9). The mean of the actual data is presented to indicate the relative magnitude of the variable over the test period.

The mean absolute percent error statistic measures the average *absolute* error of the predicted value from the actual, in percentage terms. Therefore the smaller the statistic the better the model is for predicting a particular variable. The mean absolute percent error statistics reported in Table 9 for the major endogenous variables in POLYSIM appear acceptable for farm policy analysis when one considers the time period (1973-1977) over which the validation analysis was conducted.

[9]Other crop and livestock cash receipts includes cash receipts for crops and livestock that are not modeled separately in POLYSIM. Other production expenses includes production expenses for non-model crops and livestock and fixed costs for model crops and livestock.

Table 9. Validation Statistics for Selected Endogenous Variables in POLYSIM and in the Baseline for Historical Period, 1973-1977.

	Mean (Actual)	Mean Absolute Percent Error (%)	Root-Mean Square Percent Error (%)	Theil Inequality Coefficient (U)	Mean Absolute Percent Error (%)	Root-Mean Square Percent Error (%)	Theil Inequality Coefficient (U)
		Variables in POLYSIM			Variables in Baseline		
Feed Grains							
Harvested acreage (m. ac.)	104.379	2.246	1.356	0.015	4.948	2.319	0.025
Production (m. t.)	198.911	1.867	1.208	0.014	14.723	8.499	0.077
Supply (m. t.)	223.117	3.852	2.085	0.023	21.456	10.813	0.101
Corn Price ($/bu.)	2.476	7.237	5.301	0.068	42.157	19.218	0.288
Domestic demand (m. t.)	151.199	8.651	5.090	0.055	25.439	12.344	0.117
Cash receipts (b. $)	11.236	8.982	5.299	0.057	34.657	15.649	0.218
Wheat							
Harvested acreage (m. ac.)	65.279	3.633	2.003	0.023	16.689	9.451	0.109
Production (m. bu.)	1946.518	3.877	2.122	0.023	10.523	5.567	0.071
Supply (m. bu.)	2575.188	4.614	2.342	0.028	4.963	2.954	0.029
Price ($/bu.)	3.376	5.851	3.580	0.035	42.207	19.457	0.299
Domestic demand (m. bu.)	746.427	6.717	3.373	0.040	6.929	3.866	0.039
Cash receipts (b. $)	6.285	6.970	3.723	0.041	48.536	21.958	0.341
Soybeans							
Harvested acreage (m. ac.)	53.839	5.605	3.466	0.038	7.048	4.027	0.048
Production (m. bu.)	1411.568	10.864	5.568	0.058	8.391	4.225	0.043
Supply (m. bu.)	1556.619	8.737	4.986	0.056	17.081	8.996	0.089
Price ($/bu.)	5.926	6.191	3.627	0.033	31.117	15.141	0.216
Domestic demand (m. bu.)	883.619	1.636	1.150	0.012	7.170	3.298	0.033
Cash receipts (b. $)	8.048	6.468	4.374	0.054	27.965	13.788	0.188
Cotton							
Harvested acreage (m. ac.)	10.919	4.700	2.441	0.029	10.290	5.962	0.055
Production (m. n. b.)	10.953	6.599	3.414	0.038	10.217	7.278	0.062
Supply (m. n. b.)	15.233	15.870	8.342	0.094	9.134	4.332	0.045
Price ($/lb.)	0.536	6.353	3.031	0.033	35.073	16.439	0.248
Domestic demand (m. n. b.)	6.740	12.214	6.720	0.069	15.836	8.191	0.078
Cash receipts (b. $)	2.642	8.854	4.881	0.056	26.879	13.626	0.211
Cattle and Calves							
Production (b. lbs. carcass weight)	24.166	4.091	1.978	0.022	3.959	1.991	0.023

	Mean (Actual)	Mean Absolute Percent Error (%)	Root-Mean Square Percent Error (%)	Theil Inequality Coefficient (U)	Mean Absolute Percent Error (%)	Root-Mean Square Percent Error (%)	Theil Inequality Coefficient (U)
Price ($/lb.)	0.360	1.701	1.117	0.011	12.102	5.863	0.066
Cash receipts (b. $)	19.478	4.361	2.029	0.023	12.317	5.811	0.066
Hogs							
Production (b. lbs. carcass weight)	12.660	8.389	4.075	0.043	12.592	7.261	0.071
Price ($/lb.)	0.397	2.369	1.279	0.013	18.907	9.049	0.011
Cash receipts (b. $)	7.487	7.774	3.895	0.043	9.098	5.5.4	0.061
Total Crop Cash Receipts (b. $)	46.660	2.799	1.401	0.015	35.030	15.822	0.219
Total Livestock Cash Receipts (b. $)	44.737	2.107	0.956	0.010	11.702	5.493	0.064
Realized Gross Farm Income (b. $)	100.263	1.834	0.879	0.009	25.467	11.557	0.149
Total Production Expenses (b. $)	75.585	0.932	0.464	0.005	22.460	10.290	0.134
Realized Net Farm Income (b. $)	24.752	6.315	3.462	0.042	33.549	15.840	0.217

Formulas for these statistics are:

$$\text{Mean (actual)} = \frac{\Sigma A_t}{T}$$

$$\text{Mean absolute percent error} = \frac{1}{T} \Sigma \frac{|P_t - A_t|}{A_t} * 100.0$$

$$\text{Root-Mean-Square percent error} = \frac{1}{T} \Sigma \frac{P_t - A_t}{A_t}^{2} * 100.0$$

$$\text{Theil U} = \frac{\Sigma(P_t - A_t)^2}{\Sigma(A_t)^2 \qquad \Sigma(P_t)^2}$$

Where:

A_t is actual value for year t,
P_t is predicted value for year t,
and T is number of years.

The Root-Mean-Square (RMS) percent error is a measure of the deviation of the simulated value from the actual in percentage terms. The closer to zero this statistic the better the model predicts the particular variable. The RMS percent errors reported for the major endogenous variables in POLYSIM are reasonably small (Table 9). For the five aggregate variables presented in Table 9, the largest RMS percent error is for realized net farm income which has an average error of 3.46 percent.

The Theil Inequality Coefficient (U) provides an index that measures the ability of a simulation model to give retrospective predictions of observed data [Theil, 1961]. The Theil U statistic has a lower bound of zero when the model is a perfect predictor and an upper bound or one when the model has no predictive power. All of the Theil U values reported for the major endogenous variables in POLYSIM are less than 0.100 and the majority of the values are less than 0.050 (Table 9).

Since POLYSIM utilizes a set of baseline data one might ask, how well does the baseline series predict the actual values over the historical period and how does the model compare to the baseline in predicting the actual values? To address these questions, the validation statistics for the major variables in the baseline are presented in Table 9. The mean absolute percent error and root-mean square percent error reported for the baseline variables are substantially larger than those for the same variables in the model in all but three cases, namely for soybean and cotton supply and cattle and calves production (Table 9). The Theil U statistic reported for the baseline variables are much larger than those for the same variables in the model in all but two cases, namely for soybeans and cotton supply.

The results of the historical simulation for the 1973 through 1977 period and the work reported for stages one and two of the multistage validation procedure suggest that POLYSIM is a reasonably accurate representation of the agricultural sector for use in policy analysis. Of course, a definitive once-and-for-all validations of POLYSIM or any other model is not possible. Validation must be a continuing process. Perhaps, the best validity test of a policy simulation model is its effectiveness as an aid in decision making. This type of evaluation requires a number of years of model experience.

POLYSIM STUDIES

Research articles on policy and programs that were analyzed with the use of POLYSIM have been published in several agricultural economic journals and proceedings of professional meetings. Numerous USDA unpublished staff analyses of target prices, loan rates, grain re-

November 1977	Economic Impact of a Ban on Using Toxaphene to Control Budworm-Bollworm Pest Complex for Cotton.
September 1977	Economic analysis of Selected Requests on Beef and Pork in Multilateral Trade Negotiations.
July 1977	Probabilities of Needing Export Assistance to Keep Prices Above Specified Levels.
February 1977	A Repeat of History—The 1972-75 Experience in 1978-81.
February 1977	Price Support Program Option.
February 1977	Price Support and Grain Reserve Options.
February 1977	"Grain-Livestock Interrelationships and Trade-Offs." Proceedings Farm and Food Policy Symposium, Great Plains Agr. Coun. Pub. 84, pp. 25-49.
January 1977	"Impacts of Reverting to Basic Legislation When the Agriculture and Consumer Protection Act of 1973 and Rice Production Act of 1975 Expire," ERS, AFPR-1, Jan. 1977, pp. 40-53.
January 1977	"Alternative Economic Settings for Agriculture: 1977-81." ERS, Agricultural-Food Policy Review (AFPR-1), Jan. 1977, pp. 12-30.
August 1976	"Simulation Analysis of Farm Programs with Grain Reserve Features." Anl. of Grain Reserves, USDA, ERS Rpt. 634, pp. 136-156.
August 1976	"Continuation of Minimal Provisions of 1973 Agriculture Act through 1980." in Special Rpt. 43, Ill. Agr. Exp. Sta.
June 1976	Projections of 1976 Wheat Price Under Conditions of Uncertainty, *Okla. Cur. Farm Econ.,* Vol. 49, No. 2.
May 1976	Impacts of Large Changes in 1976 Corn Yields.
March 1976	"Combining Simulation and Optimization Models—An Energy and Food Application." Proceedings 1976 Sp. Meeting of Amer. Institute of Ind. Eng., pp. 277-286.
December 1975	A Simulation Analysis of Alternative Target Price and Loan Rate Comginations, *So. Jour. of Ag. Econ.,* Vol. 7, No. 2.
December 1975	Implications of Energy and Environment Upon Growth in Food and Fiber Sector, *AJAE,* pp. 819-822.
June 1975	Simulated 1975 Wheat Price Under Varying Conditions of Production and Demand, *Okla. Cur. Farm Econ.,* Vol. 48, No. 2.
Jan.-April 1975	Alternative Target Price, Loan Rate and Export Program Options.
February 1975	A Simulation Analysis of a Reserve Stock Management Policy For Feed Grains and Wheat, *So. Jour. of Ag. Econ.,* Vol. 7, No. 1.
January 1975	Policy Issues and Research Results for U. S. Agriculture, *Okla. Cur. Farm Econ.,* Vol. 48, No. 1.
August 1974	Price Impacts Due to 3, 6, and 9 Million Tons of Additional Feed Grains.

Chart 1. Dates and Description of Published Studies and Unpublished Staff Analyses Which Used POLYSIM as Part of the Analyses.

serve strategies, and set-aside combinations have been made with POLYSIM. Other staff reports have examined the uncertainties in commodity prices and farm incomes due to potential variability in weather. One staff report examined the probabilities of export assistance that would be needed in order to keep market prices above specified levels. A partial list of the studies which utilized POLYSIM are given in Chart 1.

SUMMARY AND POLYSIM LIMITATIONS

The National Agricultural Policy Simulator was developed over the past five years by Oklahoma State University in cooperation with the U. S. Department of Agriculture for farm policy analysis. The model has been used to address numerous farm policy questions both by OSU economists and by USDA policy analysts. The model was originally developed as a deterministic simulation model but has been modified to incorporate probability distributions for crop yields and exports thus allowing stochastic analyses of farm policy questions.

Without modification POLYSIM can be used to investigate the impact of changes in the following Government variables: target prices and resulting deficiency payments, loan rates, CCC release prices, voluntary or mandatory set-aside acreages, per acre payment schedules for voluntary set-aside, program participation rates, and acreage or production quotas. Also, the effects of yield and export levels different from those in the baseline can be investigated. In addition, POLYSIM can be easily reprogrammed to include specific program provisions or to address specific policy questions.

The model provides estimates of acreage, yield, production, variable expenses, total supply, price, commercial domestic demand, exports, carryover, cash receipts for each of the four model crops (feed grains, wheat, soybeans, and cotton) and price, production, and cash receipts estimates for each of the seven livestock categories (cattle, hogs, sheep, broilers, turkeys, eggs and milk). Estimates for the various commodity variables are summed and added to endogenous data for commodities not included in the model to develop aggregate estimates of production expenses, Government payments, gross income, and realized net income. Policies can be analyzed with POLYSIM only over the period for which annual baseline projections are available. Such a consistent baseline is developed at least twice a year by analysts in the Commodity Economics Division, USDA.

POLYSIM is not a tool for all problems. As a positivistic model, it cannot estimate optimum resource allocations for specific demand levels or productive capacity subject to resource constraints. Analyses of international stock reserve schemes are hindered because the world grain market is exogenous to the system. As with econometric projection models, users must anticipate and build in structural changes in supply and demand parameters. The model does not provide estimates of changes in the organizational makeup of agriculture, in land values, or in liability and asset variables found in national balance sheets in agriculture. However, output from the model, such as net farm income under various farm policy structures, could be inputed into other analytical models designed to make these estimates. Price variations during the year cannot be analyzed because the prices in POLYSIM are season averages for crops and calendar year averages for livestock. Also, the model cannot extend the baseline, but it may be useful in revising an existing baseline if the impacts are due only to variables in POLYSIM.

Further development for POLYSIM will include enlarging the number of endogenous commodities in the model, adding a consumer sector to estimate the retail price of foods, and linking the model to optimizational routines for computing policy variable values in which the tradeoffs among farm incomes, consumer food expenditures and treasury costs are explicitly recognized.

SELECTED BIBLIOGRAPHY

Ahalt, Dawson J. and Alvin C. Egbert. 1965. "The Demand for Feed Concentrates: A Statistical Analysis." *Agr. Econ. Research.* 17:41-49.

Anderson, Jock R. 1974. "Simulation: Methodology and Application in Agricultural Economics." *Review of Marketing and Agricultural Economics.* 42:3-55.

Anderson, Kim B. and Luther Tweeten. 1975. "A Simplified Procedure to Predict Seasonal Average Wheat and Feed Grain Prices." *Okla. Current Farm Econ.* 43:3-8.

Barlowe, Russel G. and James R. Donald. 1971. "Analysis of Demand for U. S. Cotton Exports." USDA-ERS Cotton Situation Report, August.

Barr, Terry N. 1973. "Demand and Price Relationships for the U. S. Wheat Economy." USDA-ERS Wheat Situation Report, November.

Bjarnason, Harold Fredrick. 1967. *An Economic Analysis of 1980 International Trade in Feed Grains.* Ph.D. thesis, University of Wisconsin.

Blakeslee, Leroy. 1971. "Statistical Estimation of the Effect of Past World War II Farm Policy on U. S. Planted Wheat Acreage." *Proceedings of the West. Agr. Econ. Assoc.,* Forty-fourth meeting.

Blakley, Leo V. 1962. *Quantitative Relationships in the Cotton Economy With Implications for Economic Policy.* Oklahoma Agr. Exp. Sta. Bul. T-95.

Bonner, James T. and William A. Cromarty. 1958. "The Structure of Agriculture." *Agricultural Adjustment Problems in a Growing Economy,* ed. Earl O. Heady, et. al., pp. 109-27. Ames: Iowa State College Press.

Bowlen, B. J. 1955. "The Wheat Supply Function." *J. Farm Econ.* 37:1177-85.

Brandow, G. E. 1961. *Interrelations Among Demands for Farm Products and Implications for Control of Market Supply.* Pennsylvania Agr. Exp. Sta. Res. Bul. 680.

Brown, Herbert W. 1971. *Soybeans: Acreage Responses to Price and Farm Program Changes.* USDA-ERS-473.

Butell, Robert and Abner Womack. 1975. "October-December Feed Demand for Corn." USDA-ERS Feed Situation Report, November.

Cochrane, Willard W. 1955. "Conceptualizing the Supply Relation in Agriculture." *J. Farm Econ.* 37:1161-76.

Cathcart, William E. and James R. Donald. 1966. *Analysis of Factors Affecting U. S. Cotton Exports.* USDA-ERS Agr. Econ. Rep. 90.

Chen, Dean, Richard Courtney, and Andrew Schmitz. 1972. "A Polynomial Lag Formulation of Milk Production Response." *Amer. J. Agr. Econ.* 54:77-83.

Chuang, Y. H. and G. G. Judge. 1964. *Sector and Spatial Analysis of the United States Feed Economy.* Illinois Agr. Exp. Sta. Res. Bul. 699.

Clements, Alvin M., Jr., Harry P. Mapp, Jr., and Vernon R. Eidman. 1971. *A Procedure for Correlating Events in Farm Firm Simulation Models.* Oklahoma Agr. Exp. Sta. Res. Bul. T-131.

Clough, Malcolm. 1966. "Major Factors Influencing High-Protein Feed Prices." USDA-ERS Feed Situation Report, April.

Cochrane, Willard W. 1958. *Farm Prices Myth and Reality.* Minn: University of Minnesota Press.

Colyer, Dale and George D. Irwin. 1967. *Beef, Pork, and Feed Grains in the Cornbelt: Supply Response and Resource Adjustments.* Missouri Agr. Exp. Sta. Res. Bul. 921.

Cromarty, William A. 1959. "An Econometric Model for United States Agriculture." *Amer. Stat. Assoc. J.* 54:556-74.

Cromarty, William. 1962. *Predicting the Impact of Alternative Government Programs on the Wheat and Feed-Livestock Economies.* Michigan Agr. Exp. Sta. Tech. Bul. 286.

Dean, Gerald W. and Earl O. Heady. 1958. "Changes in Supply Response and Elasticity for Hogs." *J. Farm Econ.* 40:845-60.

Donald, James R., Frank Lowenstein, and Martin Simon. 1963. *The Demand for Textile Fibers in the United States.* USDA-ERS Tech. Bul. 1301.

Dudley, George E., James R. Donald and Russel G. Barlowe. 1970. "Yield and Acreage Implications for U.S. Cotton." USDA-ERS Cotton Situation Report, August.

Egbert, Alvin C. and Shlomo Reutlinger. 1965. "A Dynamic Long-Run Model of the Livestock Feed Sector." *J. Farm Econ.* 47:1288-1305.

Ericksen, Milton H., Daryll E. Ray and James W. Richardson. 1976. "Farm Programs and Grain Reserves—Simulated Results." *Analyses of Grain Reserves, A Proceedings.* Compiled by David J. Eaton and W. Scott Steele, ERS-USDA, in cooperation with the National Science Foundation. ERS Report No. 634.

Feltner, Richard Lee. 1965. *Alternative Models of the Feed-Livestock Economy.* Ph.D. thesis, North Carolina State University.

Fielder, Lonnie L., Jr. 1976. *An Analysis of Changes in the Acreage and Yield of Cotton, Rice, and Sugarcane in Louisiana.* Dept. of Agr. Econ. and Agri. Bus., D.A.E. Research Report 499, Louisiana State University.

Fisher, Franklin M. and Peter Temin. 1970. "Regional Specialization and the Supply of Wheat in the United States, 1867-1914." *Rev. of Econ. and Stat.* 52:134-149.

Fisher, Malcolm R. 1958. "A Sector Model—The Poultry Industry of the U.S.A." *Econometrica,* 16:37-66.

Foote, Richard J. 1953. "A Four Equation Model of the Feed-Livestock Economy and Its Endogenous Mechanism." *J. Farm Econ.* 35:44-61.

Folwell, Raymond J. and Hosein Shapouri. 1976. *An Econometric Analysis of the U.S. Beef Sector.* Washington Agr. Exp. Sta. Bul. (in print).

Fox, Karl A. 1953. *The Analysis of Demand for Farm Products.* USDA Tech. Bul. 1081.

Fox, Karl A. and Richard C. Taeuber. 1955. "Spatial Equilibrium Models of the Livestock-Feed Economy." *Amer. Econ. Rev.* 45:584-608.

Freebain, J. W. and Gordon C. Rausser. 1975. "Effects of Changes in the Level of U.S. Beef Imports." *Amer. J. Agr. Econ.* 54:676-688.

Gardner, Bruce L. 1976. "Futures Prices in Supply Analysis." *Amer. J. Agr. Econ.* 58:81-85.

George, P. S. and G. A. King. 1971. *Consumer Demand for Food Commodities in the United States With Projections for 1980.* Univ. of California. Giannini Foundation Monograph 26.

Gerra, Martin J. 1959. "An Econometric Model of the Egg Industry." *J. Farm Econ.* 41:284-301.

Gruber, Josef and Earl O. Heady. 1968. *Econometric Analysis of the Cattle Cycle in the United States.* Iowa Agr. Exp. Sta. Res. Bul. 564.

Hallberg, M. C. and R. F. Fallert. 1976. *Policy Simulation Model for the United States Dairy Industry.* Pennsylvania Agr. Exp. Sta. Res. Bul. 805.

Halvorson, Harlow W. 1958. "The Response of Milk Production to Price." *J. Farm Econ.* 40:1101-13.

Halvorson, Harlow W. 1955. "The Supply Elasticity for Milk in the Short Run." *J. Farm Econ.* 39:1186-89.

Harrington, David H. 1972. *A Model of Milk Production and Disposition: Supply, Utilization, and Government Support in the Dairy Sector.* Mimeo. Purdue University.

Heady, Earl O. and V. Y. Rao. 1967. *Acreage Response and Production Supply Functions for Soybeans.* Iowa Agr. Exp. Sta. Res. Bul. 555.

Heien, Dale. 1976. "An Econometric Analysis of the U. S. Poultry Sector." *Amer. J. Agr. Econ.* 58:311-16.

Heien, Dale. 1975. "An Econometric Model of the U. S. Pork Economy." *Rev. of Econ. and Stat.* 57:370-74.

Heien, Dale, Rodney Kite, and Jimmy Mathews. 1976. *The Internal Dynamics of the U. S. Livestock Economy.* Mineo, OED, ERS, USDA.

Helmberger, Peter and Willard W. Cochrane. 1957. "A Short-Run Supply Relationships for Eggs in Minnesota." *J. Farm Econ.* 39:532-39.

Helmers, G. A. and W. F. Lagrone. 1970. *Wheat and Feed Grains in the Great Plains and Northwest: Supply Response and Resource Use.* Nebraska Agr. Exp. Sta. Res. Bul. 236 (p. 20).

Houck, James P. 1964. "A Statistical Model of the Demand for Soybeans." *J. Farm Econ.* 46:366-74.

Houck, J. P., M. E. Abel, M. E. Ryan, P. W. Gallagher, R. G. Hoffman, and J. B. Penn. 1976. *Analysing the Impact of Government Programs on Crop Acreage.* Minnesota Agr. Exp. Sta. Tech. Bul. 1548.

Houck, James P. and Paul W. Gallagher. 1976. "The Price Responsiveness of U. S. Corn Yield." *Amer. J. Agr. Econ.* 58:731-34.

Houck, J. P. and J. S. Mann. 1968. *An Analysis of Domestic and Foreign Demand for U.S. Soybeans and Soybean Products.* Minnesota Agr. Exp. Sta. Techn. Bul. 256.

Houck, J. P. and M. E. Ryan. 1972. "Supply Analysis for Corn in the United States: The Impact of Changing Government Programs." *Amer. J. Agr. Econ.* 54:184-191.

Houck, James P., Mary E. Ryan and Abraham Subotnik. 1972. *Soybeans and Their Products, Markets, Models and Policy.* Minneapolis: University of Minnesota Press.

Houck, James P. and Abraham Subotnik. 1969. "The U. S. Supply of Soybeans; Regional Acreage Functions." *Agr. Econ. Research.* 21:99-108.

International Mathematical and Statistical Libraries. 1975. *IMSL Library 1.* Houston: International Mathematical and Statistical Libraries, Inc. Edition 5.

Judge, George G. 1954. *Demand and Supply Relationships for Eggs.* Conn. Agr. Exp. Sta. Bul. 307.

Kelley, Paul L. and Dale A. Knight. 1965. "Short-Run Elasticities of Supply for Milk." *J. Farm Econ.* 47:93-104.

King, Gordon A. 1958. *The Demand and Price Structure for Byproduct Feeds.* USDA Tech. Bul. 1183.

Kohls, R. L. and Don Paarlberg. 1950. *The Short-Time Response of Agricultural Production to Price and Other Factors.* Indiana Agr. Exp. Sta. Bul. 555.

Ladd, George W. and George R. Winter. 1961. "Supply of Dairy Products by Iowa Farmers." *J. Farm Econ.* 43:113-22.

Langemeier, Larry and Russel G. Thompson. 1967. "Demand, Supply and Price Relationships for the Beef Sector, Post-World War II Period." *J. Farm Econ.* 49:169-83.

Lee, Tsoung-Chao and Stanley K. Seaver. 1971. "A Simultaneous-Equation Model of Spatial Equilibrium and Its Application to the Broiler Markets." *Amer. J. Agr. Econ.* 53:63-70.

Lowenstein, Frank and Martin S. Simon. 1954. "Analysis of Factors That Affect Mill Consumption of Cotton in the United States." *Agr. Econ. Res.* 6:101-10.

Lowenstein, Frank. 1964. *Extra Long Staple Cotton, Demand and Price Prospect.* Internatl. Bank for Reconst. and Develop. Report EC-125.

McKeon, John. 1974. *Farm Commodity Programs: Their Effects on Plantings of Feed Grains and Soybeans.* Ph.D. thesis, Michigan State University.

Matthews, Jimmy L. 1973. "Supplement to: Conditional Market Forecasts and Implications for the U. S. Soybean Economy." USDA-ERS Fats and Oils Situation Report, July.

Matthews, Jimmy L., Abner Womack, and Robert G. Hoffman. 1971. "Formulation of Market Forecasts for the U. S. Soybean Economy with an Econometric Model." USDA-ERS Fats and Oils Situation Report, November.

Marsaglia, G. and T. A. Bray. 1964. "A Convenient Method for Generating Normal Variables." *S.I.A.M. Review.* 6:260-264.

Marsh, John M. and Raymond J. Folwell. 1971. *An Econometric Analysis of the U. S. Poultry Meats Sector.* Washington Agr. Exp. Sta. Tech. Bul. 67.

Martin, Larry and Richard Haack. 1976. *An Economic Analysis of Supply Management for the Canadian Beef Sector.* School of Agri. Econ. and Ext. Educ. AEEE-76-16, University of Guelph.

Martin, Larry and Anthony C. Zwart. 1976. "A Spatial and Temporal Model of the North American Pork Sector for the Evaluation of Policy Alternatives." *Amer. J. Agr. Econ.* 57:55-65.

Martin, Marshall A. and Joseph Havlicek, Jr. 1977. "Some Welfare Implications of the Adoption of Mechanical Cotton Harvesters in the United States." *Amer. J. Ag. Econ.* 59:739-744.

Meinken, Kenneth W. 1953. *The Demand and Price Structure for Oats, Barley, and Sorghum Grains.* USDA-BAE Techn. Bul. 1080.

Meinken, Kenneth W. 1955. *The Demand and Price Structure for Wheat.* USDA Tech. Bul. 1136.

Mo, William Y. 1968. *An Economic Analysis of the Dynamics of the United States Wheat Sector.* USDA-ERS Tech. Bul. 1395.

Naylor, Thomas H. 1971. *Computer Simulation Experiments With Models of Economic Systems.* New York: John Wiley and Sons, Inc.

Nerlove, Marc. 1956. "Estimates of the Elasticities of Supply of Selected Agricultural Commodities." *J. Farm Econ.* 38:496-509.

Nerlove, Marc. 1958. *The Dynamics of Supply.* Baltimore: The Johns Hopkins Press.

Paulino, Leonardo A. 1966. *A Recursive Model of the United States Domestic Soybean Market.* Ph.D. thesis, Michigan State University.

Penn, J. B. 1973. "An Econometric Policy Model of Commodity Supply Response." Mimeo draft.

Penn, J. B. and George D. Irwin. 1974. *Acreage Response of Corn, Grain Sorghum, Soybeans, and Cotton to Farm Commodity Programs.* Indiana Agr. Exp. Sta. Journal Paper 5421.

Penn, J. B. and George D. Irwin. 1971. "A Simultaneous Equation Approach to Production Response: Delta Region." *Southern J. Agr. Econ* 3:115-21.

Prato, Anthony A. 1973. "Milk Demand, Supply and Price Relationships, 1950-1968." *Amer. J. Agr. Econ.* 55:217-22.

Ray, Daryll E. 1971. *An Econometric Simulation Model of United States Agriculture with Commodity Submodels.* Ph.D. thesis. Iowa State University.

Reutlinger, Shlomo. 1976. "A Simulation Model for Evaluating Worldwide Buffer Stocks of Wheat." *Amer. J. of Agr. Econ.* 58:1-12.

Reutlinger, Shlomo. 1966. "Short-Run Beef Supply Response." *J. Farm Econ.* 48:909-919.

Richardson, James W. and Harry P. Mapp, Jr. 1976. "Use of Probabilistic Cash Flows in Analyzing Investments Under Conditions of Risk and Uncertainty." *Southern J. Agr. Econ.* 2:19-24.

Richardson, James W. and Daryll E. Ray. 1977. "Demand for Feed Grains and Concentrates by Livestock Category." Western J. Agr. Econ. 3:23-30.

Richardson, James W. and Daryll E. Ray. 1975a. *User's Manual for the National Agricultural Policy Simulator (POLYSIM).* Okla. Agr. Exp. Sta. Res. Rep. P-727.

Richardson, James W. and Daryll E. Ray. 1975b. *User's Manual for UPDATE an Auxiliary Program for POLYSIM.* Okla. Agr. Exp. Res. Rep. P-726.

Ryan, Mary E. and Martin E. Abel. 1972. "Grain Acreage Response and the Set-Aside Program." *Agr. Econ. Res.* 24:102-12.

Shuib, A. B. and D. J. Menkhaus. 1977. "An Econometric Analysis of the Beef-Feed Grain Economy." *West. J. Ag. Econ.* 1:152-156.

Spence, Lyle C. 1976. "An Analysis of Investment Strategies for Retiring Farmers." M.S. thesis, Oklahoma State University.

Sprow, Frank B. 1967. "Evaluation of Research Expenditures Using Triangular Distribution Functions and Monte Carlo Methods." *J. Industrial and Engineering Chemistry.* 59:35-38.

Taylor, Bernard W. and Ronald M. North. 1976. "The Measure of Economic Uncertainty in Public Water Resource Development." *Amer. J. Agr. Econ.* 58:636-43.

Tesler, Lester G. 1957. "The Support Program and the Stability of Cotton Prices." *J. Farm Econ.* 39:393-408.

Theil, Henri. 1961. *Economic Forecasts and Policy.* Amsterdam: North-Holland Publishing Co.

Thompson, Russel G., J. M. Sprott, and R. W. Collen. 1972. "Demand, Supply, and Price Relationships for the Broiler Sector, With Emphasis on the Jack-Knife Method." *Amer. J. Agr. Econ.* 54:245-48.

Tomek, William G. 1972. "Distributed Lag Models of Cotton Acreage Response." *Amer. J. Agr. Econ.* 54:108-10.

Trapp, James N. 1976. *An Econometric Simulation Model of the United States Agricultural Sector.* Ph.D. thesis, Michigan State University.

Tweeten, Luther, Dale Kalbfleisch, and Y. C. Lu. 1971. *An Economic Analysis of Carryover Policies for the United States Wheat Industry.* Okla. Agr. Exp. Sta. Tech. Bul. T-132.

U. S. Congress, Senate, Committee on Agriculture and Forestry. 1977. *Costs of Producing Selected Crops in the United States—1975, 1976, and Projections for 1977.* Prepared by ERS-USDA, 95th Congress, 1st session, January 21.

U. S. Department of Agriculture. 1976. *Major Statistical Series of the U. S. Department of Agriculture.* Volume 2. Agricultural Production and Efficiency. Agr. Handbook No. 365.

U. S. Department of Agriculture. 1977. *Agricultural-Food Policy Review.* ERS-AFPR-1, January.

U. S. Department of Agriculture. 1977. *Agricultural Prices Annual Summary, 1976.* SRS, Crop Reporting Board, PR-1-3, June.

U. S. Department of Agriculture. 1976. *Agricultural Statistics 1976.* SRS, Data Services.

U. S. Department of Agriculture. 1977. *Cotton Situation.* ERS, CWS-10, April.

U. S. Department of Agriculture. 1963. *Dairy Situation.* ERS, DS-345, May.

U. S. Department of Agriculture. 1977. *Dairy Situation.* ERS, DS-365 and 366, May and July.

U. S. Department of Agriculture. 1977. *Farm Income Statistics.* ERS, Stat. Bul. 576, July.

U. S. Department of Agriculture. 1977. *Fats and Oils Situation.* ERS, FOS-286 and 287, February and July.

U. S. Department of Agriculture. 1977. *Feed Situation.* ERS, Report FDS-265 and 266, May and September.

U. S. Department of Agriculture. 1977. *Livestock and Meat Statistics, Supplement for 1976.* ERS, SRS, Stat. Bul. 522, June.

U. S. Department of Agriculture. 1975. *Livestock-Feed Relationships National and State, Supplement for 1974.* ERS, Stat. Bul. 530, October.

U. S. Department of Agriculture. 1977. *Poultry and Egg Situation.* ERS, PES-294, June.

U. S. Department of Agriculture. 1972. *Supplement for 1971 to Feed Statistics.* ERS, Stat. Bul. 410, July.

U. S. Department of Agriculture. 1977. *Wheat Situation.* ERS, Report WS-241, August.

Vandenborre, Roger J. 1964. *An Econometric Analysis of the U. S. Soybean Sector.* Ph.D. thesis, University of Illinois.

Vandenborre, Roger J. 1966. "Demand Analysis of the Markets for Soybean Oil and Soybean Meal." *J. Farm Econ.* 48:920-34.

Van Horne, Richard L. 1971. "Validation of Simulation Results." *Manage. Sci.* 17:247-57.

Wallace, Tomas D. and George G. Judge. 1958. *Econometric Analysis of the Beef and Pork Sectors of the Economy.* Okla. Agr. Exp. Sta. Tech. Bul. T-75.

Walsh, Robert M. 1944. "Response to Price in Production of Cotton and Cottonseed." *J. Farm Econ.* 26:359-72.

Wipf, Larry J. and James P. Houck. 1967. *Milk Supply Response in the United States on Aggregate Analysis.* Dept. of Agr. Econ. Report 532, University of Minnesota.

Wilson, Robert R. and Russell G. Thompson. 1967. "Demand, Supply, and Price Relationships for the Dairy Sector, Post-World War II Period." *J. Farm Econ.* 49:360-71.

Witherell, William H. 1967. *Dynamics of the International Wool Market: An Econometric Analysis.* Ph.D. thesis. Princeton University.

Wold, H. 1960. "A Generalization of Causal Chain Models." *Econometrica,* 28:443-63.

Wold, H. 1964. *Econometric Model Building: Essays on the Causal Chain Approach.* Amsterdam, Holland, Nor-Holland Publishing Co.

Womack, Abner. 1976. *The U. S. Demand for Corn, Sorghum, Oats and Barley: An Econometric Analysis.* Dept. of Agr. Econ. Report 76-5, University of Minnesota.

Working, H. 1926. "Wheat Acreage and Production in the United States Since 1866." Standard Food Research Institute, *Wheat Studies II,* pp. 237-64.

APPENDIX A

REVIEW OF THE ELASTICITIES USED IN POLYSIM

As is obvious to policy analysts, policy changes that affect the price of one crop in year t not only affect the acreage of the crop in year t+1 but also impact on other crop acreages that compete for the relatively fixed quantity of land. Due to problems of multicollinearity, econometric crop acreage equations, continuing with the example, usually include the expected price of the crop and the expected price of one of most important crops which compete for the use of the land. Hence, an econometric feed grain acreage equation in a given model may include the price of feed grains and the price of soybeans. With such a specification, feed grain acreage estimates from that model would not be affected by a sharp change in the price of wheat or cotton. This lack of response would be completely unrealistic and the problem becomes acute in policy analyses.

The simulation concept used in POLYSIM allows the analyst to account for the very real and important cross commodity impacts that can not be isolated with an ordinary econometric equation. The best information available on cross commodity response based on empirical work from a number of models and accumulated experience of commodity specialists can be incorporated into POLYSIM. All elasticities used in the model have been reviewed by commodity specialists in the USDA.

It is important to remember that the elasticities indicated as used in the model are default values. These values will be used unless overridden with new values provided by the user. If the user has "better" response parameters, they should be used.

The response parameters are stated explicitly in POLYSIM and, thereby, are subjected to the constant scrutiny of the researcher. If a specification for an equation leaves out a variable that the user believes should be included, the equation can and should be modified. The computational structure of POLYSIM permits easy modification of existing relationships or addition of new relationships.

The review of elasticities is separated into five sections. The first section deals with the livestock supply elasticities. The livestock demand elasticities are described in Section 2. Section 3 describes the supply response elasticities for the four model crops; while Section 4 reviews the demand elasticities used in the derived feed demand equations for livestock.

Section 1. Supply Response Elasticities For Livestock

The livestock categories in the model are: cattle and calves, hogs, sheep and lambs, broilers, turkeys, eggs and milk (in milk equivalents). Supply elasticities for these livestock categories found in the literature are reported here along with the discussion of the rationale for selecting the values used in the model.

CATTLE AND CALVES SUPPLY RESPONSE ELASTICITIES

The short run supply elasticity for beef is expected to be relatively inelastic due to the lengthy production process and fixity of resources. The lag between a decision to change calf numbers and the time they reach the market is relatively long. Of course, short term production levels are affected by feeding rates and marketing weights. Published estimates of beef supply response indicate that the supply response of cattle and calf production is indeed relatively inelastic (Table 10).

The cattle supply elasticities with respect to (wrt) own price in Table 10 fall mostly in the range between .08 and .17, with the majority of the studies reporting values in the .10 to .12 range. The Egbert and Reutlinger study [1966] indicates that the supply response parameter has become more inelastic over time (.344 for 1923-1946, and .162 for 1947-1962); this is supported by the recent work of Folwell and Shapouri [1976] and Heien, Kite and Matthews [1976] (Table 10). The default cattle supply elasticities used in POLYSIM are .11 in the short run and .44 in the long run.

The default cross elasticity of supply wrt feed grain price in the model is —.07; which is a little low relative to results by Colyer and Irwin [1967] of —.30; and Martin and Haack [1976] of —.23 (Table 10). However, this lower value is in line with the values reported by Folwell and Shapouri [1976] of —.09, by Heien, Kite and Matthews [1976] of —.08, and by Gruber and Heady [1968] of —.08 to —.09.

HOGS SUPPLY RESPONSE ELASTICITIES

While the supply of hogs is expected to be inelastic, the shorter gestation and finishing time for swine would suggest a larger supply elasticity for hogs than for cattle. Published estimates of the supply elasticity for hogs tend to support this contention (Table 11). The values reported by Egbert and Reutlinger [1965], Cochrane [1955 and 1958],

Table 10. Cattle and Calves Response Elasticities.

Author	Period of Data	Model[2]	Point of Elasticity	Other Dependent Variables Reported[1]	Own Elasticity	Cross Elasticity
Cochrane [1955]			Implicit		.6 to .8	
Colyer & Irwin [1967]	1929-62	LS	mean		.12 (.34)	-.30 wrt fg price t-1
Cromarty [1959]	1929-53	LI	mean		.037	
Cromarty [1962]	1929-57	LI	mean		.017	-.016 wrt fg price t-1
Folwell & Shapouri [1976]	1952-73	2SLS	mean	average slaughter weight	.125	-.09 wrt fg price t-1
Gruber & Heady [1968]	1925-62	LS	1962	cows & heifers over 2 yrs. kept	.060 to .123	.03 wrt corn supply t-1
	1925-62	LS	1962	calves kept as heifers	.083 to .138	-.09 wrt corn supply t-1
	1925-62	LS	1962	calves raised	.082 to .104	-.08 wrt fg price t-1
	1925-62	LS	mean	calves available	.056	
Heien, Kite & Matthews [1976]	1950-70	LS	mean		.17	-.08 wrt fg price t-1
Langemeier & Thompson [1967]	1947-64	2SLS	mean		.16	
Martin & Haack [1976]	1963-74	LS	mean	steer & heifer slaughter	.124	-.23 wrt fg price t-1
	quarterly	LS	mean	breeding inventory	.12 (.49)	
Reutlinger [1966]	1947-62	LS	mean	steers slaughtered	.162	
	1923-62	LS	mean.	steers slaughtered	.282	
	1947-62	LS	mean	cows & heifers slaughtered	.108	
	1923-62	LS	mean	cows & heifers slaughtered	.284	
	1923-46	LS	mean	steers slaughtered	.344	
Shuib & Menkhaus [1977]	1950-74	2SLS	mean	fed beef	.14	
				non-fed beef	.12	
Trapp [1976]	1954-71	Polynomial Lag	mean	fed beef	.45 (1.31)	-.40 wrt fg price t-1 (-.49)
	1954-71	Polynomial Lag	mean	non-fed beef	.37 (.86)	
Wallace & Judge [1958]	1925-55	ML	mean		.043 (.080)	.069 wrt corn prod. t-1

[1]Indicates use of a dependent variable other than that specified by the table title.

[2]The various models are abbreviated throughout this Appendix as: least squares denoted by LS, limited information by LI, two stage least squares by 2SLS, autocorrelated least squares by ALS, linear programming by LP, joint generalized least squares by JGLS, maximum likelihood estimators by ML, generalized least squares by GLS, and three stage least squares by 3SLS.

Heien [1975] and Colyer and Irwin [1967] indicate that the supply reponse of hogs is about three times as large as for cattle and calves (Table 11). Trapp [1976], Cromarty [1959 and 1962], and Martin and Zwart [1975] report supply elasticities in the area of .15, which is near the level used for cattle and calves (Table 11). Based on the empirical results summarized in Table 11 and a priori understanding of the swine production process, the default supply response elasticity of hogs in Polysim is .30 in the short run and .60 in the long run.

The default cross supply elasticity for hog production wrt feed grain prices is —.25 in the model. This value is slightly lower than that reported by Egbert and Reutlinger [1965] of —.349 but larger than Heien's [1975] value of —.125 and Trapp's [1976] value of —.15 (Table 11).

SHEEP AND LAMBS SUPPLY RESPONSE ELASTICITIES

In the U. S., the production of mutton has been secondary to the production of wool. Given the nature of wool-mutton production, one might expect that the production of sheep and lambs for meat is more price inelastic than the supply elasticity for wool. Sheep usually are shorn annually for several years and then butchered after they have passed maturity. Thus making the supply of mutton more dependent upon the average age of sheep on farms than the price of sheep and lambs received by farmers.

Published studies of the supply response for sheep are almost nonexistent as indicated by Table 12. The supply response reported by Witherall [1967] for wool production wrt sheep price is .13 and wrt feed grain price it is —.36. The default supply elasticity of sheep and lambs used in the model is .025. This value was selected based upon the a priori knowledge of the mutton and wool production relationships in the U. S. and the value for wool supply response in Table 12. The default cross supply response elasticity of sheep production wrt feed grain price is —.040 and wrt cattle and calf price is —.010.

POULTRY SUPPLY RESPONSE ELASTICITIES

The poultry industry has undergone a great deal of change in the last twenty years due to increased mechanization and concentration in the industry. The increased concentration has resulted from vertical integration of feed companies with poultry producers and through the use of contracts between producers and processors. A priori, it would be expected that these changes might make poultry supplies more price responsive. Published estimates of the elasticity of broiler supplies do indicate that the industry was less price responsive prior to 1960 than it is today, Table 13. The secular changes in supply elasticities for turkeys and eggs are in Tables 14 and 15.

Table 11. Swine Production Supply Response Elasticities.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Cochrane [1955]			implicit		.30	
Cochrane [1958]	1921-56	LS	mean	spring pigs	.309	
Colyer & Irwin [1967]	1929-62	LS	mean		.32 (.48)	
Cromarty [1959]	1929-53	LI	mean		.130	
Cromarty [1962]	1929-57	LI	mean		.158	
Dean & Heady [1958]	1924-37	LS	mean	farrowing, total	.46	
excludes 1940-44	1938-56	LS	mean	farrowing, total	.65	
excludes 1940-44	1938-56	LS	mean	fall farrowing	.30	
	1924-37	LS	mean	fall farrowing	.28	
excludes 1942-44	1938-56	LS	mean	spring farrowing	.60	
	1924-37	LS	mean	spring farrowing	.50	
Egbert & Reutlinger [1965]	1950-64	LS	mean		.309	-.349 wrt fg price t-1
Heien [1975]	1950-69	LS	mean		.31	-.125 wrt fg price t-1
Martin & Zwart [1975] quarterly	1961-72	2SLS	mean		.16 (.43)	-.002 wrt fg price t-1 -.02 wrt beef price t-1
Trapp [1976]	1954-71	Polynomial Lag	mean		.17 (.44)	-.15 wrt fg price t-1 -.04 wrt meal price t-1

Table 12. Sheep and Lamb Supply Response Elasticities.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Witherall [1967]	1949-56	LS	mean	wool supply	.136 (.345)	-.367 wrt fg price t-1• -.108 wrt beef price t-1

The default supply elasticity for broilers in POLYSIM is .26 in the short run and .36 in the long run with a default cross supply elasticity wrt feed grain price of —.22. The own supply elasticity .26, lies within the range of .21 reported by Lee and Seaver [1971] for the Southern States and the higher values reported by Heien [1976], Trapp [1976], and Fisher [1958] of .36, .39, and .31, respectively, (Table 13). The default cross supply elasticity wrt feed grain price (—.22) is consistent with the values reported in Table 13.

The default supply response elasticity for turkeys used in the model is .25 in the short run and .425 in the long run. The default cross supply elasticity wrt feed grain price is —.20. The cross supply elasticity reported by Egbert and Reutlinger [1965] of —.212 is the source for the values used in the model. The empirical values reported in Table 14 do not support the own supply elasticity; however it can be argued that due to similarity between turkey and broiler production arrangements the own supply elasticity of turkeys should be about the same as for broilers (.26). Hence, .25 is used as the default elasticity while the reported elasticities are in the .57 to .67 range (Table 14).

The supply elasticity of eggs received a great deal of attention in the literature in the 50's; however, this interest did not follow through to the current time period (Table 15). The elasticity of the supply of eggs when estimated using data for 1920-1950 appears to be about .20 to .40 and when data for 1950-1964 is used the elasticity is about .09 (Table 15). The default supply elasticity in the model used is .10 in the short run and .15 in the long run. The default cross supply elasticity wrt feed grain price in POLYSIM of —.06 is in line with the values reported in Table 15.

MILK SUPPLY RESPONSE ELASTICITIES

As indicated by the large number of references cited in Table 16 there has been a great deal of interest in the area of supply response for milk, both at the regional and the national level. The supply elasticity for milk is relatively inelastic wrt to own price due to biological lag required in getting a milk cow into full production and the limited alternatives available for the resources used in the dairy industry. Empirical estimates of the supply elasticity for milk tend to support this reasoning (Table 16). The default short run supply elasticity wrt milk price in the model is .10 and the long run elasticity is .25. These values are in line with those published in the literature and reported in Table 16.

The cross elasticity of milk supply wrt feed grain price is —.06 and wrt beef is —.005. These values tend to be in line with the cross elasticities reported in Table 16.

Table 13. Broilers Supply Response Elasticities.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Cromarty [1959]	1923-59	LI	mean	all poultry	.678	-.03 wrt fg price t-1
Egbert & Reutlinger [1965]	1950-64	LS	mean		.055	-.19 wrt fg price t-1
Fisher [1958]	1915-40	LI	mean		-.18 to +.31	-.43 wrt fg price t-1
	1915-50	LI	mean		.106	-.29 wrt fg price t-1
Freebain & Rousser [1975]	1957-71	LS	mean		.177	-.23 wrt fg price t-1
Heien [1976]	1950-70	LS	mean	broilers	.360	-.00 wrt fg price t-1
	1950-70	LS	mean	other chickens	.060	(-.02) wrt fg price t-1
Lee & Seaver [1971]	1956-67	2SLS	mean	Northern U.S.	.10	-.10 wrt fg price t-1
	1956-67	2SLS	mean	Southern U.S.	.21	-.21 wrt fg price t-1
	1956-67	2SLS	mean	Rest of the U.S.	.09	-.09 wrt fg price t-1
Marsh & Folwell [1971]	1950-68	2SLS	mean	all poultry	.13	
Thompson, et al. [1972]	1935-68	2SLS	mean			-.176 to -.21 wrt fg price t-1
Trapp [1976]	1954-71	Polynomial lag	mean		.39 (.80)	-.36 wrt fg price t-1 -.31 wrt mean price t-1

Table 14. Supply Response Elasticities for Turkeys.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Egbert & Reutlinger [1965]	1950-64	LS	mean		.672	-.212 wrt fg price t-1
Heien [1976]	1950-70	LS	mean		.560	-.00 wrt fg price t-1 (-.02) wrt fg price t-1
Trapp [1976]	1954-71	Polynomial lag	mean		.57 (.85)	-.45 wrt fg price t-1 -.01 wrt meal price t-1

Table 15. Supply Response Elasticities for Egg Production.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Cochrane [1955]			implicit		1.0 to 1.2	
Cromarty [1959]	1923-53	LI	mean		.298	-.054 wrt fg price t-1
Cromarty [1962]	1927-59	LI	mean		1.09	
Egbert & Reutlinger [1965]	1950-64	LS	mean		.087	-.112 wrt fg price t-1
Fisher [1958]	1925-40	LS	mean		.217	-.107 wrt fg price t-1
	1925-40	LI	mean		.20	-.16 wrt fg price t-1
	1915-40	LI	mean		.21	-.17 wrt fg price t-1
Gerra [1959]	1931-41 &	LI	mean		.40	-.05 wrt fg price t-1
	1946-54	LS	mean		.43	
Helmberger & Cochrane [1957]	1938-54	LS	mean	Minnesota data	.46	
Judge [1954]	1921-50	LS	mean		.30	
	1921-50	LI	mean		.19 to .229	-.40 wrt fg price t-1

Table 16. Milk Supply Response Elasticities.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Chen, Courtney, & Schmitz [1972]	1953-68	Polynomial Lag	mean	California production	.381 to .16 (2.54 to 2.53)	
Cochrane [1955]			implicit		.3 to .4	
Cochrane [1958]	1947-56	LS	mean		.03	
Cromarty [1959]	1929-53	LI	mean		.212	-.01 wrt fg price t-1
Cromarty [1963]	1929-57	LI	mean		.789	-.674 wrt fg price t-1
Egbert & Reutlinger [1965]	1950-64	LS	mean		.0703	-.082 wrt fg price t-1
Hallberg & Fallert [1976]	1955-73	LS	mean	weighted regional average	.20	-.10 wrt fg price t-1
Halverson [1955]	1931-54	LS	mean	lb./cow/day summer	.029	-.029 wrt fg price t-1
	1931-54	LS	mean	lb./cow/day winter	.135	-.135 wrt fg price t-1
Halverson [1958]	1927-57	LS	mean		.132 to .157 (.31 to .39)	-.0002 wrt beef price t-1
	1941-57	LS	mean		.18 to .28 (.15 to .52)	-.0097 wrt beef price t-1
Harrington [1972]	1946-70	LS	mean	weighted regional average	.11 (.55)	-.03 wrt beef price t-1 -.06 wrt fg price t-1
Kelley & Knight [1965]		LP		Kansas sample of 49 farms	.187 to .04	
Ladd & Winter [1961]	1926-56	LS	mean	Iowa production	.06	-.06 wrt beef price t-1
Parato [1973]	1950-68	2SLS	mean	lbs./cow	.046	-.02 to -.08 wrt fg price t-1
Trapp [1976]	1954-71	Polynomial Lag	mean		.06 (.58)	-.06 wrt fg price t-1
Wilson & Thompson [1967]	1947-63	2SLS	mean		.003 (.521)	
Wipf & Houck [1967]	1945-64	LS	mean		.068 to .127 (.148 to .192)	-.062 wrt fg price t-1 -.089 wrt beef price t-1
less Korean War Years	1945-64	LS	mean		.058 to .14 (.138 to .19)	-.098 wrt beef price t-1 -.066 wrt fg price t-1

Section 2. The Demand Elasticities in the Model For Livestock and Livestock Products

The demand elasticities for livestock have been estimated by a theoretical model by Brandow [1961] and by George and King [1971]. The own and the cross demand elasticities for the major livestock categories were calculated by these researchers. The matrix of own and cross elasticities is inverted to obtain the own and cross price flexibilities for the major livestock categories (Table 17). The percent change in price of each livestock category from their baseline prices can be calculated by cross multiplying the percentage change in livestock production by the price flexibility matrix as described in the text.

The Commodity Economics Division of the USDA developed the CED price flexibility matrix by adjusting some of the own and cross price flexibilities in the George and King [1971] matrix (Table 17). These adjustments were to account for changes in the livestock sectors that have occurred since the studies. All three price flexibility matrices are available to the model and the user specifies which one to use.

Section 3. Crop Supply Response Elasticities

The acreage and yield response elasticities for the four model crops are presented in Table 3. This section reviews the literature on crop supply elasticities. To the extent that total crop acreage is fixed, the supply of acreage for a given crop is a homogeneous function of degree zero with respect to the own and cross crop prices. Since total acreage can and does vary somewhat, the sum of the cross supply elasticities may not equal the own supply elasticity.

FEED GRAIN HARVESTED ACREAGE SUPPLY ELASTICITIES

The published estimates of the short-run supply elasticity of feed grain acreage wrt feed grain price are about .10 (Table 18).[10] The separate cross elasticities of feed grain acreage wrt wheat price and soybean price reported in Table 18 are generally too large to be used in a linear homogeneous supply function of degree zero. Since soybeans are a closer substitute than wheat, the cross feed grain acreage elasticity for soybean price would be expected to be greater (in absolute value) than that for wheat price. Trapp's [1976] estimate for the cross supply elasticity wrt the price of soybeans of —.05 was considered to be a lower bound. The default cross elasticities used in the model are —.06 for soybean price, —.03 for wheat price and —.01 for cotton price.

[10]All own and cross crop prices used in the acreage, yield and expense per acre relationships are lagged one year.

Table 17. Farm Level Price Flexibilities for the Seven Major Livestock Categories.

Logs of Prices of	BRANDOW MATRIX[1] - Logarithm of Quantities of:						
	Cattle[2]	Hogs[2]	Sheep and Lambs[2]	Chickens[2]	Turkeys[2]	Eggs[3]	Milk[4]
Cattle[5]	-1.5862	-.2787	-.0363	-.1458	-.0248	-.0245	-.0283
Hogs[5]	-.4180	-2.3269	-.0478	-.1929	-.0331	-.0351	-.0407
Sheep and Lambs[5]	-.5026	-.4460	-.4832	-.1917	-.0317	-.0212	-.0243
Chickens[5]	-.4750	-.4205	-.0450	-1.4907	-.1375	-.0301	-.0347
Turkeys[5]	-.3112	-.2757	-.0295	-.5364	-1.1332	-.0265	-.0307
Eggs[6]	-.1018	-.0856	-.0068	-.0348	-.0087	-3.5000	-.0648
Milk[7]	-.0506	-.1189	-.0033	-.0172	-.0043	-.0230	-2.6390

Logs of Prices of	GEORGE AND KING MATRIX[1] - Logarithm of Quantities of:						
	Cattle[2]	Hogs[2]	Sheep and Lambs[2]	Chickens[2]	Turkeys[2]	Eggs[3]	Milk[4]
Cattle[5]	-2.3946	-.9051	-.0746	-.2716	-.0268	-.0270	-.0271
Hogs[5]	-.7184	-4.7626	-.1231	-.2774	-.0296	-.0693	-.0696
Sheep and Lambs[5]	-.5845	-.6916	-.6673	-.3299	-.0303	-.0420	-.0422
Chickens[5]	-.9064	-.9825	-.0936	-1.8671	-.1011	-.0471	-.0472
Turkeys[5]	-.4315	-.5858	-.0416	-.5126	-.7962	-.0207	-.0208
Eggs[6]	-.2683	-.4699	-.0262	-.0926	-.0163	-4.3350	-.4316
Milk[7]	-.0884	-.1313	-.0089	-.0282	-.0060	-.1750	-3.1801

Table 17. Continued.

Logs of Prices of	CED LIVESTOCK MATRIX[1] - Logarithum of Quantities of:						
	Cattle[2]	Hogs[2]	Sheep and Lambs[2]	Chickens[2]	Turkeys[2]	Eggs[3]	Milk[4]
Cattle[5]	-1.6446	-.9051	-.0746	-.2716	-.0268	-.0269	-.0271
Hogs[5]	-.7184	-2.3269	-.0478	-.1929	-.0331	-.0351	-.0407
Sheep and Lambs[5]	-.5026	-.4460	-.4832	-.1917	-.0317	-.0212	-.0243
Chickens[5]	-.7750	-.4205	-.0450	-1.4907	-.1375	-.0301	-.0347
Turkeys[5]	-.4612	-.2757	-.0295	-.5364	-1.1332	-.0265	-.0307
Eggs[6]	-.2684	-.4699	-.0262	-.0926	-.0164	-4.3350	-.4316
Milk[7]	-.0885	-.1313	-.0089	-.0282	-.0060	-.1750	-3.1801

[1]Sources: Brandow [1961], George and King [1971] and Commodity Economics Division, USDA.

[2]Million pounds slaughtered.

[3]Million dozen sold.

[4]Million hundred weight sold.

[5]Dollars per pound.

[6]Dollars per dozen.

[7]Dollars per hundredweight.

Table 18. Feed Grain Acreage Response Elasticities.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Bonner & Cromarty [1958]	1929-53	LS	mean	total production	.364	
Cochrane [1955]			implicit	total production	.2 to .3	
Colyer & Irwin [1967]	1929-62	LS	mean		.11	
Cromarty [1959]	1929-53	LS	mean	total production	.43	
Houck et al. [1976]	1949-70	LS	mean	corn acreage	.125	-.135 wrt soybean price t-1
	1950-74	LS	mean	corn acreage	.130	
	1957-74	LS	mean	sorghum acreage	.149	
	1950-74	LS	mean	barley acreage	.301	
	1956-74	LS	mean	oat acreage	.298	
Houck & Ryan [1972]	1948-70	LS	mean		.126 to .138	
Kohls & Paarlburg [1950]	1924-42	LS	mean		.07	
Nerlove [1956]	1909-32	LS	mean	(restricted model)	.09	
	1909-32	LS	mean	(unrestricted model)	.18 (.36)	
Nerlove [1958]	1909-32	LS	mean		.09, .10, .14	
	1909-32	LS	mean		.10	-.07 to -.08 wrt wheat price t-1
Penn [1973]	1967-71	JGLS	mean	corn acreage	.21	-.17 wrt soybean price t-1
	1954-71	JGLS	mean	corn acreage	.23	-.15 wrt soybean price t-1
Penn & Irwin [1971]	1947-69	2SLS	mean	Delta states	-.13	.91 wrt soybean price t-1 -.81 wrt cotton price t-1
Ray [1971]	1930-67	LS	mean		.17 (.21)	-.25 wrt wheat price t-1 (-.31)
Ryan & Abel [1972]	1949-70	LS	mean	corn acreage	.124 to .13	-.27 wrt soybean price t-1
Shuib & Menkhaus [1977]	1950-74	2SLS	mean	corn supply	.145	
Trapp [1976]	1954-71	geometric lag	mean		.132	-.157 wrt wheat price t-1 -.05 wrt soybean price t-1
Womack [1976]	1950-74	LS	mean	corn acreage	.13	-.163 wrt soybean price t-1
	1950-74	LS	mean	sorghum acreage	.09	

WHEAT HARVESTED ACREAGE SUPPLY ELASTICITIES

Flexibility of land use in wheat areas is often quite limited, especially in the Plains States. Hoffman [1973] reports that the elasticity of supply for wheat acreage is twice as large in the Corn Belt as in the Plains States (Table 19). Since most wheat is grown in the Plains States, the elasticity of wheat acreage wrt to wheat price is expected to be quite low. The default own price acreage elasticity used in POLYSIM is .10. The default cross supply elasticities for wheat acreages that were agreed upon by commodity specialists are: —.03 wrt feed grain price, —.02 wrt soybean price and —.01 wrt cotton price.

SOYBEAN HARVESTED ACREAGE SUPPLY ELASTICITIES

In many areas soybeans tend to be a residual crop with corn or cotton being the preferred or more profitable crop. Hence, soybean acreage is highly sensitive to changes in the relative price of soybeans, feed grains and cotton. There is general agreement in the literature that the own price elasticity for soybean acreage is between .17 and .40 with a large number of observations at .25 (Table 20). The default short-run supply elasticity used in the model is .25 and .312 is the default long-run elasticity. The default cross elasticity of soybean acreage wrt feed grain price is —.15; a value that lies within the extremes of —.07 to —.22 reported in Table 20. The default cross elasticity of soybean acreage wrt cotton price is —.03, slightly lower than the —.04 reported by Houck and Subotnik [1969]. The default cross elasticity of soybean supply wrt wheat price is —.02.

COTTON HARVESTED ACREAGE SUPPLY ELASTICITIES

The literature suggests that the own price supply elasticity for cotton is about the same as for soybeans. Nearly all of the empirical estimates for the cotton own price acreage elasticity are in the range of .17 to .45 (Table 21). The default values used in POLYSIM are .30 in the short-run and .60 in the long-run.

The default cross elasticities of supply for cotton acreage in the model are: —.05 wrt feed grain price, —.01 wrt wheat price, and —.10 wrt soybean price. The cross elasticity wrt feed grain price is in line with the values reported by Penn and Irwin [1971] and by Brenner [1958] (Table 21). The cross elasticities wrt soybean price reported in Table 21 appear to be too large relative to the default own supply elasticity of .30. Therefore, the default cotton supply elasticity wrt soybean price is twice the cross elasticity wrt feed grain price.

Table 19. Wheat Acreage Response Elasticities.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Blakeslee [1971]	1948-69	LS	mean		.18	-.30 wrt fg price t-1
Bonner & Cromarty [1958]	1929-53	LS	mean	total supply	.129	
Bowlen [1955]	1926-52	LS	mean	Eastern Kansas	.315	
Cochrane [1955]			implicit		.1 to .2	
Cromarty [1959]	1929-52	LS	mean		.370	
Fisher & Temin [1970]	1867-14	ML	mean		.12 to .14	
Helmers & Lagrone [1970]		LP			.12	-.07 wrt fg price t-1
Hoffman [1973]	1950-70	LS	mean	Southern Plains	.42	
	1950-70	LS	mean	Northern Plains	.43	
	1950-70	LS	mean	Corn Belt	.84	
	1950-70	LS	mean	other states	.41	
	1950-70	LS	mean	Northwest	.00	
Houck et al. [1976]	1950-70	LS	mean		.39	
Kohls & Paarlburg [1950]	1924-42	LS	mean		.19 to .24	
Nerlove [1956]	1909-32	LS	mean		.47	
Nerlove [1958]	1909-32	LS	mean		.35	-.06 wrt fg price t-1
Penn & Irwin [1974]	1954-71	JGLS	mean		.268	
Ray [1971]	1930-67	LS	mean		.13 (.25)	
Trapp [1976]	1954-71	geometric lag	mean		.472	-.05 wrt fg price t-1 -.237 wrt soybean price t-1
Tweeten, Kalbfleisch & Lu [1971]			implicit		.30 (1.00)	
Working [1926]	1866-13	LS	mean		.06 to .07	

Table 20. Soybean Acreage Response Elasticities.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Bonner & Cromarty [1958]	1929-53	LS	mean		.171	
Brown [1971]	1946-70	LS	mean		.20 to .27	
		LP			.227	
Gardner [1976]	1950-74	LS	mean	(wrt futures price t)	.61 to .45	
	1950-74	LS	mean	(wrt actual price t-1)	.56	
Heady & Rao [1967]	1929-63	LS	mean		.217 to .237	-.337 wrt fg price t-1
	1929-63	LS	mean	total supply	.443	
Houck et al. [1976]	1950-72	LS	mean		.39	-.39 wrt fg price t-1
Houck & Mann [1968]	1945-64	LS	1960-64		.16	
					(.29)	
Houck & Subotnik [1969]	1946-66	LS	mean	Lake states	.91	-.49 wrt fg price t-1
	1946-66	LS	mean	Lake states		-.35 wrt wheat price t-1
	1946-66	LS	mean	Corn Belt states	.50	-.50 wrt fg price t-1
	1946-66	LS	mean	Delta states	.75	-.81 wrt fg price t-1
	1946-66	LS	mean	Aggregate	.84	-.65 wrt fg price t-1
	1946-66	LS	mean	Aggregate		-.07 wrt wheat price t-1
	1946-66	LS	mean	Aggregate		-.04 wrt cottle price t-1
Matthews [1973]	1948-70	LS	mean	Lake states	.741	-.096 wrt fg price t-1
	1948-70	LS	mean	Corn Belt states	.242	-.075 wrt fg price t-1
	1948-70	LS	mean	Delta states	.094	-.163 wrt fg price t-1
Matthews, Womack & Hoffman [1971]	1954-70	LS	mean		.241 to .395	-.085 to .096 wrt fg price t-1
Penn & Irwin [1971]	1947-69	2SLS	mean	Delta states	.16	.09 wrt fg price t-1
						-.40 wrt cotton price t-1
Penn & Irwin [1974]	1967-71	JGLS	mean		.206	-.146 wrt fg price t-1
	1954-71	JGLS	mean		.261	-.232 wrt fg price t-1
Ray [1971]	1930-67	LS			.17	-.22 wrt fg price t-1
					(1.31)	
Trapp [1976]	1954-71	geometric lag			.260	-.333 wrt fg price t-1
						-.087 wrt wheat price t-1

Table 21. Cotton Acreage Response Elasticities.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
Blakley [1962]	1921-32	LS	mean		.27	
	1944-49, 51-53	LS	mean		.75	
	1934, 35, 38-43 1950, 54-56	LS	mean		.155	
Blakley & Hill [1961]	1929-57	LS	mean	Oklahoma	1.05	-.73 wrt fg price t-1
	1929-57	LS	mean	Oklahoma		-2.33 wrt wheat price t-1
Bonner & Cromarty [1958]	1929-53	LS	mean	total supply	.361	
Brenner [1958]	1933-55	LS	mean	Southeastern states	.33	-.05 wrt fg price t-1
	1933-55	LS	mean	Delta states	.31	-.06 wrt fg price t-1
	1933-55	LS	mean	Southwestern states	.37	-.03 wrt fg price t-1
	1933-55	LS	mean	Southwestern states		-.07 wrt wheat price t-1
Cochrane [1955]			implicit		.2 to .3	
Cromarty [1959]	1929-53	LS	mean	total supply	.361	
Dudley, Donald & Barlowe [1970]	1957-69	LS	mean	Western states	.41	
	1957-69	LS	mean	Delta states	.45	-.45 wrt soybean price t-1
	1957-69	LS	mean	Southeastern states	1.29	-.71 wrt soybean price t-1
	1957-69	LS	mean	U.S.	.59	
	1957-69	LS	mean	Southwestern states	.41	
Gardner [1976]	1950-74	LS	mean	(wrt futures price t)	.24 to .23	
	1950-74	LS	mean	(wrt actual price t-1)	.23	
Houck et al. [1976]	1954-72	GLS	mean		.30	
Nerlove [1956]	1909-32	LS	mean		.20	
Nerlove [1958]	1909-32	LS	mean		.27	
Penn & Irwin [1971]	1947-69	2SLS	mean		.24 to .36	+.11 wrt fg price t-1 -.38 wrt soybean price t-1
Penn & Irwin [1974]	1967-71	JGLS	mean		.30	
	1954-71	JGLS	mean		.268	
Tomek [1972]	1909-32	LS	mean		.17 to .24 (.24 to .25)	
Trapp [1976]	1954-71	geometric lag	mean		1.078	+1.057 wrt soybean price t-1
Walsh [1944]	1910-24	LS	mean		.23	
	1925-33	LS	mean		.22	

YIELD RESPONSE ELASTICITIES FOR FEED GRAINS, WHEAT SOYBEANS, AND COTTON

The literature reporting yield response to own crop price is very sparse. The default yield response elasticities used in the model (Table 3 of the text) are in line with the published values reported in Table 22. The feed grain yield elasticity wrt to feed grain price is .10 in the model, which compares closely with the elasticities reported by McKeon [1974] weighted by the separate feed grain components. The default soybean yield elasticity wrt to own price is .10, which is the same as for feed grains.

The yield response wrt wheat price (.05) is in agreement with the values reported by Fisher and Temin [1970] and by McKeon [1974] in Table 22. Weather is, of course, a more important determinant of wheat yield in the Northern and Southern Plains than wheat price. Farmers do adjust fertilizer and pesticide applications with changing output prices but input use is less important than weather on wheat yield.

The default cotton yield elasticity wrt cotton price in the model is .15, a value that is in line with the values reported by Dudley, et. al. [1970], Fiedler [1976] and McKeon [1974] (Table 22). Cotton yield is more price elastic than for the other crops because farmers tend to more readily change their use of inputs (fertilizer, pesticides, etc.) per acre in response to price changes. The default variable expense per acre elasticities with respect to own crop prices are identical to the own price elasticities used for yields.

Section 4. Demand Elasticities for the Model Crops

The default domestic and export elasticities for feed grains, wheat, soybeans and cotton used in the model are reported in Tables 5 and 7 of the text. This section presents the empirical background for selecting the values for the parameters in the model.

FEED GRAIN DEMAND ELASTICITIES

The price flexibility for feed grains is a function of expected carryover of stocks relative to expected demand. When expected carryover is small relative to expected demands the price flexibility is large (say, —5.0), indicating that price is relatively responsive. When expected carryover is large relative to expected demand the price flexibility is small (say, —2.0). A schedule of price flexibilities (Table 5) has been developed by commodity analysts in CED, USDA and is used in POLYSIM for the four model crops.

The default own price elasticity of export demand for feed grains is —.50. This value is at the lower end of the estimated values reported in Table 23.

Table 22. Crop Yield Response Elasticities for Feed Grain, Wheat, Soybeans and Cotton.

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Elasticity	Cross Elasticity
			Feed Grains			
Houck & Gallagher [1976]	1951-71	LS	mean	corn	.24	
McKeon [1974]	1950-70	LS	mean	corn	.128	-.25 wrt fertlizer price t-1
	1950-70	LS	mean	sorghum	.066	
	1950-70	LS	mean	oats	.161	
	1950-70	LS	mean	barley	.305	
			Wheat Yield			
Fisher & Temin [1970]	1867-14	ML	mean		.034 to .042	
McKeon [1974]	1950-70	LS	mean		.096	-.09 wrt fertlizer price t-1
			Soybean Yield			
McKeon [1974]	1950-70	LS	mean		Not Reported	-.29 wrt fertlizer price t-1
			Cotton Yield			
Dudley, Donald & Barlowe [1970]	1957-69	LS	mean		.21	
Fielder [1976]	1947-74	LS	mean	Louisiana cotton yields	.16	
McKeon [1974]	1950-70	LS	mean		.122	-.13 wrt fertilizer price t-1

Table 23. Domestic and Export Elasticity of Demand for Feed Grains.[1]

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Price Flexibility	Own Export Demand
Anderson & Tweeten [1975]	1955-73	LS	mean		-1.789	
Brandow [1961]		theoretical	1955-57		-2.00	-1.4
Foote [1953]	1922-42	2SLS	mean		-2.36	
Fox [1953]	1922-41	2SLS	mean		-1.93	
King [1958]	1921-41 1946-54	LS	mean		-2.06 to -2.14	
Matthews [1973]	1954-70	3SLS	mean			-.9
Meinken [1953]	1922-42	LS	mean	corn	-1.59	
	1922-42	LS	mean	oats	-2.04	
	1922-42	LS	mean	barley	-2.41	
Meinken [1973]	1945-70	LS	mean	corn	-2.85	-.8 to -1.0
Shuib & Menkhaus [1977]	1950-74	2SLS	mean			-1.51

[1] Cross elasticities were not reported for the dependent variables wrt other variables, in the literature cited here.

WHEAT DEMAND ELASTICITIES

This price flexibility schedule for wheat developed by CED commodity analysts is presented in Table 5. The default own price elasticity of wheat food demand in the model is —.10; a value that is consistent with estimates from several studies (Table 24). The food demand for wheat is more inelastic than wheat feed demand due to the relative number of available substitutes for the two types of demand. The default elasticity of livestock feed demand for wheat wrt wheat price is —.30. This value is similar to estimates by Hoffman and Barr [1973], Meinken [1955], and Ray [1971] (Table 24).

The default elasticity of export demand for wheat is —.50 in the model. The published values for this elasticity range from —.33 to —.64 with several values reported at the —.50 level (Table 24).

SOYBEAN DEMAND ELASTICITIES

A price flexibility schedule for soybeans developed by CED commodity analysts is presented in Table 5. The domestic mill demand for soybeans is price inelastic due to the relatively inelastic final demand for processed soybeans [Houck and Mann, 1968]. The default elasticity of soybean domestic mill demand is —.35; a value which is commonly reported as the estimated elasticity of mill demand (Table 25). The majority of the published estimates for this elasticity are in the —.3 to —.4 range (Table 25).

The default elasticity of soybean export demand is —.65 in the model. This estimate is in broad agreement with the estimates of Brandow [1961], Houck [1964], Houck and Mann [1968], Houck, Ryan, and Subotnik [1972], and Matthews [1973] (Table 25). The most recent estimate [Matthews, 1973] used data for 1954 to 1970 and reported the elasticity at —.61 and —.77 (Table 25).

COTTON DEMAND ELASTICITIES

The price flexibility schedule for cotton developed by CED analysts is presented in Table 5. The demand for cotton fiber in the U. S. most likely has changed in the past decade due to the shift away from synthetics; however, no empirical estimates are available for this time period (Table 26). The hypothesized shift would have made the price more responsive at the farm level. At the domestic mill demand level, the elasticity of demand would have become more inelastic by shifting away from substitute fibers. The empirical values for domestic mill demand own price elasticity range from —.11 to —.80 with numerous estimates near —.20 (Table 26). Due to the suggested shift in domestic demand, we selected a value of —.10 for the price elasticity of demand at the mill level.

Table 24. Domestic and Export Elasticity of Demand for Wheat.[1]

Author	Period of Data	Model	Point of Elasticity	Own Price Flexibility	Own Food Demand Elasticity	Own Feed Demand Elasticity	Own Export Demand Elasticity
Anderson & Tweeten [1975]	1955-73	LS	mean	-3.362			
Barr [1973]	1960-71	LS	mean		-.004	-.16	
Brandow [1961]		theoretical	1955-57		-.0242		
Cochrane & Danin [1976]		implicit		-2.35	-.37 (all domestic demand)		-.50
Cromarty [1959]	1929-53	LI	mean	-2.00	-.518 (all domestic demand and export demands)		
Cromarty [1962]	1929-57	LI	mean		-.365	-1.55	
Fox [1953]	1922-41	2SLS	mean		-.067		-.50
Hoffman & Barr [1973]	1950-72	LS	mean		-.09	-.35	-.35
Matthews [1973]	1954-70	3SLS	mean		-.15		-.35
Meinken [1955]	1921-29 & 1931-38	LS	mean	-1.43	-.04	-.33	
	1921-29 & 1931-38	LI	1953	-.74	-.11		-.39
	1921-29 & 1931-38	LI	1931	-2.48	-.04	-.40	
Mo [1968]	1928-64	2SLS	mean		-.119	-1.335	
	1928-64	LS	mean		-.096	-1.697	
	1928-64	2SLS	1951		-.188		
	1928-64	2SLS	1961		-.191		
Ray [1971]	1930-67	ATS-2	mean		-.05	-.36	-.64
Tweeten, Kalbfleisch, & Lu [1971]		implicit		-2.78	-.046 to -.06	-.56	-.5

[1] Cross elasticities were not reported for the dependent variables wrt other variables, in the literature cited here. All elasticities reported here used "all wheat" as the dependent variables so the column reporting other dependent variables was omitted.

Table 25. Domestic and Export Elasticities for Soybeans.[1]

Author	Period of Data	Model	Point of Elasticity	Other Dependent Variables Reported	Own Price Flexibility	Own Mill Demand Elasticity	Own Export Demand Elasticity
Brandow [1961]		theoretical	1955-57			.56	-.79
Clough [1966]	1950-64	LS	mean		-1.80		
Houck [1964]	1946-60	2SLS	mean		-1.30	-1.06	-.86
Houck & Mann [1968]	1946-66	2SLS	mean	soybeans	-3.25	-.32 to -.35	-.46
	1946-66	2SLS	mean	oil		-.51	-.15 to -.18
	1946-66	2SLS	mean	meal		-.33	-.57
Houck, Ryan & Subotnik [1972]	1946-66	LS	mean		-3.5	-.21	-.53
	1946-66	2SLS	mean		-3.7	-.19	-.54
	1946-66	3SLS	mean		-3.0	.18 and -.19	-.67 and -.68
Paulino [1966]	1946-63	LS	mean		-2.72 to -2.84	-.411	
Matthews	1954-70	3SLS	mean		-2.38 and -2.44	-.35	-.61 and -.77
Ray [1971]	1930-67	2SLS	mean			-.14	-.13
						(-.39)	
Vandenborre [1964]	1947-61	LS	mean			-.39	-.28
	1947-61	2SLS	mean			-.417	-.26
	1947-61	LI	mean			-.494	-.26

[1] Cross elasticities were not reported for the dependent variables wrt other variables, in the literature cited here.

The export demand for cotton has been relatively stable for many years. The estimates of the export demand elasticity range from—.01 to —2.0 (Table 26). The default elasticity in the model is —.50 in the short run and —1.50 in the long run.

Section 5. Elasticity of Livestock Feed Demand

The demand by livestock for feed grains and by-product feeds is calculated within the model as a derived demand based upon the quantity of livestock produced and the prices of livestock and feed. The response parameters used for this section of the model came from elasticities estimated by the authors in an econometric model of the feed grain feed demand sector of POLYSIM [Richardson and Ray, 1977].

The elasticity of the feed conversion rate wrt own livestock price is positive because as the price received for the livestock output increases, the producers tend to use a ration that is higher in concentrates relative to roughages (Table 27). Thus resulting in a higher feed conversion rate (pounds of concentrates fed per pound of livestock production). The cross elasticity of the feed conversion rate wrt feed price has a negative sign because as feed grains cost more, producers tend to decrease their use of feed grains by substituting roughages in the ration, everything else constant. The elasticity of the percent of feed grains in concentrates fed to livestock is positive wrt the individual livestock prices (Table 27). The elasticity of the percent of feed grains in concentrates fed wrt feed grain price and soybean meal price are opposite in sign because of the substitution effect between these two feeds.

APPENDIX B.

LISTING AND DESCRIPTION OF SUBROUTINES IN POLYSIM

A listing of POLYSIM and a description of the primary function of each subroutine is presented in this Appendix. The subroutines are listed in the following order: MAIN, INT1, INITAL, INT2, SETUP, LVSK, TGTP, ADJLOT, CROPQ, FDGR, FEED, WHEAT, SOYB, COTTON, FED2, RECPTS, GOVP, TOTALS, CONS, TAB1, TAB2, TAB3, GOVSTK, SUPPRT, and WPLCP. The order in which these subroutines are listed is the general order in which they are used in the program.

The function of the MAIN is to organize the order in which the other subroutines are called and to pass information from one subroutine to another through common statements. Subroutine INT1, INITAL, and INT2 are the subroutines that provide data input to the program from

Table 26. Domestic and Export Elasticities for Cotton.[1]

Author	Period of Data	Model	Point of Elasticity	Own Price Flexibility	Own Mill Demand Elasticity	Export Demand Elasticity
Barlow & Donald [1971]			implicit			-2.0
Blakley [1962]	1921-40	LS	mean		-.53	-.01 (not significant)
	1921-40	LI	mean		-.84	-.45
	1921-40 & 1947-56	LS	mean		-.65	-.05
	1921-40 & 1947-56	LI	mean		-.80 and -.86	-.13
Bonner & Cromarty [1958]	1929-53	LI	mean		-.30	
Brandow [1961]		theoretical	1955-57		-.40	-.87
Cathcart & Donald [1966]	1948-62	LS	mean			-.25 and -.27
Cromarty [1959]	1929-53	LI	mean		-.21 and -.30	
Donald, Lowenstein, & Simon [1963]	1927-32, 1935-40, 1948-60	LS	mean		-.14	
Fox [1953]	1922-41	2SLS	mean			-.50
Lowenstein [1964]	1921-40, 1947-52	LS	mean		-.20 and -.24	
Lowenstein & Simon [1954]	1927-32, 1935-40, 1948-52	LS	mean		-.23	
	1921-40, 1947-50	LS	mean		-.30	
	1920-52	LS	mean		-.24 and -.27	
Martin & Havlicek	1952-69	2SLS	mean		-.89	-1.07
Ray [1971]	1930-67	ALS	mean		-.11	
Telser [1957]	1933-54	LS	mean	-1.64 to -2.00		

[1] Cross elasticities were not reported for the dependent variables wrt other variables, in the literature cited here. All elasticities reported here used cotton as the dependent variable so the column reporting other dependent variables was omitted.

Table 27. Elasticity of Feed Conversion Rate and Elasticity of Percent of Feed Grains in Concentrates Fed for Each of the Livestock Categories in the Model.

Elasticity of Feed Conversion Ratio t for:	Own Livestock Price t	Feed Grains Price t	Soybean Meal Price t
cattle and calves wrt	.894	—.834	
hogs wrt	.132	—.051	
sheep and lambs wrt	.566	—.222	
chickens wrt	.180	—.180	
turkeys wrt	.197	—.069	
eggs wrt	.153	—.122	.069
milk wrt	.080	—.080	

Elasticity of Percent of Feed Grains in Concentrates Fed t for:	Own Livestock Price t	Feed Grains Price t	Soybean Meal Price t
cattle and calves wrt		—.114	.087
hogs wrt	—.099	—.092	.071
sheep and lambs wrt	—.230	—.009	.220
chickens wrt	—.133	—.002	.037
turkeys wrt	—.097	—.099	.118
eggs wrt	—.007	—.106	
milk wrt	—.005	—.078	.042

disk and cards. The first subroutine called, INT1, reads the Label Cards and data from disk used to print the output table titles and labels. Subroutine INITAL reads the Core Data Cards and the baseline data from disk. The Optional Data Cards are read and processed by statements in subroutine INT2. Normal terminations for the program occur in the latter two subroutines and result in the trailer page being printed.

The first subroutine called from the actual simulation loop is SETUP, which adjusts baseline crop acreages for changes in acreage set-aside provisions provided by the user. The second subroutine called is LVSK, the part of the model responsible for calculating production and prices for each of the seven livestock categories.

At the user option target prices can be adjusted according to the provisions of the 1977 Agricultural Act. When this option is specified, the target price adjustments are carried out in subroutine TGTP. Once these adjustments are made (or skipped at the users option) the program calculates values for harvested acreage, yield, variable production expense, production and supply for each of the four model crops. The equations for these calculations are in subroutine CROPQ.

The crop demand section is then entered, with feed grains being the first crop considered. The price received by farmers, export demand and carryover is calculated by subroutine FDGR. The domestic feed demand for feed grains, by-product feeds and roughages is calculated in subroutine FEED which is called from FDGR. Other subroutines called by FDGR are SUPPRT and GOVSTK which are called at the user's discretion. Subroutine SUPPRT is used when price is less than the loan rate and calculates the quantity of stocks that would have to be put under CCC loan to raise the market price to the loan rate. If the price is greater than the release price the subroutine controls the release of stocks to the market. Government costs of CCC operations also are computed. The GOVSTK subroutine is a reserve management program that operates on a target stock level, a support price and a release price. The wheat price, domestic demands, export demands, and carryover are calculated in subroutine WHEAT. These same variables are calculated for soybeans in subroutine SOYB and for cotton in the COTTON subroutine.

The cost of feed grains, by-products and roughages fed to livestock are calculated in the FED2 subroutine. The cash receipts for each of the seven livestock categories and four crops are calculated in subroutine RECPTS. The total government payments for deficiency payments and acreage set-aside, if any, are computed in subroutine GOVP. The aggregate totals of receipts and expenses are calculated in TOTALS, as well as, the value for net farm income. The last subroutine in the simulation loop CONS computes the value for total consumer expenditures for food.

The three output subroutines in the model, TAB1, TAB2, and TAB3 are called after the program finishes the simulation process. TAB1 computes the percentage change in the baseline from the simulated values for the endogenous variables in the model. The tables for the endogenous and exogenous models are printed in subroutine TAB2, and the summary tables are printed in subroutine TAB3.

```
C***********************************************************************
C              DETERMINISTIC & STOCHASTIC POLYSIM MAIN
C***********************************************************************
C---- LATEST REVISION 9-4-77
      COMMON  /CMAIN3/ SIMNAM(20), NEXOG(180), NFILE(300), DM(7,7),
     1EE(200)
      INTEGER SUMFIL(160), SUMTAB(160,6), SUMF(160)
      COMMON  /CMAIN4/ SUMFIL, SUMTAB, SUMF, NOEXC
      INTEGER FT(90), TITLE(20,20), LABEL(84,33), SKIP(8)
      COMMON  /CMAIN5/ FT, TITLE, LABEL, SKIP, JUMP
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CMAIN7/ NFILEE(40), NCFILE(180), NDUM(180), ICFILE(200)
      COMMON  /CMAINB/ IFI(50), IF2(50), A(20), TREND(80), NAR,
     1FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDEV
      COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON  /CMAINF/ IFSTYR, NOB, ISIMND, IMONTH, IDAY, IBASYR, IOBJT
      COMMON /CMAING/ NBC, NE, NADJ, NEX, NPRE, NERD, NESTOR, NFACT,
     1  NADJST, KING, NPRDM, NDIVAC, NOTARG, NOALL, NLOAN, NDIV, NEXP,
     2 NOACRE, NYIELD, NPROD, IVARE, INDXX, NFSTST, NPART, NCONST
      COMMON /CMAINH/ NOPOL, NEPOL, NRO, IDROP, LASTYR ,ACRE(14,12)
      COMMON /CMAINL/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
      COMMON  /CMAINJ/  JNEW,IAJSET,KNEW,INEW
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CSTOC/  YIELDX(4,4), EXPORT(4,4), AMIN(80), AMODE(80),
     1AMAX(80), PERC(80), IDATA(3,100),CDATA(14,100),INTER, NTER,AMATRX(
     28,8) ,IEND1, IEND2,IST1,IST2,IEX2
      COMMON /CUMUL/ PVAL(80,12) ,ISTART,IEND
      COMMON /CSTAL/ TALM(17,14)
      DEFINE FILE 10(999,90,U,JNEXT)    ,11(999,580,U,JNEX)
      DEFINE FILE  13(301,250,U,JN1),14(14,600,U,JN2)
    2 FORMAT(' ','ITERATION NO. ' , I4)
12345 FORMAT(1H0, 'POLYSIM    MAIN   BEGUN')
      WRITE(8,12345)
      NAR=9999979
      CALL INT1
      DO 1900  LFM=1,100
  200 CALL  INITAL
      IF(NPRB.NE.0) CALL TAB2
      NPRB=0
      CALL  INT2
      IF (IFLAG.EQ.5) GO TO 200
      DO 2000 INTER=1,IHOLD1
      NTER= INTER
      IF(IHOLD1.GT.1) WRITE(6,2) NTER
C-----SIMULATION LOOP
      DO 1000 I= 3  ,NOBS
      J=I-1
      CALL  SETUP
      CALL  LVSK
      CALL  AJLOAN
      CALL  TGTP
      CALL  ADJLOT
C/////// INSERT THE CALL FOR THE SUB YOU WANT FOR NO. GENERATOR....
C///////  ACCORDING TO THIS FORMAT       IF(IHOLD1.GT.1) CALL XXXXXX
      CALL  CROPQ
      CALL  FDGR
      CALL  WHEAT
      CALL  SOYB
      CALL  COTTON
      CALL  FED2
      CALL  RECPTS
      CALL  GOVP
```

```
      CALL  TOTALS
      CALL  CONS
 1000 CONTINUE
 2000 CONTINUE
      CALL  TAB1
      CALL  TAB2
      CALL  TAB3
 1900 CONTINUE
        STOP
       END
C***********************************************************************
C                                   SUBROUTINE  INT1
C***********************************************************************
      SUBROUTINE  INT1
C---- LATEST REVISION 6-1-77
      INTEGER SUMFIL(160), SUMTAB(160,6), SUMF(160)
      COMMON  /CMAIN4/ SUMFIL, SUMTAB, SUMF, NOEXC
      INTEGER FT(90), TITLE(20,20), LABEL(84,33), SKIP(8)
      COMMON  /CMAIN5/ FT, TITLE, LABEL, SKIP, JUMP
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      INTEGER  CHECK,FILE,ARRAY  ,READ(6) ,TLE(720)
      DATA AEX/'EXOG'/
    1 FORMAT(1H0, 'SUBROUTINE INT1    ENTERED')
    2 FORMAT ( I1, 6A4, A4, I3)
    5 FORMAT(' ','PROGRAM BOMBED BECAUSE USER READ TO MANY LABEL CARDS')
      WRITE(8,1)
      IEN = 0
      IFLAG = 0
      K = 0
      DO136 J=671,710
      K2=0
      READ (10' J) (FT(I),I=1,66)
      DO134 LLK=1,2
      K=K+1
      DO 133KK=1,33
      LABEL(K,KK) =FT(K2+KK)
  133 CONTINUE
      K2=K2+33
  134 CONTINUE
  136 CONTINUE
      K=0
      DO139 JJ=727,731
      K2=0
      READ (10' JJ) (FT(J),J=1,80)
      DO138 LKK=1,4
      K=K+1
      DO 137KK=1,20
      TITLE(K,KK)=FT(K2+KK)
  137 CONTINUE
      K2=K2+20
  138 CONTINUE
  139 CONTINUE
      K=1
C------ READ FROM DISK THE SUMMARY TABLE LABELS----
      J1=1
      J2=90
      DO 151 I=576,583
      READ( 10' I)  (TLE(J),J=J1,J2)
      J1=J1+90
  151 J2=J2+90
      J1=0
      DO 152 I=1,110
      DO 153 J=1,6
  153 SUMTAB(I,J)=TLE(J1+J)
  152 J1=J1+6
      READ (10' 551) (SUMFIL(I),I=1,90)
      READ (10' 552) (SUMFIL(I),I=91,110)
      READ (10' 554) (SUMF(I),I=1,90)
      READ (10' 559) (SUMF(I),I=91,110)
C--READ THE SUMMARY TABLES VARIABLE LABELS  FROM  CARDS
C--CHECK MUST BE A  9, FILE IS THE C OR EXOG FILE # , ARRAY IS 1IF C,
C--AND 2 IF EXOG, ...., LAST CARD MUST BE BLANK
   50 CONTINUE
      IF (K.GE.51) WRITE (6,5)
      READ( 5,2) CHECK, ( READ(I),I=1,6),ARR,FILE
```

```
      IF(CHECK.NE.9) GO TO 200
      L=K+91
      IF (ARR.EQ.AEX) ARRAY=2
      IF (ARR.NE.AEX) ARRAY=1
      SUMF(L)= ARRAY
      SUMFIL(L)= FILE
      DO 40 I=1,6
   40 SUMTAB(L,I) = READ(I)
      K=K+1
      GO TO 50
  200 CONTINUE
      NOEXC= K-1
      RETURN
      END
C***********************************************************************
C                             SUBROUTINE INITAL
C***********************************************************************
      SUBROUTINE INITAL
C---- LATEST REVISION 9-4-77
      COMMON  /CMAIN3/ SIMNAM(20), NEXOG(180), NFILE(300), DM(7,7),
     1EE(200)
      INTEGER FT(90), TITLE(20,20), LABEL(84,33), SKIP(8)
      COMMON  /CMAIN5/ FT, TITLE, LABEL, SKIP, JUMP
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CMAIN7/ NFILEE(40), NCFILE(180), NDUM(180), ICFILE(200)
      COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON  /CMAINF/ IFSTYR, NOB, ISIMND, IMONTH, IDAY, IBASYR, IOBJT
      COMMON /CMAING/ NBC, NE, NADJ, NEX, NPRE, NERD, NESTOR, NFACT,
     1  NADJST, KING, NPRDM, NDIVAC, NOTARG, NOALL, NLOAN, NDIV, NEXP,
     2 NOACRE, NYIELD, NPROD, IVARE, INDXX, NFSTST, NPART, NCONST
      COMMON /CMAINH/ NOPOL, NEPOL, NRO, IDROP, LASTYR ,ACRE(14,12)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
      COMMON  /CMAINJ/  JNEW,IAJSET,KNEW,INEW
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      INTEGER Z1
      DIMENSION  BY(50)    , Z(1), BRAN(49), AA(40)
      DATA SIM/'    '/ ,IIM/'    '/
      SIMNAM(20)=SIM
   50 FORMAT ('1',15(/) )
   51 FORMAT (' ', T55,'P O L Y S I M',////, T43,  'NATIONAL AGRICULTURA
     1L POLICY SIMULATOR',
     1             ///,T48, 'DEVELOPED AND IMPLEMENTED BY' ,///,T55,
     2'DARYLL E. RAY' ,//, T60 ,'AND',//,T52,'JAMES W. RICHARDSON',///,
     3T44, 'DEPARTMENT OF AGRICULTURAL ECONOMICS',/ ,T49, 'OKLAHOMA STAT
     4E UNIVERSITY',//,T52,'IN COOPERATION WITH',//
     5      , T41,'COMMODITY PROGRAM AND POLICY ANALYSIS AREA',/,  T48,
     6'COMMODITY ECONOMICS DIVISION', /, T57,'ERS, USDA')
   60 FORMAT ('1',05X,'  ***ERROR*** FIRST YEAR OF SIMULATION ',I4,'  IS
     1 LESS THAN 1970')
   67 FORMAT ('1','POLYSIM JUST READ SIMULATION CARD, USER SPECIFIED A S
     1IMULATION OF 11 OR MORE YEARS'/,T1,'IF YOU REALLY WANT TO DO THIS
     2YOU HAVE SEVERAL ALTERNATIVES, SUCH AS ENLARGE B,C,EXOG,OLDEXO,',
     3/,T1,' OR DROPPING  SUB TAB1 & MODIFING WRITES IN TAB2')
 4321 FORMAT (' ',30I4)
10005 FORMAT(I1, 19X, 20I3)
10002 FORMAT(I1, 2X, 19A4)
10014 FORMAT(I1, 2X, 3A4,     5X,20I3)
12345 FORMAT(1H0, 'SUBROUTINE INITAL ENTERED')
30002 FORMAT(1H0, 'CARDS ARE OUT OF SEQUENCE OR MISSING FOR SIMULATION',
     2        ':', 20A4/,
     2       1H0, 'LAST CARD SEQUENCE NUMBER READ IS ', I1)
30012 FORMAT(1H0, 'THE REMAINING PARAMETER CARDS FOR THIS SIMULATION ',
     1           'ARE PRINTED BELOW')
30022 FORMAT(1H0, I1, 2X, 20A4)
      WRITE(8,12345)
      IF(IFLAG.EQ.5) GO TO 10000
      IF(IEN .NE.0) GO TO 40000
C*    OBTAIN SIMULATION NAME ______________________
      READ(5,10002,END=40000) ICHEC, (SIMNAM(II), II=1,19)
      IF(ICHEC.NE.1) GO TO 30000
10000 IFLAG = 0
C*    OBTAIN BASE YEAR, ETC. ______________________
10013 READ( 5,10014)  ICHEC,  IMONTH,  IDAY,  IBASYR,  IFSTYR,  NOB,
```

```
     1ISIMND,  KING,  NESTOR,  NPRC,  NPRB,  NPRE,  NPRDM,  JUMP,
     2NFSTST,IHOLD1,NH1,NH2,IHOLD2,NH3,NH4,INDXX,IKEY1,IKEY2
      IF(ICHEC.NE.2) GO TO 30000
      IF(IMCNTH.EQ.IIM) READ (10' 575) IMONTH, IDAY, IBASYR
C*    DETERMINE FARM PROGRAM OPTIONS -------------------
      READ(5,10005) ICHEC, DIVAC, TARGET, LOAN, FREMKT, SUPFG, SUPWHT,
     1    SUPCOT, SUPSOY,IADJTG, IAJLOT ,A73 ,IAJSET,INEW,JNEW,KNEW
      IF(ICHEC.NE.3) GO TO 30000
      IF (FREMKT.EQ.0) GO TO 103
      DIVAC=0
      TARGET=0
      LOAN=0
      SUPFG=0
      SUPWHT=0
      SUPCOT=0
      SUPSOY=0
      ADJTG=2000.0
      IAJTOT     =0
  103 CONTINUE
      IAJSET = 1900 + IAJSET
      IF(IAJSET.LT.1970) IAJSET = 2000
      INEW = 1900 + INEW
      IF(INEW.LT.1970) INEW = 2000
      IF (IHOLD1.EQ.0) IHOLD1=1
      IFSTYR = IFSTYR + 1900
      IF (IFSTYR.LT.1970) GO TO 2100
      IF (NOB.GT.10) GO TO 2700
      IF(KING.EQ.0)  KING=3
      ADJTG = FLOAT(IADJTG) + 1900.0
      IF (IADJTG.EQ.0)  ADJTG = 2000.0
      IAJLOT=IAJLOT  +  1900
      IF(IAJLOT.EQ.1900) IAJLOT=2025
      IF (ISIMND.EQ.0) ISIMND=LFM
C---- THESE ARE COLUMN SIZES FOR C,B,EXOG,OLDEXO,ADJ,E,EE,CONST
      NE=146
      NBC=300
      NEX=180
      NADJ=45
      NCON  = 110
C READ DATA FROM DISK
        IF(LFM.GT.1) GO TO 104
      READ (10' 508) (ADJ(I),I=1,NADJ)
      READ  (10' 537) (NCFILE(I),I=1,90)
      READ  (10' 538) (NCFILE(I),I=91,180)
      READ (10'543)   (NFILEE (J),J=1,40)
      READ (10' 502)  (CONST(I),I=1,90)
      READ (10' 503)  (CONST(I),I=91,NCON)
      READ (10' 527) (NFILE(I),I=01,090)
      READ (10' 528) (NFILE(I),I=91,180)
      READ (10' 529)  (NFILE(I),I=181 ,270)
      READ  (10' 565) (NFILE(I),I=271,NBC)
C     WRITE(10' 528) (NFILE(I),I=91,180)
C     WRITE(10' 529) (NFILE(I),I=181,270)
C     WRITE (10' 565) (NFILE(I),I=271,NBC)
      READ (10' 530)  (NEXOG(I),I=1,90)
      READ( 10' 531) (NEXOG(I),I=91,NEX)
C     WRITE (10' 531) (NEXOG(I),I=91,NEX)
      WRITE (8,4321)    (NFILE(I),I=1,NBC)
      WRITE (8,4321)    (NEXOG(I),I=1,NEX)
      WRITE (8,4321)    (NCFILE(I),I=1,180)
  104 CONTINUE
      READ (10' 504)  (E(I),I=01,90)
      READ (10' 505)  (E(I),I=91,NE)
      READ( 10'506) (EE(I),I=1,90)
      READ( 10'507) (EE(I),I=91,NE)
C-IDROP IS NO.OF WORDS DROPPED FROM DISK FILES WHEN READING FROM DISK T
      IDROP =(IFSTYR-1945)-1
      NOBS  = NOB+2
C-LOOP TO CREATE THE YEARS FILE TO DISPLAY IN OUTPUT
      READ  (10' 556)  (BY(I),I=1,50)
      DO 105  I=1,50
      IKK = I + 1949
      IF ((( IFSTYR-3)+1).EQ.IKK) GO TO 107
  105 CONTINUE
  107 DO 108 IL=1,NOBS
  108  AY(IL) = BY(IL + (I-1))
```

```
      NO1 =14
      DO 106 I=1,NEX
      DO 106 J=1,NO1
      OLDEXO(J,I)=0.0
  106 EXOG(J,I) = 0.0
      DO110 I=1,NBC
      DO 110J=1,NO1
      C(J,I)=0.0
  110 B(J,I)=0.0
C     READ ENDOGENOUS BASE DATA FROM DISK....
      DO 115 J=1,NBC
      READ( 10'NFILE(J))  AA(I),I=1,IDROP),(B(I,J),I=1,NOBS)
  115 CONTINUE
      ID = IDROP - 2
C     READ YIELDS FOR ADJUSTING THE TARGET PRICES
      DO 4011 I = 6,8
      J = I - 4
 4011 READ( 10'NFILE(I)) (AA(K), K=1,ID), (YIELD(L,J), L=1,15)
      READ( 10' 26) (AA(K),K=1,ID),(YIELD(L,1),L=1,15)
      DO 119 L=1,15
  119 YIELD(L,3) = YIELD(L,1)
C     READ EXOGENOUS  BASE DATA FROM DISK....
      DO 120 K=1,108
      READ( 10'NEXOG(K))(AA(I),I=1,IDROP),(EXOG(J,K),J=1,NOBS)
  120 CONTINUE
C-----CREATE LIVESTK MATRIX FRCM DISK STORED ARRAY---
      IF(KING.EQ.1) LLL =510
      IF(KING.EQ.2) LLL =509
      IF(KING.EQ.3) LLL =511
      READ (10' LLL)  (BRAN(I),I=1,49)
  165 I=1
  166 DO170 J=1,7
      L=(I-1)*7+J
  170 DM(I,J)=BRAN(L)
      I=I+1
      IF(I.LE.7) GO TO 166
C-----INITIALIZE FIRST TWO ROWS B=C
      DO 235 I=1,NBC
      DO 235 J=1,2
  235 C(J,I)=B(J,I)
      DO 300 I=1,108
      DO 300 J=1,NOBS
  300 OLDEXO(J,I)=EXOG(J,I)
      DO 310 J=1,4
      DO 310 I=1,NOBS
  310 ACRE(I,J) = B(I,J)
C     PUT BASELINE HARVESTED AC, SET-ASIDE, & 1 - SLIIIAGE IN STORAGE
      DO 330 I=1,NOBS
      ACRE(I,05)=EXOG(I,1)
      ACRE(I,06)=EXOG(I,3)
      ACRE(I,07)=EXOG(I,5)
      ACRE(I,08)=EXOG(I,6)
      ACRE(I,09)=1.0 - EXOG(I,82)
      ACRE(I,10)=1.0 - EXOG(I,83)
      ACRE(I,11)=1.0 - EXOG(I,84)
  330 ACRE(I,12)=1.0 - EXOG(I,85)
      RETURN
C-THE FOLLOWING ARE EMBEDDED ERROR MESSAGES
 2100 WRITE (6,60) IFSTYR
      GO TO 30010
 2700 WRITE (6,67)
      GO TO 30010
30000 WRITE(6,30002) SIMNAM, ICHEC
30010 WRITE(6,30012)
30020 IF(IEN .NE.0) GO TO 40000
      READ( 5,10002,END=40000) ICHEC, (SIMNAM(II), II=1,19)
      IF(ICHEC.EQ.1) GO TO 10013
      WRITE(6,30022) ICHEC, SIMNAM
      GO TO 30020
C     WRITE  FINAL  OUTPUT PAGE
40000 WRITE (6, 50)
      WRITE (6, 51)
      WRITE (6,50)
      STOP 40000
      END
```

```
C***********************************************************************
C                           SUBROUTINE INT2
C***********************************************************************
      SUBROUTINE INT2
C---- LATEST REVISION 9-4-77
      COMMON  /CMAIN3/ SIMNAM( 20), NEXOG(180), NFILE(300), DM(7,7),
     1EE(200)
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16) , C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON  /CMAINF/ IFSTYR, NOB, ISIMND, IMONTH, IDAY, IBASYR, IOBJT
      COMMON /CMAING/ NBC, NE, NADJ, NEX, NPRE, NERD, NESTOR, NFACT,
     1  NADJST, KING, NPRDM, NDIVAC, NOTARG, NOALL, NLOAN, NDIV, NEXP,
     2 NOACRE, NYIELD, NPROD, IVARE, INDXX, NFSTST, NPART, NCONST
      COMMON /CMAINH/ NOPOL, NEPOL, NRO, IDROP, LASTYR ,ACRE(14,12)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
      COMMON  /CMAINJ/  JNEW,IAJSET,KNEW,INEW
      COMMON  /CSTOC/  YIELDX(4,4), EXPORT(4,4), AMIN(80), AMODE(80),
     1AMAX( 80), PERC(80), IDATA(3,100),CDATA(14,100),INTER, NTER,AMATRX(
     28,8) ,IEND1, IEND2,IST1,IST2,IEX2
      REAL *8 DAT
      INTEGER  ETOADJ(150) ,ADJIX
      DIMENSION AA(14) ,A( 5),INDEX( 150),DT(2)
      EQUIVALENCE (DAT,DT(1))
    1 FORMAT ('0', T37,'SIMULATION NAME' , T109, 'IDENTIFICATION NO.',
     2//,T5,20A4,T115,I4,//)
    2 FORMAT ('0', T05,'SIMULATE', I4,  T19, 'YEARS, BEGINNING IN ',I4)
    3 FORMAT ('0', T05,'BASELINE PROJECTIONS USED IN THIS SIMULATION WER
     1E DEVELOPED ',3A4)
    4 FORMAT('0',T11,'ADJUST SET-ASIDE FOR EXPECTED CARRYOVER BEGIN IN '
     1,I4)
    5 FORMAT('0',T11,'ADJUST SET-ASIDE FOR EXPECTED PRICE BEGIN IN ',I4)
    8 FORMAT ('0',T05,'A STOCHASTIC RUN WITH ',I4,' ITERATIONS')
    9 FORMAT ('-',T47,'  GEORGE AND KING MATRIX')
   10 FORMAT ('0',T11,'THE GEORGE & KING LIVESTOCK PRICE FLEXIBILITY MAT
     1RIX WILL BE USED.')
   12 FORMAT ('0',T11,'THE BRANDOW LIVESTOCK PRICE FLEXIBILITY MATRIX WI
     1LL BE USED.')
   13 FORMAT ('0',T11,'THE CED LIVESTOCK PRICE FLEXIBILITY MATRIX WILL B
     1E USED.')
   14 FORMAT ('0', T05,'SIMULATION RESULTS ARE STORED ON DISK BEGINNING
     1IN DATA FILE ', I4)
   15 FORMAT ('-',T50,' BRANDO MATRIX')
   17 FORMAT      (8F10.4)
   18 FORMAT ('-',T50,' CED LIVESTOCK MATRIX')
   19 FORMAT ('0',T11,'LOAN RATES WILL BE USED TO SUPPORT MARKET PRICES
     1AND RELEASE STOCKS AT 115% OF LOAN')
   20 FORMAT ('-',T05,'FARM PROGRAM FOR THIS SIMULATION USED THE FOLLOWI
     1NG POLICY VARIABLES:')
   21 FORMAT ('0',T11,'ACREAGE SET-ASIDE')
   22 FORMAT('0',T11,'TARGET PRICE PROGRAM FOR 1973 ACT')
   23 FORMAT ('0',T11,'TARGET PRICES ADJUSTED BEGINNING IN YEAR ',F5.0)
   24 FORMAT ('0',T11,'ALLOTED ACREAGE ADJUSTED BEGINNING IN ',I4)
   25 FORMAT ('0',T11,'LOAN RATES WILL BE USED TO SUPPORT MARKET PRICES
     1AND RELEASE STOCKS AT 115% OF TARGET PRICE')
   26 FORMAT ('0',T11,'GOVERNMENT STOCK MANAGEMENT WILL BE USED FOR- FEE
     1D GRAIN.')
   27 FORMAT ('0',T11,'GOVERNMENT STOCK MANAGEMENT WILL BE USED FOR- WHE
     1AT.')
   28 FORMAT ('0',T11,'GOVERNMENT STOCK MANAGEMENT WILL BE USED FOR- SOY
     1BEAN.')
   29 FORMAT ('0',T11,'GOVERNMENT STOCK MANAGEMENT WILL BE USED FOR- COT
     1TON.')
   30 FORMAT ('0',T11,'A FREE MARKET WILL BE USED FOR THIS SIMULATION.')
   31 FORMAT ('0',T11,'LOAN RATES WILL BE USED TO SUPPORT MARKET PRICES
     1AND RELEASE STOCKS AT 130% OF TARGET PRICE')
   32 FORMAT ('-',T05,'ELASTICITY INFORMATION')
   33 FORMAT ('0',T11,'THE NEW ELASTICITIES WILL NOT BE STORED ON DISK')
   34 FORMAT ('0',T11,'THE NEW ELASTICITIES WILL BE STORED ON DISK')
   35 FORMAT ('0',T11,'THE NEW ELASTICITIES ARE:',/, T12,'ORDER NO.',
     1 T26, 'SHORT RUN',   T39, 'LONG RUN')
   36 FORMAT ('0',T14, I4, T26,F9.4,  T39, F7.3)
   37 FORMAT ('0',T11,'LOAN RATES WILL BE USED TO SUPPORT MARKET PRICES
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     1AND RELEASE STOCKS AT 140 TO 160% OF LOAN')
  38 FORMAT ('-',T05,'THE USER SUPPLIED ',          'POLICY DATA CARDS,
     1ARE:')
  39 FORMAT ('0',T11,'DEFAULT ELASTICITIES WILL BE USED FOR ALL ELASTIC
     1ITIES')
  40 FORMAT ('0',T15,'VARIABLE NAME',T37,'CROP CODE', T49,'FIRST YEAR',
     1 T63,'NO. YEARS',T82,'CONSECUTIVE OBSERVATIONS')
  41 FORMAT ('0',T11,'EXCEPT THE FOLLOWING USER SUPPLIED ELASTICITIES')
  42 FORMAT ('0',T11,5A4, T39,I4, T52,I4, T64,I4, T73,6F10.3,/,T73,
     1 6F10.0)
  43 FORMAT ('-',T05,'THE USER SUPPLIED '    ,'PREDETERMINED DATA CARDS,
     1 ARE:')
  44 FORMAT (' ',20X,7( 2X,F10.6))
  45 FORMAT('0',T05,'A CONTROL THEORY RUN')
  46 FORMAT('0',T11,'TARGET PRICE PROGRAM FOR 1977 ACT')
  50 FORMAT ('1',15(/) )
  51 FORMAT (' ', T55,'P O L Y S I M',////, T43,  'NATIONAL AGRICULTURA
     1L POLICY SIMULATOR',
     1           ///,T48, 'DEVELOPED AND IMPLEMENTED BY' ,///,T55,
     2'DARYLL E. RAY' ,//, T60 ,'AND',//,T52,'JAMES W. RICHARDSON',///,
     3T44, 'DEPARTMENT OF AGRICULTURAL ECONOMICS',/ ,T49, 'OKLAHOMA STAT
     4E UNIVERSITY',//,T52,'IN COOPERATION WITH',//
     5        , T41,'COMMODITY PROGRAM AND POLICY ANALYSIS AREA',/,  T48,
     6'COMMODITY ECONOMICS DIVISION', /, T57,'ERS, USDA')
  62 FORMAT ('1','THE LAST EXOGENOUS OR ENDOGENOUS DATA CARD READ WAS '
     1,I4,' THE FIRST YEAR OF DATA IS ',I4,', POLYSIM ONLY ALLOWS A TWO
     2YEAR LAG')
  63 FORMAT ('1','THE LAST EXOGENOUS OR ENDOGENOUS DATA CARD READ WAS '
     1,I4,' THE USER READ MORE OBSERVATIONS THAN THERE IS ARRAY STORAGE'
     2)
  77 FORMAT ('1','POLYSIM WAS READING OPTIONAL DATA    CARDS WHEN ERROR
     1OCCURRED. CHECK #CARDS & COL. 36-38 OF ELASTICITY CARD ',I4)
  86 FORMAT ('0','NO. I',T12,15(2X,I3,3X))
  92 FORMAT (' ','SHORT RUN',T12,15(1X,F6.3,1X))
  93 FORMAT (' ','LONG RUN',T12,15(1X,F6.3,1X))
  94 FORMAT ('1',T48,'TABLE OF ELASTICITIES  USED')
  99 FORMAT('1')
12345 FORMAT(1H0, 'SUBROUTINE INT2   ENTERED')
10002 FORMAT(I1, 2X, 19A4)
10016 FORMAT(I1, 19X, I3, I2,4X,  I1, 5F10.0)
30012 FORMAT(1H0, 'THE REMAINING PARAMETER CARDS FOR THIS SIMULATION '
     1          'ARE PRINTED BELOW')
30022 FORMAT(1H0, I1, 2X, 20A4)
      WRITE(8,12345)
      DO 119 I=1,14
      DO 119 J=1,3
  119 DUM(I,J)=0.0
C------ WRITE STATEMENTS TO PRINT THE SIMULATION TITLE PAGE ----
      WRITE(6,99)
      WRITE (6,1) SIMNAM, ISIMND
      WRITE (6,2) NOB,IFSTYR
      IF(IHOLD1.GT.1) WRITE(6,8) IHOLD1
      IF(IKEY1.NE.0) WRITE(6,45)
      WRITE (6,3) IMONTH, IDAY, IBASYR
      IF (NFSTST.NE.0)WRITE(6,14)
      WRITE (6,20)
      IF (DIVAC.NE.0) WRITE(6,21)
      IF(IAJSET.LT.2000) WRITE(6,4) IAJSET
      IF(INEW.LT.2000) WRITE(6,5) INEW
      IF(TARGET.EQ.073) WRITE(6,22)
      IF(TARGET.EQ.077) WRITE(6,46)
      IF(TARGET.EQ.001) WRITE(6,46)
      IF (ADJTG.LT. 1999.0) WRITE (6,23) ADJTG
      IF(IAJLOT.GT.1975.AND.IAJLOT.LT.2020) WRITE(6,24) IAJLOT
      IF(LOAN.EQ.1) WRITE(6,19)
      IF(LOAN.EQ.2) WRITE(6,37)
      IF(LOAN.EQ.3) WRITE(6,25)
      IF(LOAN.EQ.4) WRITE(6,31)
      IF (SUPFG.NE.0) WRITE(6,26)
      IF (SUPWHT.NE.0)WRITE(6,27)
      IF (SUPSOY.NE.0)WRITE(6,28)
      IF (SUPCOT.NE.0)WRITE(6,29)
      IF (FREMKT.NE.0)WRITE(6,30)
      WRITE (6,32)
      IF (KING .EQ.1) WRITE(6,10)
      IF (KING .EQ.2) WRITE(6,12)
      IF (KING .EQ.3) WRITE(6,13)
```

```
      WRITE (6,39)
      J=0
      NERD=0
      NOEX=0
C
C     READ OPTIONAL DATA CARDS
C
  800 READ(5,10016,END=690,ERR=3000)ICHEC,KOD,IYEAR,NUMYRS,(AA(I),I=1,5)
      IF(ICHEC.EQ.0) GO TO 700
      IF(ICHEC.EQ.4 .AND. NERD.EQ.0)  GO TO 400
      IF(ICHEC.EQ.4 .AND. NERD.NE.0)  GO TO 410
      IYEAR=IYEAR+1900
      IF(IYEAR.GT.3000) IYEAR = IYEAR-1900
      IF (IYEAR.LT.IFSTYR-2) GO TO 2400
      IF((IYEAR-IFSTYR + NUMYRS).GT.14) GO TO 2500
      IF(NUMYRS-5) 228,228,227
  227 READ(5,17) ( AA (I),I=6,NUMYRS)
  228 CONTINUE
      ISTART=3+(IYEAR-IFSTYR)
      IEND=(NUMYRS+ISTART)-1
      IF(ICHEC.EQ.5 .AND. NOEX.EQ.0) GO TO 500
      IF(ICHEC.EQ.5 .AND. NOEX.NE.0) GO TO 510
      IF(ICHEC.EQ.6 .AND. J    .EQ.0) GO TO 600
      IF(ICHEC.EQ.6 .AND. J    .NE.0) GO TO 610
C    ---- READ NEW ELASTICITIES----
  400 WRITE (6,41)
      IF (NESTOR.EQ.0)WRITE(6,33)
      IF (NESTOR.NE.0)WRITE(6,34)
      WRITE (6,35)
      READ (10' 533)  (INDEX(I),I=1,90)
      READ (10' 534)  (INDEX(I),I=91,NE)
      READ(10' 545) (ETOADJ(I),I=1,90)
      READ(10' 546) (ETOADJ(I),I=91,NE)
  410 NERD=NERD+1
      E(KOD)=AA(1)
      EE(KOD)=AA(2)
      IF (EE(KOD).EQ. 0.0)  EE(KOD)= E(KOD)
      IF (ETOADJ(KOD) .EQ. 0)  GO TO 120
      ADJ(INDEX(KOD)) =   1.0D0 - (E(KOD) / EE(KOD))
      IF (ADJ(INDEX(KOD)).EQ.0.0) ADJ(INDEX(KOD)) =1.0
  120 CONTINUE
      WRITE (6,36) KOD,E(KOD),EE(KOD)
      GO TO 800
C     READ POLICY CHANGES FOR EXOGENEOUS DATA
  500 WRITE (6,38)
      WRITE (6,40)
  510 NOEX=NOEX+1
      READ (10' NEXOG(KOD))ACA,(A(KK),KK=1,5)
      WRITE(6,42)A,KOD,IYEAR,NUMYRS,( AA (I),I=1,NUMYRS)
      DO 229 I=ISTART,IEND
      K=(I-ISTART)+1
      EXOG(I,KOD)= AA (K)
      IF(KOD.EQ.32) DUM(I,1)= AA(K)
      IF(KOD.EQ.33) DUM(I,2)= AA(K)
      IF(KOD.EQ.34) DUM(I,3)= AA(K)
      IF(IHOLD1.GT.1) OLDEXO(I,KOD)=AA(K)
      IF(IKEY1 .NE.0) OLDEXO(I,KOD)=AA(K)
  229 CONTINUE
      GO TO 800
C-----      READ POLICY     CHANGES--ENDOGENEOUS ---
  600 WRITE (6,43)
      WRITE (6,40)
  610 J=J+1
      DO 170 K=1,NUMYRS
  170 CDATA(K,J)=AA(K)
      READ (10' NFILE(KOD))ACA,(A(KK),KK=1,5)
      WRITE(6,42) A,KOD,IYEAR,NUMYRS,(CDATA(I,J),I=1,NUMYRS)
      DO 525 I = ISTART,IEND
      K = (I - ISTART) + 1
      C' T.KOD)=CDATA(K,J)
      IDATA(1,J)=KOD
      IDATA(2,J)=ISTART
      IDATA(3,J)= IEND
  525 CONTINUE
      GO TO 800
  690 IEN = IEN +1
  700 EXG=EXOG(2,37)
      NOPOL=J
```

```
      IFST=IFSTYR-2
C-----     CALCULATE LONG RUN ELASTICITY- IF READ NEW ELASTICITIES
      IF(NERD.EQ.0) GO TO 305
      DO 300 I=1,NE
       ADJIX=INDEX(I)
      IF (ADJ( ADJIX).EQ.1.0) GO TO 295
      EE(I)= (E(I)/(1.0D0-ADJ(ADJIX)))
      GO TO 300
  295 EE(I) = E(I)
  300 CONTINUE
C      ---- STORE ELASTICITIES OPTION----
      IF (NESTOR.EQ.0) GO TO 305
      WRITE (10' 504)  (E(I),I=1,90)
      WRITE (10' 505)  (E(I),I=91,NE)
      WRITE (10'506) (EE(I),I=1,90)
      WRITE (10'507) (EE(I),I=91,NE)
      WRITE (10'508) (ADJ(I),I=1,NADJ)
  305 CONTINUE
C IF DESIRED WRITE ELASTICITY PARAMETERS
      IF(NPRE.EQ.0) GO TO 315
      WRITE (6,94)
      NPEL=(NE/15)+1
      NEL=15
      NP=1
      DO 310 I=1,NPEL
      IF (NEL.GT.NE) NEL=NE
      WRITE (6,86) (K,K=NP,NEL)
      WRITE (6,92) (E(K),K=NP,NEL)
      WRITE (6,93) (EE(K),K=NP,NEL)
      NP=NP+15
      NEL=NEL+15
  310 CONTINUE
C-NPRDM IS OPTION TO PRINT LIVESTOCK PRICE FLEXIBILITY MATRIX,WITH TITLE
  315 IF(NPRDM.EQ.0) GO TO 325
      IF (KING.EQ.1) WRITE (6,9)
      IF (KING.EQ.2) WRITE (6,15)
      IF(KING.EQ.3) WRITE(6,18)
      DO320 I=1,7
  320 WRITE(6,44)(DM(I,K),K=1,7)
  325 CONTINUE
      WRITE (6,99)
      RETURN
C-THE FOLLOWING ARE EMBEDDED ERROR MESSAGES
 2400 WRITE(6,62) KOD,IYEAR,IFSTYR
      GO TO 30010
 2500 WRITE (6,63) KOD
      GO TO 30010
 3000 WRITE(6,77)  KOD
      GO TO 30010
30010 WRITE(6,30012)
30020 IF( IEN .NE.0) GO TO 40000
      READ(5,10002,END=40000) ICHEC, (SIMNAM(II), II=1,19)
      IF(ICHEC.EQ.1) GO TO 35000
      WRITE(6,30022) ICHEC, SIMNAM
      GO TO 30020
35000 IFLAG = 5
      RETURN
C     WRITE  FINAL  OUTPUT PAGE
40000 WRITE (6, 50)
      WRITE (6, 51)
      WRITE (6,50)
      STOP 40002
      END
C**********************************************************************
C                               SUBROUTINE SETUP
C**********************************************************************
      SUBROUTINE SETUP
C---- LATEST REVISION 9-4-77
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG( 14,180), OLDEXO(14, 180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON /CMAINH/ NOPOL, NEPOL, NRO, IDROP, LASTYR ,ACRE(14,12)
      COMMON  /CMAINJ/  JNEW,IAJSET,KNEW,INEW
```

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      DIMENSION DHOLD(16)
   10 FORMAT (' ',A4, 11F10.3)
12345 FORMAT(1H0, 'SUBROUTINE SETUP  ENTERED')
      WRITE(8,12345)
      WRITE(8,10)AY(I)
C     TIME
      C(I,106)=B(I,106)
C     CONVERT SLIPPAGE TO ONE MINUS SLIPPAGE
      DO 5 LJK=82,85
    5 EXOG(I,LJK)=1.0- EXOG(I,LJK)
C     CAL. SET-ASIDE VALUES BASED ON SUPPLY, DEMAND, & YIELDS EXPECTED.
      IF(IAJSET.GT.C(I,106)) GO TO 20
      EXOG(I,1) =((B(I,09) +EXOG(I,2) +C(J,41)-B(I,33)-B(I,37)-40.0     )
     1 / B(I,5)   ) / EXOG(I,82)
      EXOG(I,3) =((B(I,10) +EXOG(I,4) +C(J,42)-B(I,34)-B(I,38)-800.0    )
     1 / B(I,6)   ) / EXOG(I,83)
      EXOG(I,5) =((B(I,11)            +C(J,43)-B(I,35)-B(I,39)-125.0    )
     1 / B(I,7)   ) / EXOG(I,84)
      EXOG(I,6) =((B(I,12) +EXOG(I,7) +C(J,44)-B(I,36)-B(I,40)-3.000    )
     1 /(B(I,8)/480.0) ) / EXOG(I,85)
   20 CONTINUE
      IF(INEW.GT.C(I,106)) GO TO 30
      DO 21 K=1,16
   21 DHOLD(K) = C(I,K)
C     GET THE CALULATED VALUES FOR SUPPLY
      CALL CROPQ
      EXOG(I,15) = EXOG(I,12) * 1.30
C     SET-ASIDE FOR  4  CROPS.
      EXOG(I,1)=((C(I,21)*((1.0-((EXOG(I,58)+(EXOG(I,57)-EXOG(I,58))/3.0
     1) / B(I,25) ) ) / E(27) )) / C(I,5) ) / EXOG(I,82)
      EXOG(I,3)=((C(I,22)*((1.0-((EXOG(I,55)+(EXOG(I,52)-EXOG(I,55))/3.0
     1) / B(I,26) ) ) / E(30) )) / C(I,6) ) / EXOG(I,83)
      EXOG(I,5)=((C(I,23)*((1.0-((EXOG(I,12)+(EXOG(I,15)-EXOG(I,12))/3.0
     1) / B(I,27) ) ) / E(33) )) / C(I,7) ) / EXOG(I,84)
      EXOG(I,6)=((C(I,24)*((1.0-((EXOG(I,56)+(EXOG(I,53)-EXOG(I,56))/3.0
     1) / B(I,28) ) ) / E(35) )) /(C(I,8)/480.))/EXOG(I,85)
      DO 25 K=1,16
   25 C(I,K) = DHOLD(K)
   30 CONTINUE
      IF((IAJSET.GT.C(I,106)) .AND. (INEW.GT.C(I,106)) ) GO TO 40
C     MINIMUM SET-ASIDE
      IF(EXOG(I,1).LT.0.0) EXOG(I,1) = 0.0
      IF(EXOG(I,3).LT.0.0) EXOG(I,3) = 0.0
      IF(EXOG(I,5).LT.0.0) EXOG(I,5) = 0.0
      IF(EXOG(I,6).LT.0.0) EXOG(I,6) = 0.0
C     MAXIMUM SET-ASIDE
      IF(EXOG(I,1).GT.(0.28*B(I,1)) ) EXOG(I,1) = 0.28* B(I,1)
      IF(EXOG(I,3).GT.(0.28*B(I,2)) ) EXOG(I,3) = 0.28* B(I,2)
      IF(EXOG(I,5).GT.(0.28*B(I,3)) ) EXOG(I,5) = 0.28* B(I,3)
      IF(EXOG(I,6).GT.(0.28*B(I,4)) ) EXOG(I,6) = 0.28* B(I,4)
   40 CONTINUE
C-IF FREE MARKET (FREMKT=1)HARVESTED ACRES IS SET TO BASE LEVEL OF HAR.
C ACRES IF NO SET-ASIDE PROGRAM
      IF(FREMKT.EQ.1.OR.DIVAC.EQ.0) EXOG(I,1)=0.0
      IF(FREMKT.EQ.1.OR.DIVAC.EQ.0) EXOG(I,3)=0.0
      IF(FREMKT.EQ.1.OR.DIVAC.EQ.0) EXOG(I,5)=0.0
      IF(FREMKT.EQ.1.OR.DIVAC.EQ.0) EXOG(I,6)=0.0
C ADJUST BASE ACRES FOR THE LEVEL OF SET-ASIDE IN THE BASELINE,
C     AS IF THERE HAD BEEN NO SET-ASIDE
      FGAC= ACRE(I,1) + ACRE(I,09) * ACRE(I,5)
      WHAC= ACRE(I,2) + ACRE(I,10) * ACRE(I,6)
      SYAC= ACRE(I,3) + ACRE(I,11) * ACRE(I,7)
      CTAC= ACRE(I,4) + ACRE(I,12) * ACRE(I,8)
C-IF USER HAS READ SET-ASIDE POLICY CARDS IN,AND DIVAC.NE.0 THE NEW SET-
C ASID E LEVEL IS MULT  BY 1-SLIPPAGE & SUBTRACTED FROM FGDMAC TO GET NE
C W BASE HARVESTED ACRES.
      B(I,1)=FGAC - (EXOG(I,82) * EXOG(I,1))
      B(I,2)=WHAC - (EXOG(I,83) * EXOG(I,3))
      B(I,3)=SYAC - (EXOG(I,84) * EXOG(I,5))
      B(I,4)=CTAC - (EXOG(I,85) * EXOG(I,6))
      IF (B(I,1).GT.EXOG(I,79)) B(I,1)=EXOG(I,79)
      IF (B(I,2).GT.EXOG(I,80)) B(I,2)=EXOG(I,80)
      IF (B(I,4).GT.EXOG(I,81)) B(I,4)=EXOG(I,81)
      RETURN
      END
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C***********************************************************************
C                              SUBROUTINE LVSK
C***********************************************************************
      SUBROUTINE LVSK
C---- LATEST REVISION 6-1-77
      COMMON  /CMAIN3/ SIMNAM(20), NEXOG(180), NFILE(300), DM(7,7),
     1EE(200)
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
12345 FORMAT(1H0, 'SUBROUTINE LVSK   ENTERED')
      WRITE(8,12345)
C-CHFGPR IS A VARIABLE FOR PERCENTAGE CHANGE IN FEED GRAIN PRICE,IS USED
C IN THE LIVESTOCK PRODUCTION EQUATIONS.
      CHFGPR = 1.00 * ((C(J,025)-B(J,025)) / B(J,025)) + 0.00 * ((C(I,020
     15) -B(I,025)) / B(I,025))
      IF(CHFGPR.LE.0.001.AND.CHFGPR.GT.0.0) CHFGPR=0.0
      IF(CHFGPR.GT.-0.001.AND.CHFGPR.LE.0.0) CHFGPR=0.0
C     ---- BEEF  PRODUCTION----
      C(I,049)=   B(I,049) * ( 1.0   + E(66) * ((C(J,070) - B(J,070)) /
     1 B(J,070))  +   E(77) * CHFGPR + E(67) * ((C(J,071) - B(J,071)) /
     2 B(J,071)) + E(68) * ((C(J,072) - B(J,072)) /B(J,072)) )
     3 + (1.0 - ADJ(30)) *(C(J,049) -  B(J,049))
C     ---- HOG  PRODUCTION
      C(I,050)=   B(I,050) * ( 1.0   + E(69) * ((C(J,071) - B(J,071)) /
     1 B(J,071))  +   E(83) * CHFGPR + E(70) * ((C(J,070) - B(J,070)) /
     2 B(J,070)) +E(71) * ((C(J,072) - B(J,072)) / B(J,072)) ) +(1.0 - A
     3  DJ(31)) * (C(J,050) - B(J,050))
C     ---- SHEEP  PRODUCTION----
      C(I,051)=   B(I,051) * ( 1.0   + E(72) * ((C(J,072) - B(J,072)) /
     1 B(J,072)) + E(74) * CHFGPR    + E(73) * ((C(J,070) - B(J,070)) /
     2 B(J,070)) ) +  ( 1.0 - ADJ(32)) * (C(J,051) - B(J,051))
C     ---- CHICKEN  PRODUCTION----
      C(I,052)=   B(I,052) * ( 1.0   + E(75) * ((C(J,073) - B(J,073)) /
     1 B(J,073))  +   E(76) * CHFGPR )   +( 1.0 - ADJ(33)) *(C(J,052) -B(
     3 J,052))
C     ---- TURKEY  PRODUCTION----
      C(I,053)=   B(I,053) * ( 1.0   + E(78) * ((C(J,074) - B(J,074)) /
     1 B(J,074))  +   E(79) * CHFGPR ) + (1.0 -ADJ(34))   * (C(J,053)- B(
     3 J,053))
C     ---- EGG PRODUCTION
      C(I,054)=   B(I,054) * ( 1.0   + E(81) * ((C(J,075) - B(J,075)) /
     1 B(J,075))  +   E(82) * CHFGPR ) + (1.0 -ADJ(35))   * (C(J,054)- B(
     4 J,054))
C     ---- MILK PRODUCTION----
      C(I,055)=   B(I,055) * (1.0    + E(84) * ((C(J,076) - B(J,076)) /
     1 B(J,076)) + E(46) * CHFGPR    + E(85) * ((C(J,070) - B(J,070)) /
     2 B(J,070)) )+( 1.0 - ADJ(36)) * (C(J,055) - B(J,055))
C     ---- LIVESTOCK PRODUCTION UNITS
      C(I,85) =  B(I,85)          + ( (C(I,49)-B(I,49)) * CONST(45))
     1          + ((C(I,50)-B(I,50)) * CONST(46)  )  +
     2  ((C(I,51) - B(I,51) ) * CONST(47))               +  ((C(I,52) - B(
     3I,52) ) * CONST(48)  )                   +  ((C(I,53) - B(I,53)) * CONS
     4T(49))                 +    (C( I,54) - B(I,54)) * CONST(50) +
     5  (C( I,55) - B(I,55)) *   CONST(51)
C-----------BEEF AVAILABLE FOR DOMESTIC CONSUMPTION -----
      C(I,56) =C(I,49) +EXOG(I,23) - EXOG(I,40)
      C(I,57) = C(I,50) + EXOG(I,24) - EXOG(I,41)
      C(I,58) = C(I,51) + EXOG(I,25) - EXOG(I,42)
      C(I,59) = C(I,52) + EXOG(I,26) - EXOG(I,43)
      C(I,60) = C(I,53) + EXOG(I,27) - EXOG(I,44)
      C(I,61) = C(I,54) + EXOG(I,28) - EXOG(I,45)
      C(I,62) = C(I,55) + EXOG(I,29) - EXOG(I,46)
C---------- PERCENTAGE CHANGE LS AVALIABLE FOR DOMEXTIC CONSUMPTION------
C-BFPER IS % CHANGE IN BEEF AVAILABLE TO DOMESTIC CONSUMERS IN CALCULATE
      BFPER=(C(I,56)-B(I,56))/B(I,56)
      BKPER=(C(I,57)-B(I,57))/B(I,57)
      SPPER=(C(I,58)-B(I,58))/B(I,58)
      CKPER=(C(I,59)-B(I,59))/B(I,59)
      TKPER=(C(I,60)-B(I,60))/B(I,60)
      EGPER=(C(I,61)-B(I,61))/B(I,61)
      AMKPER=(C(I,62)-B(I,62)) /B(I,62)
C     PRICES OF SEVEN LIVESTOCK GROUPS IS CAL. BY THE SELECTED LIVESTOCK
C PRICE FLEXIBILITY MATRIX.
      DO 460 K=1,7
      L=70+K-1
  460 C(I,L)=B(I,L)*(1.0+ (DM(K,1)*BFPER)+(DM(K,2)*BKPER)+(DM(K,3)*SPPER
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     1)+(DM(K,4)*CKPER)+(DM(K,5)*TKPER)+(DM(K,6)*EGPER)+(DM(K,7)*AMKPER)
     2)
C    ---- INDEX OF PRICES RECIEVED LIVESTOCK AND PRODUCTS----
C-BEFPRC IS PRICE OF CATTLE AND CAFPRC IS AVERAGE CALF PRICE,THE FACTORS
C COME FROM THE INDEX OF PRICES RECIEVED FOR LIVESTOCK SOURCE.
      BEFPRC = C(I,70) / 1.014D0
      CAFPRC = BEFPRC * 1.20D0
      C(I,099)= B(I,099) *(1.0+(((C(I,70)-B(I,70))/B(I,70))*CONST(31) *
     10.01 + ((C(I,71)-B(I,71))/B(I,71))*CONST(33)*0.01 + ((C(I,72) -
     2B(I,72))/B(I,72))*CONST(34)*0.01) *CONST(35)  + ( ((C(I,73)-B(I,73
     3))/B(I,73))*CONST(38)*0.01 + ((C(I,74)-B(I,74))/B(I,74))*CONST(39)
     4*0.01 + ((C(I,75)-B(I,75))/B(I,75))*CONST(40)*0.01) *CONST(41) +
     5 ((C(I,76)-B(I,76))/B(I,76))*CONST(36)*CONST(37)*0.01)
 1205 CONTINUE
      RETURN
      END
C*************************************************************************
C                             SUBROUTINE AJLOAN
C*************************************************************************
      SUBROUTINE AJLOAN
C     WRITTEN FOR THE 1977 AG. ACT   11/16/77   JWR.
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
    1 FORMAT (1H0, 'SUBROUTINE AJLOAN ENTERED')
      WRITE(8,1)
      IF(A73.EQ.0) GO TO 100
      IF(LOAN.EQ.0) GO TO 100
C     ADJUST THE LOANS IN T IF PRICE IS WITHIN 105% OF LOAN IN T-1
      IF(C(J,102).LT.(1.05*EXOG(J,54)) ) EXOG(I,54) = 0.9 * EXOG(I,54)
      IF(C(J,026).LT.(1.05*EXOG(J,55)) ) EXOG(I,55) = 0.9 * EXOG(I,55)
C     CHECK LOAN LEVEL AGINST LEGAL MINIMUM.
      IF(EXOG(I,54) .LT. 1.75) EXOG(I,54) = 1.75
      IF(EXOG(I,55) .LT. 2.00) EXOG(I,55) = 2.00
C     SNAP-BACK EFFECT FOR INCREASING THE LOAN LEVEL.
      IF(C(J,102).GT.(1.05*EXOG(J,54)) ) EXOG(I,54) = 2.00
      IF(C(J,026).GT.(1.05*EXOG(J,55)) ) EXOG(I,55) = 2.35
      EXOG(I,61) = EXOG(I,54) * (OLDEXO(I,61) / OLDEXO(I,54) )
      EXOG(I,62) = EXOG(I,54) * (OLDEXO(I,62) / OLDEXO(I,54) )
  100 RETURN
      END
C*************************************************************************
C                             SUBROUTINE TGTP
C*************************************************************************
      SUBROUTINE TGTP
C---- LATEST REVISION 6-1-77
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
12345 FORMAT(1H0, 'SUBROUTINE TGTP   ENTERED')
      IF(FREMKT.EQ.1) GO TO 485
      EXOG(I,48) = EXOG(I,68) + EXOG(I,69) + EXOG(I,70)
      IF(TARGET.EQ.077) GO TO 485
      WRITE(8,12345)
C---- ADJ TARGET PRICES BASED ON AGRIC. ACT OF 1973
      IF(TARGET.EQ.0) GO TO 485
      IF(ADJTG.EQ.0.0) GO TO 485
      IF( ADJTG.GT.C(I,106)) GO TO 485
      DO  4012  L=1,4
      IF(L.EQ.3) GO TO 4012
      K=L
      KK=I+2
      AYD1  = (YIELD(KK-4,K)+YIELD(KK-3,K)+YIELD(KK-2,K))/3.0
      AYD2  = (YIELD(KK-3,K)+YIELD(KK-2,K)+YIELD(KK-1,K))/3.0
      IF  (L.EQ.1)  IT=51
      IF  (L.EQ.2)  IT=52
      IF  (L.EQ.4)  IT=53
C---- CALCULATE TARGET PRICE USING PRICES PAID & YIELD
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      EXOG  (I,IT)  =EXOG(J,IT)*(1.0+((EXOG(I-1,108)-EXOG(I-2,108))
     1 /EXOG(I-2,108))  -((AYD2-AYD1)/AYD1))
C---- TARGET PRICE IF USE ONLY PRICES PAID
      HOLD1 = EXOG(J,IT)* (1.0 + ((EXOG(I-1,108)-EXOG(I-2,108)) /EXOG(I-
     12,108)) )
      HOLD2 = EXOG(I,IT)
C---- IF THE TARGET PRICE IS GREATER J VALUE GO AROUND THIS ACTION
      IF (HOLD2.GE.EXOG(J,IT)) GO TO 120
C---- THE REMAINING SITUATIONS ARE HOLD2 LESS THAN EXOG(J,IT)
      IF(HOLD1.GE.EXOG(J,IT).AND.HOLD2.LT.EXOG(J,IT)) EXOG(I,IT)=EXOG(J,
     1IT)
      IF(HOLD1.LE.EXOG(J,IT).AND.HOLD1.GE.HOLD2) EXOG(I,IT)=HOLD1
      IF(HOLD1.LE.EXOG(J,IT).AND.HOLD2.GE.HOLD1) EXOG(I,IT)=HOLD2
  120 CONTINUE
 4012 CONTINUE
      EXOG(I,59)=EXOG(I,59) *(1.0+((EXOG(I,51)-OLDEXO(I,51))/OLDEXO(I,51
     1)) )
      EXOG(I,60)=EXOG(I,60) *(1.0+((EXOG(I,51)-OLDEXO(I,51))/OLDEXO(I,51
     1)) )
  485 CONTINUE
C-CALCULATE FEED GRAIN LOAN RATE.
      EXOG(I,58)=EXOG(I,54) *(35.714*(CONST(27)+CONST(79)*CONST(28) +
     1CONST(80) * CONST(29)+ CONST(81) * CONST(30) ))
      EXOG(I,57)=EXOG(I,51) *(35.714*(CONST(27)+CONST(79)*CONST(28) +
     1CONST(80) * CONST(29)+ CONST(81) * CONST(30) ))
      RETURN
      END
C***********************************************************************
C                              SUBROUTINE ADJLOT
C***********************************************************************
      SUBROUTINE  ADJLOT
C---- LATEST REVISION 6-1-77
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
12345 FORMAT(1H0, 'SUBROUTINE ADJLOT ENTERED')
      IF(IAJLOT.GT.C(I,106)) GO TO 200
      WRITE(8,12345)
      FEEDFD= C(I,29)
      FEDGEX= C(I,37)
      WHEXP= C(I,38)
      CTEXP= C(I,40)
      FGPROD = B(I,9)
      IF(C(I,5).NE.0.0) FGPROD=C(I,5) * B(I,1)
      IF(C(I,1).NE.0.0) FGPROD=C(I,1) * B(I,5)
      IF(C(I,1).NE.0.0 .AND. C(I,5).NE.0.0) FGPROD=C(I,1)*C(I,5)
      IF (C(I,9).NE.0.0) FGPROD=C(I,9)
      WHPROD =B(I,10)
      IF(C(I,6).NE.0.0) WHPROD=C(I,6)   *B(I,2)
      IF(C(I,2).NE.0.0) WHPROD=C(I,2)   *B(I,6)
      IF(C(I,2).NE.0.0 .AND. C(I,6).NE.0.0) WHPROD=C(I,2)*C(I,6)
      IF (C(I,10).NE.0.0) WHPROD= C(I,10)
      CTPROD =B(I,12)
      IF(C(I,7).NE.0.0) CTPROD=C(I,7)*B(I,3)
      IF(C(I,3).NE.0.0) CTPROD=C(I,3)*B(I,7)
      IF(C(I,3).NE.0.0 .AND. C(I,7).NE.0.0) CTPROD=C(I,3)*C(I,7)
      IF (C(I,12).NE.0.0) CTPROD= C(I,12)
C           EXPECTED SUPPLIES FOR FEEDGRAINS, WHEAT, AND COTTON
      C(I,21) =   FGPROD + EXOG (I,2) +C(J,41)  -C(J,150)
      C(I,22) =   WHPROD + EXOG (I,4) +C(J,42)  -C(J,151)
      C(I,24) =   CTPROD + EXOG (I,7) +C(J,44)  -C(J,152)
C     FEED GRAIN PRICE
C-FGEXP IS VARIABLE FOR FEED GRAIN EXPORT,IF USER HAS READ A PRE-DETER.E
C XPORT IN IT WILL BE STORED IN FGEXP AND USED TO CALCULATE PRICE;IF NOT
C BASE VALUE IS STORED HERE AND HAS NO AFFECT ON PRICE.
      IF (C(I,037).EQ. 0.0) FGEXP  =B(I,37)
      IF (C(I,037).NE. 0.0) FGEXP  =C(I,37)
      IF(C(I,29).NE.0.0)  FGFEED=C(I,29)
      IF(C(I,29).EQ.0.0)  FGFEED=B(I,29)
      C(I,25) =  B(I,25) * (1.0 + (E(27)* ((( C(I,21)-B(I,21)) -(FGEXP
     1 -B(I,37))-(FGFEED-B(I,29))                         )/B(I,21)))
     2  + (E(28) * ((EXOG(I,58)-EXOG(I,58))/EXOG(I,58)))  + (E(29) *
     3((C(I,22) - B(I,22)) / B(I,22))) ) +((1.0 -ADJ(5)) * (C(J,25) -
     4 B(J,25)))
      IF(C(I,25).LT.EXOG(I,57)) C(I,25) = EXOG(I,57)
C-SCHEDULE FOR WHEAT PRICE FLEXIBILITY AT DIFFERENT STOCK LEVELS.
      IF(                     C(J,42).GE.500.0)E(30)=-2.0
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      IF(C( J,42).LT.500.0.AND.C(J,42).GE.400.0) E(30)=-2.4
      IF(C( J,42).LT.400.0.AND.C(J,42).GE.300.0) E(30)=-3.0
      IF(C( J,42).LT.300.0.AND.C(J,42).GE.190.0) E(30)=-3.5
      IF(C( J,42).LT.190.0) E(30)=-4.0
C     WHEAT PRICE
C-WHEXPT IS VARIABLE FOR PRE-DETER.WHEAT STOCKS TO ENTER THE WHEAT PRICE
C EQUATION.
      IF (C(I,038).EQ. 0.0) WHEXPT =B(I,38)
      IF (C(I,038).NE. 0.0) WHEXPT =C(I,38)
      C(I,26) =  B(I,26) * (1.0 +(E(30)* ((C(I,22)-B(I,22)) - (WHEXPT
     1-B(I,38))                    )/B(I,22)) +(E(31) * ((EXOG(I,55) - EXOG(
     2I,55)) / EXOG(I,55))) + (E(32) * ((C(I,21) - B(I,21)) / B(I,21)))
     3) + (1.0 - ADJ(6)) * (C(J,26) - B(J,26))
      IF(C(I,26).LT.EXOG(I,52)) C(I,26) = EXOG(I,52)
C     COTTON PRICE
C-COEXPT IS VARIABLE TO ALLOW PRE-DETER.COTTON EXPORTS TO INFLUENCE COTT
C PRICE.
      EXOG( I,15)=EXOG(I,56)
      IF (C(I,040).EQ.0.0)  COEXPT =B(I,40)
      IF (C(I,040).NE.0.0)  COEXPT =C(I,40)
      C(I,28) = B(I,28) * (1.0 + (E(35) *(((C(I,24)-B(I,24)) -(COEXPT
     1-B(I,40))                    )/B(I,24)))+   (E(36) * ((EXOG(I,56) -
     2EXOG(I,56))/ EXOG(I,56))))+ (1.0 - ADJ(8))* (C(J,28) -B(J,28))
      IF(C( I,28).LT.EXOG(I,53)) C(I,28) = EXOG(I,53)
C     ---- FEED GRAINS FED TO LIVESTOCK----
      IF(C(I,29).NE.0.0                   ) GO TO 3009
      C(I,29) = B(I,29) * (1.0 + E(088)* ((C(I,025)- B(I,025))/B(I,025))
     2              ) + (1.0-ADJ(38))*(C(J,29)-B(J,29))
 3009 CONTINUE
C     FEED GRAIN EXPORTS
      IF(C( I,37).NE.0.0                  ) GO TO 3010
      C(I,37)= B(I,37)*(1.0+(E(40)*((C(I,25)-B(I,25))/B(I,25)))) +(1.0-A
     1DJ(10))*(C(J,37)-B(J,37))
 3010 CONTINUE
C     WHEAT FOOD DEMAND
      C(I,84)=(B(I,84)*(1.0+(E(41)*((C(I,26)-B(I,26))/B(I,26)))))+(1.0-A
     1DJ(11))*(C(J,84)-B(J,84))
C     WHEAT FEED DEMAND
      C(I,30)=(B(I,30)*(1.0+(E(42)*((C(I,26)-B(I,26))/B(I,26)))+(E(43)*(
     1(C(I,25)-B(I,25))/B(I,25)))))+(1.0-ADJ(12))*(C(J,30)-B(J,30))
      IF(C( I,38).NE.0.0                  ) GO TO 3011
      C(I,38)= B(I,38)*(1.0+(E(44)*((C(I,26)-B(I,26))/B(I,26)))) +(1.0-A
     1DJ(13))*(C(J,38)-B(J,38))
 3011 CONTINUE
C     COTTON MILL CONSUMPTION
      C(I,32)=(B(I,32)*(1.0+(E(48)*((C(I,28)-B(I,28))/B(I,28)))))+(1.0-A
     1DJ(16))*(C(J,32)-B(J,32))
C     COTTON EXPORTS
      IF(C( I,40).NE.0.0                  ) GO TO 3013
      C(I,40)= B(I,40)*(1.0+(E(49)*((C(I,28)-B(I,28))/B(I,28)))) +(1.0-A
     1DJ(17))*(C(J,40)-B(J,40))
 3013 CONTINUE
C             ADJUSTMENT IN ALLOTTED ACRES FOR FEED GRAINS, WHEAT,
C                COTTON, CORN, GRAIN SORGHUM  AND BARLEY
      FGALOT=  EXOG(I,48)
      EXOG (I,48) = EXOG(I,48) + (C(I,29)+C(I,37)-B(I,29)-B(I,37)
     1                                          )/B(I,5)
      EXOG (I,49) = EXOG(I,49) + (C(I,84)+C(I,30)-B(I,84)-B(I,30)
     1+C(I,38)-B(I,38)                          )/B(I,6)
      EXOG  (I,50) = EXOG(I,50) + (C(I,32)+C(I,40)-B(I,32)-B(I,40)
     1                                          )/(B(I,8)/480.)
      IF(EXOG(I,50).LT.10.1) EXOG(I,50)=10.1
      IF(FGALOT.EQ.0.0) GO TO 100
      EXOG (I,68) =EXOG(I,68)*((EXOG(I,48)-FGALOT) /FGALOT   + 1.0 )
      EXOG (I,69) =EXOG(I,69)*((EXOG(I,48)-FGALOT) /FGALOT   + 1.0)
      EXOG (I,70) =EXOG(I,70)*((EXOG(I,48)-FGALOT) /FGALOT   + 1.0)
  100 CONTINUE
      DO 3014 K = 25,36
         C(I,K) = 0.0
 3014 CONTINUE
      C(I,29) = FEEDFD
      C(I,37) = FEDGEX
      C(I,38) = WHEXP
      C(I,40) = CTEXP
      C(I,84) = 0.0
  200 RETURN
      END
```

```
C*****************************************************************************
C                                   SUBROUTINE CROPQ
C*****************************************************************************
      SUBROUTINE CROPQ
C---- LATEST REVISION 9-4-77
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON /CMAINH/ NOPOL, NEPOL, NRO, IDROP, LASTYR ,ACRE(14,12)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
    1 FORMAT (' ',T60,'FEEDGRAIN ACREAGE SET TO MAXIMUM FOR ',F5.0)
    2 FORMAT (' ',T60,'  WHEAT   ACREAGE SET TO MAXIMUM FOR ',F5.0)
    4 FORMAT (' ',T60,'  COTTON  ACREAGE SET TO MAXIMUM FOR ',F5.0)
12345 FORMAT(1HO, 'SUBROUTINE CROPQ  ENTERED')
      WRITE(8,12345)
C IF LOAN RATE IS GREATER THAN LAST YEARS MKT.PRICE THEN LOAN RATE = T-1
C YEAR'S PRICE IN INFLUENCING ACREAGE,YIELD AND VARIABLE EXPENSE PER AC.
      FGPRIC=0.0
      WHPRIC=0.0
      SOYPRC=0.0
      COTPRC=0.0
      IF(LOAN.NE.0 .AND. C(J,25).LT.EXOG(I,58) .AND. EXOG(I,58).NE.OLDEX
     1O(I,58) ) FGPRIC = C(J,25)
      IF(LOAN.NE.0 .AND. C(J,25).LT.EXOG(I,58) .AND. EXOG(I,58).NE.OLDEX
     1O(I,58) ) C(J,25) = EXOG(I,58)
      IF(LOAN.NE.0 .AND. C(J,26).LT.EXOG(I,55) .AND. EXOG(I,55).NE.OLDEX
     1O(I,55) ) WHPRIC = C(J,26)
      IF(LOAN.NE.0 .AND. C(J,26).LT.EXOG(I,55) .AND. EXOG(I,55).NE.OLDEX
     1O(I,55) ) C(J,26) = EXOG(I,55)
      IF(LOAN.NE.0 .AND. C(J,27).LT.EXOG(I,12) .AND. EXOG(I,12).NE.OLDEX
     1O(I,12) ) SOYPRC = C(J,27)
      IF(LOAN.NE.0 .AND. C(J,27).LT.EXOG(I,12) .AND. EXOG(I,12).NE.OLDEX
     1O(I,12) ) C(J,27) = EXOG(I,12)
      IF(LOAN.NE.0 .AND. C(J,28).LT.EXOG(I,56) .AND. EXOG(I,56).NE.OLDEX
     1O(I,56) ) COTPRC = C(J,28)
      IF(LOAN.NE.0 .AND. C(J,28).LT.EXOG(I,56) .AND. EXOG(I,56).NE.OLDEX
     1O(I,56) ) C(J,28) = EXOG(I,56)
      IF (C(I,1).NE.0.0 .AND.C(I,5).NE.0.0 .AND. C(I,9).NE.0.0) C(I,5)=C
     1(I,9)/C(I,1)
C     FEED GRAIN HARVESTED ACREAGE
C-THIS IS THE WAY WE HANDLE PREDETERMINED POLICY VARIABLES.IF READ A FG
C ACREAGE CARD IT IS STORED IN C(I,1)AND THUS CAUSES CONTROL TO JUMP
C USUAL ACREAGE CALCULATION.
      IF(C(I,1).NE.0.0) GO TO 330
      C(I,1)=(B(I,1)*(1.0+(E(1)*((C(J,25)-B(J,25))/B(J,25)))+(E(2)*((C(J
     1,26)-B(J,26))/B(J,26)))+(E(3)*((C(J,27)-B(J,27))/B(J,27)))+(E(4)*(
     2(C(J,28)-B(J,28))/B(J,28)))+(E(55)*EXOG(I,38))))+(1.0-ADJ(1))*(C(J
     3,1)-B(J,1))
C-IF CALCULATED HARVESTED ACRES IS GREATER THAN MAXIMUM HARVESTED ACRES
C THEN ACREAGE SET TO LATTER LEVEL.
      IF (C(I,1).GT.EXOG(I,79)) WRITE(6,01)C(I,106)
      IF (C(I,1).GT.EXOG(I,79)) C(I,1)=EXOG(I,79)
C     FEED GRAIN YIELD PER HARVESTED ACRE
  330 IF (C(I,5).NE.0.0) GO TO 335
      C(I,5)=(B(I,5)*(1.0+(E(5)*((C(J,25)-B(J,25))/B(J,25)))+(E(6)*EXOG(
     1I,38))))+(1.0-ADJ(19))*(C(J,5)-B(J,5))
  335 YIELD(I+2,1)   =YIELD(I+2,3)*(1.0+(C(I,5)-B(I,5))/B(I,5))
C     FEED GRAIN PRODUCTION
      IF(C(I,9).NE.0.0) GO TO 340
      C(I,9)=C(I,1)*C(I,5)
  340 CONTINUE
      IF ((C(I,1)*C(I,5)).NE.C(I,9)) C(I,5)=C(I,9)/C(I,1)
C     FEED GRAIN SUPPLY
      C(I,21)=C(I,9)+EXOG(I,2)+C(J,41) - C(J,150) - C(J,209)
     1 +B(J,150) + B(J,209)
C     FEED GRAIN EXPENSE PER HARVESTED ACRE
      IF (C(I,13).NE.0.0)  GO TO 205
      C(I,13)=(B(I,13)*(1.0+(E(7)*((C(J,25)-B(J,25))/B(J,25)))+(E(59)*EX
     1OG(I,38))))+(1.0-ADJ(23))*(C(J,13)-B(J,13))
  205 CONTINUE
C     FEED GRAIN TOTAL PRODUCTION EXPENSES
      C(I,17)=C(I,1)*C(I,13)
      IF (C(I,2).NE.0.0 .AND. C(I,6).NE.0.0 .AND. C(I,10).NE.0.0) C(I,6)
     1=C(I,10)/C(I,2)
```

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C       WHEAT HARVESTED ACREAGE
        IF(C(I,2).NE.0.0) GO TO 345
        C(I,2)= B(I,2)*(1.0+(E(8)*((C(J,26)-B(J,26))/B(J,26)))+(E(9)*((C(J
       1,25)-B(J,25))/B(J,25)))+(E(10)*((C(J,27)-B(J,27))/B(J,27)))+(E(52
       2*((C(J,28)-B(J,28))/B(J,28)))+(E(56)*EXOG(I,38))) +(1.0-ADJ(2))*(C
       3(J,2)-B(J,2))
        IF (C(I,2).GT.EXOG(I,80)) WRITE(6,02) C(I,106)
        IF (C(I,2).GT.EXOG(I,80)) C(I,2)=EXOG(I,80)
C       WHEAT YIELD PER HARVESTED ACRE
  345   IF(C(I,6).NE.0.0) GO TO 350
        C(I,6)= B(I,6)*(1.0+(E(11)*((C(J,26)-B(J,26))/B(J,26)))+(E(12)*EX
       1G(I,38))) +(1.0-ADJ(20))*(C(J,6)-B(J,6))
C       WHEAT PRODUCTION
  350   YIELD(I+2,2) = C(I,6)
        IF(C(I,10).NE.0.0) GO TO 355
        C(I,10)=C(I,2)*C(I,6)
  355   CONTINUE
        IF ((C(I,2)* C(I,6)).NE.C(I,10)) C(I,6)=C(I,10) / C(I,2)
C       WHEAT SUPPLY
        C(I,22)=C(I,10)+EXOG(I,4)+C(J,42) - C(J,151) - C(J,210)
       1 +B(J,151) + B(J,210)
C       WHEAT EXPENSE PER HARVESTED ACRE
        IF (C(I,14).NE.0.0)  GO TO 210
        C(I,14)=(B(I,14)*(1.0+(E(13)*((C(J,26)-B(J,26))/B(J,26)))+(E(60)*E
       1XOG(I,38))))+(1.0-ADJ(24))*(C(J,14)-B(J,14))
  210   CONTINUE
C       WHEAT TOTAL PRODUCTION EXPENSE
        C(I,18)=C(I,2)*C(I,14)
        IF (C(I,3).NE.0.0.AND.C(I,7).NE.0.0.AND. C(I,11).NE.0.0) C(I,7)
       1=C(I,11)/C(I,3)
C       SOYBEANS HARVESTED ACREAGE
        IF(C(I,3).NE.0.0) GO TO 360
        C(I,3)=(B(I,3)*(1.0+(E(14)*((C(J,27)-B(J,27))/B(J,27)))+(E(15)*((C
       1(J,25)-B(J,25))/B(J,25)))+(E(16)*((C(J,26)-B(J,26))/B(J,26)))+(E(5
       23)*((C(J,28)-B(J,28))/B(J,28)))+(E(57)*EXOG(I,38))))+(1.0-ADJ(3))*
       3(C(J,3)-B(J,3))
C       SOYBEAN YIELD PER HARVESTED ACRE
  360   IF(C(I,7).NE.0.0) GO TO 365
        C(I,7)=(B(I,7)*(1.0+(E(17)*((C(J,27)-B(J,27))/B(J,27)))+(E(18)*EX
       1G(I,38))))+(1.0-ADJ(21))*(C(J,7)-B(J,7))
C       SOYBEANS PRODUCTION
  365   CONTINUE
        IF(C(I,11).NE.0.0) GO TO 370
        C(I,11)=C(I,3)*C(I,7)
  370   CONTINUE
        IF ((C(I,3)*C(I,7)) .NE.C(I,11)) C(I,7)=C(I,11)/C(I,3)
C       SOYBEAN SUPPLY
        C(I,23)=C(I,11)+C(J,43) - C(J,156) - C(J,211)
       1 +B(J,156) + B(J,211)
C       SOYBEAN PRODUCTION EXPENSES PER HARVESTED ACRE
        IF (C(I,15).NE.0.0)  GO TO 215
        C(I,15)=(B(I,15)*(1.0+(E(19)*((C(J,27)-B(J,27))/B(J,27)))+(E(61)*E
       1XOG(I,38))))+(1.0-ADJ(25))*(C(J,15)-B(J,15))
  215   CONTINUE
C       SOYBEAN TOTAL PRODUCTION EXPENSES
        C(I,19)=C(I,3)*C(I,15)
        IF (C(I,4).NE.0.0 .AND. C(I,8).NE. 0.0 .AND. C(I,12).NE.0.0) C(I,8
       1)=(C(I,12)/C(I,4))*480.0D0
C       COTTON HARVESTED ACREAGE
        IF(C(I,4).NE.0.0) GO TO 375
        C(I,4)=(B(I,4)*(1.0+(E(20)*((C(J,28)-B(J,28))/B(J,28)))+E(21)*((C(
       1J,25)-B(J,25))/B(J,25)) +(E(22)*((C(J,27)-B(J,27))/B(J,27)))+(E(54
       2)*((C(J,26)-B(J,26))/B(J,26)))+(E(58)*EXOG(I,38))))+(1.0-ADJ(4))*(
       3C(J,4)-B(J,4))
        IF (C(I,4).GT.EXOG(I,81)) WRITE(6,04) C(I,106)
        IF (C(I,4).GT.EXOG(I,81)) C(I,4)=EXOG(I,81)
C       COTTON YIELD PER HARVESTED ACRE
  375   IF(C(I,8).NE.0.0) GO TO 380
        C(I,8)=(B(I,8)*(1.0+(E(23)*((C(J,28)-B(J,28))/B(J,28)))+(E(24)*EX
       1G(I,38))))+(1.0-ADJ(22))*(C(J,8)-B(J,8))
C       COTTON PRODUCTION
  380   YIELD(I+2,4) =C(I,8)
        IF(C(I,12).NE.0.0) GO TO 385
        C(I,12)=(C(I,4)*C(I,8))/480.0D0
  385   CONTINUE
        IF (((C(I,4)*C(I ,8))/480.0).NE.C(I,12))C(I,8)= (C(I,12)/C(I,4))*
       1480.0D0
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C     COTTON SUPPLY
      C(I,24)=C(I,12)+EXOG(I,7)+C(J,44) - C(J,152) - C(J,212)
     1 +B(J,152) + B(J,212)
C     COTTON PRODUCTION EXPENSES PER HARVESTED ACRE
      IF (C(I,16).NE.0.0)  GO TO 220
      C(I,16)=(B(I,16)*(1.0+(E(25)*((C(J,28)-B(J,28))/B(J,28)))+(E(26)*E
     1XOG(I,38))))+(1.0-ADJ(26))*(C(J,16)-B(J,16))
  220 CONTINUE
C     COTTON TOTAL PRODUCTION EXPENSES
      C(I,20)= C(I,4)*C(I,16)
C-SWITCH THE T-1 PRICES OF WH,CAT,AND FG BACK TO ORIGINAL VALUES IF THEY
C ARE  STORED IN VARIABLES WHPRIC,COTPRC,FGPRC.
      IF (FGPRIC .NE. 0.0) C(J,25) =FGPRIC
      IF (WHPRIC .NE. 0.0) C(J,26) =WHPRIC
      IF(SOYPRC.NE.0.0) C(J,27) = SOYPRC
      IF (COTPRC .NE. 0.0) C(J,28) =COTPRC
      RETURN
      END
C***********************************************************************
C                               SUBROUTINE FDGR
C***********************************************************************
      SUBROUTINE FDGR
C---- LATEST REVISION 9-02-77.
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LC, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
      COMMON /CRLOAN/ FGEXP1, SYEXP1, WHEXP1, CTEXP1
12345 FORMAT(1H0, 'SUBROUTINE FDGR   ENTERED')
      WRITE(8,12345)
      WPLCP1=0.0
      IP=25
C     PREDETERMINED DEMANDS
      IF(C(I,29).EQ.0.0) FEDD  =B(I,29)
      IF(C(I,29).NE.0.0) FEDD  =C(I,29)
      IF(C(I,37).EQ.0.0) FGEXP1=B(I,37)
      IF(C(I,37).NE.0.0) FGEXP1=C(I,37)
C     PRICE FLEXIBILITY SCHEDULE FOR FG
      EXPCAR = C(I,21) - (B(I,33) + FGEXP1)
      RELCOV = EXPCAR / (B(I,33) + FGEXP1)
      IF(RELCOV.LT.0.05)                              E(27)=-6.0
      IF(RELCOV.GE.0.05   .AND.  RELCOV.LT.0.10)  E(27)=-4.0
      IF(RELCOV.GE.0.10   .AND.  RELCOV.LT.0.15)  E(27)=-3.5
      IF(RELCOV.GE.0.15   .AND.  RELCOV.LT.0.20)  E(27)=-2.75
      IF(RELCOV.GE.0.20   .AND.  RELCOV.LT.0.30)  E(27)=-2.00
      IF(RELCOV.GE.0.30)                              E(27)=-1.00
C     FEED GRAIN PRICE $/TON
      IF(C(I,25).NE.0.0) GO TO 100
      C(I,25) =  B(I,25) * (1.0 + (E(27)* (( (C(I,21)-B(I,21)) -(FGEXP1-
     1B(I,37)) - (FEDD-B(I,29)) ) / B(I,21))) + ( E(29) *  ((C(I,22)-
     2B(I,22)) / B(I,22))) )
  100 CONTINUE
      IF(IHOLD2.EQ.0) CALL WPLCP
      FPRIC =C(I,25)
C     GOVT STOCKS
      IF(LOAN.EQ.0) C(I,150) = B(I,150)
      IF(LOAN.EQ.0) C(I,209) = B(I,209)
C     FG CALL SUPPORT
      CALL SUPPRT
      IFLAG = 1
  394 CONTINUE
C---------PRICE OF CORN---------
      C(I,102)=C(I,25)/ ( 35.714D0*(CONST(27) + CONST(79) * CONST(28) +
     1CONST(80)*CONST(29) + CONST(81) * CONST(30)))
C---------PRICE OF GRAIN SOGRGHUM---------
      C(I,103) = (B(I,103) / B(I,102)) * C(I,102)
C---------PRICE OF BARLEY---------
      C(I,104) = (B(I,104) / B(I,102)) * C(I,102)
C---------PRICE OF OATS---------
      C(I,105) = (B(I,105) / B(I,102)) * C(I,102)
      CALL FEED
      IF(WPLCP1.GT.0.0) C(I,29)=C(I,29) - WPLCP1
C     FEED GRAIN TOTAL DOMESTIC UTILIZATION
      C(I,33)=C(I,29)+EXOG(I,16)
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C     FEED GRAIN EXPORTS
      IF(FGEXP1.NE.B(I,37) .AND. C(I,209).EQ.0.0) GO TO 110
      C(I,37)= FGEXP1 *(1.0+(E(40)*((C(I,25)-B(I,25))/B(I,25)))) +(1.0-A
     1DJ(10))*(C(J,37)-B(J,37))
  110 CONTINUE
C     FEED GRAIN ENDING YEAR INVENTORY
      C(I,41)=C(I,21)-C(I,33)-C(I,37) +C(J,150) + C(J,209)
     1 -B(J,209) - B(J,150)
      IF(C(I,41)-(C(I,150)+C(I,209) + 5.0)) 405,405,410
  405 C(I,41) = C(I,41) -C(I,150) -C(I,209) - 5.0
      C(I,29)=C(I,29)+((C(I,29)/(C(I,29)+C(I,37)))*C(I,41))
      C(I,37)=C(I,37)+((C(I,37)/(C(I,29)+C(I,37)))*C(I,41))
      C(I,33)=C(I,29)+EXOG(I,16)
      C(I,41)=C(I,150) + C(I,209) + 5.0
  410 CONTINUE
C     PRIVATE CARRYOVER FG
      C(I,153)= C(I,41)-C(I,150) -C(I,209)
      C(I,158)=C(I,33) + C(I,37)
C     FEED GRAINS CALL TO GOVT STOCK SUB-ROUTINE
      IF (IFLAG.EQ.0 .OR. SUPFG .EQ.0) GO TO 415
      CALL GOVSTK
      GO TO 394
  415 CONTINUE
      C(I,21)=C(J,209)+ C(I,21)+  C(J,150)
     1 -B(J,209) - B(J,150)
      RETURN
      END
C***********************************************************************
C                               SUBROUTINE FEED
C***********************************************************************
      SUBROUTINE FEED
C---- LATEST REVISION 6-1-77
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      REAL MLKCN,MLKFG,MLKPT
12345 FORMAT(1H0, 'SUBROUTINE FEED   ENTERED')
      WRITE(8,12345)
       FGPB=B(J,25)
      FGP=C(J,25)
C     SET UP A WEIGHTED PRICE OF FG, FOR CROP YEAR & FEEDING YEAR
      B(J,25)=(0.80*FGPB) + (0.20* B(I,25))
      C(J,25) = (0.80 * FGP) + (0.20 * C(I,25))
C     FEED CONVERSION RATIO
      C(I,147) = B(I,147) * (1.0 + E(108) * ((C(J,25)-B(J,25))/B(J,25))+
     1E(109) *((C(I,70)-B(I,70))/B(I,70)) )
      C(I,148) = B(I,148) * (1.0 + E(112) * ((C(J,25)-B(J,25))/B(J,25))+
     1E(113) *((C(I,72)-B(I,72))/B(I,72)) )
      C(I,149) = B(I,149) * (1.0 + E(120) * ((C(J,25)-B(J,25))/B(J,25))+
     1E(121) *((C(I,76)-B(I,76))/B(I,76)) )
      C(I,130) = B(I,130) * (1.0 + E(110) * ((C(J,25)-B(J,25))/B(J,25))+
     1E(111) *((C(I,71)-B(I,71))/B(I,71)) )
      C(I,131) = B(I,131) * (1.0 + E(114) * ((C(J,25)-B(J,25))/B(J,25))+
     1E(115) *((C(I,73)-B(I,73))/B(I,73)) )
      C(I,132) = B(I,132) * (1.0 + E(116) * ((C(J,25)-B(J,25))/B(J,25))+
     1E(117) *((C(I,74)-B(I,74))/B(I,74))
     2 + E(099) * ((C(J,193) - B(J,193)) / B(J,193)) )
      C(I,133) = B(I,133) * (1.0 + E(118) * ((C(J,25)-B(J,25))/B(J,25))+
     1E(119) *((C(I,75)-B(I,75))/B(I,75)) )
C     PERCENT OF FG IN CONCENTRATES FED
      C(I,137) = B(I,137) * (1.0 +E(135)*((C(J,25)-B(J,25))/ B(J,25))  +
     1E(136)*((C(I,70)-B(I,70))/ B(I,70))
     2 + E(144) * ((C(J,193) - B(J,193)) / B(J,193)) )
      C(I,138) = B(I,138) * (1.0 +E(137)*((C(J,25)-B(J,25))/ B(J,25))  +
     1E(138)*((C(I,71)-B(I,71))/ B(I,71))
     2 + E(145) * ((C(J,193) - B(J,193)) / B(J,193)) )
      C(I,139) = B(I,139) * (1.0 +E(139)*((C(J,25)-B(J,25))/ B(J,25))  +
     1E(140)*((C(I,72)-B(I,72))/ B(I,72))
     2 + E(143) * ((C(J,193) - B(J,193)) / B(J,193)) )
      C(I,140) = B(I,140) * (1.0 +E(100)*((C(J,25)-B(J,25))/ B(J,25))  +
     1E(101)*((C(I,73)-B(I,73))/ B(I,73))
     2 + E(141) * ((C(J,193) - B(J,193)) / B(J,193)) )
      C(I,141) = B(I,141) * (1.0 +E(102)*((C(J,25)-B(J,25))/ B(J,25))  +
     1E(103)*((C(I,74)-B(I,74))/ B(I,74))
     2 + E(142) * ((C(J,193) - B(J,193)) / B(J,193)) )
      C(I,142) = B(I,142) * (1.0 +E(104)*((C(J,25)-B(J,25))/ B(J,25))  +
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     1 +E(146)*((C(J,193) - B(J,193)) / B(J,193)) )
C     UN-ADJUSTED  CAL. CONCENTRATES DEMANDED
      BEFCN =((C(I,49)/CONST(42))*C(I,147))/2000.0D0
      HOGCN =((C(I,50)/CONST(43))*C(I,130))/2000.0D0
      SHPCN =((C(I,51)/CONST(44))*C(I,148))/2000.0D0
      CHKCN =((C(I,52)/CONST(60))*C(I,131))/2000.0D0
      TRKCN =((C(I,53)/CONST(61))*C(I,132))/2000.0D0
      EGGCN = (C(I,54)              *C(I,133))/2000.0D0
      MLKCN = (C(I,55)              *C(I,149))/2000.0D0
C     UN-ADJUSTED CAL. FEED GRAINS DEMANDED
      BEFFG = BEFCN * (C(I,137) * 0.01D0)
      HOGFG = HOGCN * (C(I,138) * 0.01D0)
      SHPFG = SHPCN * (C(I,139) * 0.01D0)
      CHKFG = CHKCN * (C(I,140) * 0.01D0)
      TRKFG = TRKCN * (C(I,141) * 0.01D0)
      EGGFG = EGGCN * (C(I,142) * 0.01D0)
      MLKFG = MLKCN * (C(I,143) * 0.01D0)
C     UN-ADJUSTED CAL. PROTEIN DEMANDED.
      BEFPT = BEFCN * (100.0D0-C(I,137)) *0.01D0
      HOGPT = HOGCN * (100.0D0-C(I,138)) *0.01D0
      SHPPT = SHPCN * (100.0D0-C(I,139)) *0.01D0
      CHKPT = CHKCN * (100.0D0-C(I,140)) *0.01D0
      TRKPT = TRKCN * (100.0D0-C(I,141)) *0.01D0
      EGGPT = EGGCN * (100.0D0-C(I,142)) *0.01D0
      MLKPT = MLKCN * (100.0D0-C(I,143)) *0.01D0
C     FEED GRAIN DEMANDED BY LS CLASS
      C(I,165) = B(I,165)  *  (1.0  + ( BEFFG  - B(I,179)) / B(I,179))
      C(I,166) = B(I,166)  * (1.0 + ( HOGFG  - B(I,180)) / B(I,180))
      C(I,167) = B(I,167)  * (1.0 + ( SHPFG  - B(I,181)) / B(I,181))
      C(I,168) = B(I,168)  * (1.0 + ( CHKFG  - B(I,182)) / B(I,182))
      C(I,169) = B(I,169)  * (1.0 + ( TRKFG  - B(I,183)) / B(I,183))
      C(I,170) = B(I,170)  * (1.0 + ( EGGFG  - B(I,184)) / B(I,184))
      C(I,171) = B(I,171)  * (1.0 + ( MLKFG  - B(I,185)) / B(I,185))
      C(I,172) = B(I,172)  * (1.0 + ( BEFPT  - B(I,186)) / B(I,186))
      C(I,173) = B(I,173)  * (1.0 + ( HOGPT  - B(I,187)) / B(I,187))
      C(I,174) = B(I,174)  * (1.0 + ( SHPPT  - B(I,188)) / B(I,188))
      C(I,175) = B(I,175)  * (1.0 + ( CHKPT  - B(I,189)) / B(I,189))
      C(I,176) = B(I,176)  * (1.0 + ( TRKPT  - B(I,190)) / B(I,190))
      C(I,177) = B(I,177)  * (1.0 + ( EGGPT  - B(I,191)) / B(I,191))
      C(I,178) = B(I,178)  * (1.0 + ( MLKPT  - B(I,192)) / B(I,192))
C     TOTAL FEED GRAIN DEMANDED
      FEEDGR  = C(I,165)+ C(I,166)+ C(I,167)+ C(I,168)+ C(I,169)+ C(I,17
     10)+ C(I,171)
C     TOTAL BY PRODUCTS DEMANDED
      BYPROD = C(I,172)+ C(I,173)+ C(I,174)+ C(I,175)+ C(I,176)+ C(I,177
     1)+ C(I,178)
      C(I,29)=FEEDGR
      C(I,94)= BYPROD
C     ROUGHAGE TO CONCENTRATE RATIO
      C(I,144) = B(I,144) * (1.0 + E(122) *((C(J,25)-B(J,25))/ B(J,25))+
     1E(123) *((C(I,70)-B(I,70))/ B(I,70)) )
      C(I,145) = B(I,145) * (1.0 + E(124) *((C(J,25)-B(J,25))/ B(J,25))+
     1E(125) *((C(I,72)-B(I,72))/ B(I,72)) )
      C(I,146) = B(I,146) * (1.0 + E(126) *((C(J,25)-B(J,25))/ B(J,25))+
     1E(127) *((C(I,76)-B(I,76))/ B(I,76)) )
C     RUGHAGE  DEMANDED BY CATTLLE ,SHEEP, AND MILK PROD.
      C(I,161)= B(I,161) +(((C(I,49)-B(I,49))/2000.00) *C(I,144)*C(I,147
     1)  +  ((C(I,51)-B(I,51))/2000.0)*C(I,145) *C(I,148) + ((C(I,55)-
     2 B(I,55))/2000.00) * C(I,146)  * C(I,149) )
      C(J,25) = FGP
      B(J,25)=FGPB
      RETURN
      END
C*********************************************************************
C                              SUBROUTINE WHEAT
C*********************************************************************
      SUBROUTINE WHEAT
C---- LATEST REVISION 9-02-77.
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
      COMMON /CRLOAN/ FGEXP1, SYEXP1, WHEXP1, CTEXP1
12345 FORMAT(1H0, 'SUBROUTINE WHEAT  ENTERED')
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      WRITE(8,12345)
      IP=26
C     PREDETERMINED DEMANDS
      IF(C(I,38).EQ.0.0) WHEXP1=B(I,38)
      IF(C(I,38).NE.0.0) WHEXP1=C(I,38)
C     PRICE FLEXIBILITY SCHEDULE FOR WHEAT
      EXPCAR = C(I,22) - (B(I,34) + WHEXP1)
      RELCOV = EXPCAR / (B(I,34) +  WHEXP1)
      IF(RELCOV.LT.0.10)                               E(30)=-6.0
      IF(RELCOV.GE.0.10  .AND.  RELCOV.LT.0.15)  E(30)=-4.0
      IF(RELCOV.GE.0.15  .AND.  RELCOV.LT.0.20)  E(30)=-3.0
      IF(RELCOV.GE.0.20  .AND.  RELCOV.LT.0.30)  E(30)=-2.4
      IF(RELCOV.GE.0.30  .AND.  RELCOV.LT.0.50)  E(30)=-2.0
      IF(RELCOV.GE.0.50  .AND.  RELCOV.LT.0.60)  E(30)=-1.5
      IF(RELCOV.GE.0.60)                               E(30)=-1.0
C     WHEAT PRICE $/BU.
      IF(C(I,26).NE.0.0) GO TO 105
      C(I,26)=  B(I,26) *  (1.0 + (E(30) * ((C(I,22)-B(I,22)) -(WHEXP1-
     1B(I,38)) ) / B(I,22)) + (E(32) * ((C(I,21) - B(I,21)) / B(I,21))))
  105 CONTINUE
      FPRIC=C(I,26)
C     GOVT STOCKS
      IF(LOAN.EQ.0) C(I,151) = B(I,151)
      IF(LOAN.EQ.0) C(I,210) = B(I,210)
C     WHEAT  CALL SUPPORT
      CALL SUPPRT
      IFLAG = 1
  412 CONTINUE
C     WHEAT FOOD DEMAND
      IF(C(I,84).NE.0.0) GO TO 120
      C(I,84)=(B(I,84)*(1.0+(E(41)*((C(I,26)-B(I,26))/B(I,26)))))+(1.0-A
     1DJ(11))*(C(J,84)-B(J,84))
  120 CONTINUE
C     WHEAT FEED DEMAND
      C(I,30)=(B(I,30)*(1.0+(E(42)*((C(I,26)-B(I,26))/B(I,26)))+(E(43)*(
     1(C(I,25)-B(I,25))/B(I,25)))))+(1.0-ADJ(12))*(C(J,30)-B(J,30))
      IF(WPLCP1.GT.0.0) C(I,30) = C(I,30)+((WPLCP1*2000.0)/60.0)/1.12
C     WHEAT TOTAL DOMESTIC UTILIZATION
      C(I,34)=C(I,84)+C(I,30)+EXOG(I,18)
C     WHEAT EXPORT DEMAND
      IF(WHEXP1.NE.B(I,38) .AND. C(I,210).EQ.0.0) GO TO 110
      C(I,38)= WHEXP1 *(1.0+(E(44)*((C(I,26)-B(I,26))/B(I,26)))) +(1.0-A
     1DJ(13))*(C(J,38)-B(J,38))
  110 CONTINUE
C     WHEAT ENDING YEAR INVENTORY
      C(I,42)=C(I,22)-C(I,34)-C(I,38)+ C(J,151)+ C(J,210)
     1 -B(J,210) - B(J,151)
      IF(C(I,42)-(C(I,151)+100.0+C(I,210))) 420,420,425
  420 CONAD=         C(I,30)+C(I,38)
      C (I,42) = C(I,42) - C(I,151) - C(I,210) - 100.0
      C(I,30)=C(I,30)+((C(I,30)/CONAD)*C(I,42))
      C(I,38)=C(I,38)+((C(I,38)/CONAD)*C(I,42))
      C(I,34)=C(I,84)+C(I,30)+EXOG(I,18)
      C(I,42)=C(I,151) + C(I,210) + 100.0
  425 CONTINUE
C     PRIVATE CARRYOVER WHEAT
      C(I,154)= C(I,42)- C(I,151)- C(I,210)
      C(I,159)=C(I,34) + C(I,38)
C     WHEAT CALL TO GOVT STOCKS SUB-ROUTINE
      IF (IFLAG.EQ.0 .OR. SUPWHT.EQ.0) GO TO 430
      CALL GOVSTK
      GO TO 412
  430 CONTINUE
      IF (C(I,151).LT.0.0)
     1WRITE(6,6) C(I,22),B(I,22),C(I,38),B(I,38),EXOG(I,55),C(I,21),
     1B(I,21),B(I,26),C(I,26)
    6 FORMAT (' ',10F10.2,'NEGATIVE  WHEAT GOVT STOCKS')
      C(I,22)=C(J,151) +C(I,22)+  C(J,210)
     1 -B(J,210) - B(J,151)
      RETURN
      END
C***********************************************************************
C                                 SUBROUTINE SOYB
C***********************************************************************
      SUBROUTINE SOYB
C---- LATEST REVISION 9-02-77.
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
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     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
      COMMON /CRLOAN/ FGEXP1, SYEXP1, WHEXP1, CTEXP1
12345 FORMAT(1H0, 'SUBROUTINE SOYB   ENTERED')
      WRITE(8,12345)
      IP=27
C     PREDETERMINED DEMANDS
      IF(C(I,39).EQ.0.0) SYEXP1=B(I,39)
      IF(C(I,39).NE.0.0) SYEXP1=C(I,39)
      IF(C(I,31).EQ. 0.0) CRUSH =B(I,31)
      IF(C(I,31).NE. 0.0) CRUSH =C(I,31)
C     PRICE FLEXIBILITY SCHEDULE FOR SOYBEANS
      EXPCAR = C(I,23) - (B(I,35) + SYEXP1  )
      RELCOV = EXPCAR / (B(I,35) +  SYEXP1)
      IF(RELCOV.LT.0.033)                               E(33)=-6.0
      IF(RELCOV.GE.0.033 .AND. RELCOV.LT.0.066)  E(33)=-4.0
      IF(RELCOV.GE.0.066 .AND. RELCOV.LT.0.100)  E(33)=-3.0
      IF(RELCOV.GE.0.100 .AND. RELCOV.LT.0.150)  E(33)=-2.5
      IF(RELCOV.GE.0.150 .AND. RELCOV.LT.0.200)  E(33)=-2.0
      IF(RELCOV.GE.0.200)                               E(33)=-1.75
C     SOYBEAN PRICE $/BU.
      IF(C(I,27).NE.0.0) GO TO 430
      C(I,27) = B(I,27) * (1.0 + (E(33) *(((C(I,23)-B(I,23))- (SYEXP1 -
     1B(I,39))- (CRUSH-B(I,31)) )  /  B(I,23)) ) )
  430 CONTINUE
      FPRIC=C(I,27)
C     GOVT STOCKS
      IF(LOAN.EQ.0) C(I,156) = B(I,156)
      IF(LOAN.EQ.0) C(I,211) = B(I,211)
      CALL SUPPRT
      IFLAG = 1
  431 CONTINUE
C     SOYBEAN MEAL PRICE
      C(I,193) =B(I,193) * (1.0  +E(64) * ((C(I,27)-B(I,27))/ B(I,27))+
     1 E(65)  * ((C(I,85)-B(I,85))/ B(I,85)) )
C     SOYBEAN MILL DEMAND
      IF (C(I,31).NE.0.0) GO TO 90
      C(I,31)=(B(I,31)*(1.0+(E(45)*((C(I,27)-B(I,27))/B(I,27)))+(E(37)*(
     1(C(I,85)-B(I,85))/B(I,85)))))+(1.0-ADJ(14))*(C(J,31)-B(J,31))
   90 CONTINUE
C     SOYBEAN TOTAL DOMESTIC UTILIZATION
      C(I,35)=C(I,31)+EXOG(I,20)
C     SOYBEAN EXPORTS
      IF(SYEXP1.NE.B(I,39) .AND. C(I,211).EQ.0.0) GO TO 100
      C(I,39)= SYEXP1 *(1.0+(E(47)*((C(I,27)-B(I,27))/B(I,27)))) +(1.0-A
     1DJ(15))*(C(J,39)-B(J,39))
  100 CONTINUE
C     SOYBEAN ENDING YEAR INVENTORY
      C(I,43)=C(I,23)-C(I,35)-C(I,39)      +C(J,156) + C(J,211)
     1 -B(J,211) - B(J,156)
      IF(C(I,43)-(C(I,156)+50.0+C(I,211))) 435,435,440
  435 C(I,43) = C(I,43) - C(I,156)   -50.0 - C(I,211)
      C(I,31)=C(I,31)+((C(I,31)/(C(I,31)+C(I,39)))*C(I,43))
      C(I,39)=C(I,39)+((C(I,39)/(C(I,31)+C(I,39)))*C(I,43))
      C(I,35)=C(I,31)+EXOG(I,20)
      C(I,43)=C(I,156) + 50.0 + C(I,211)
  440 CONTINUE
C     PRIVATE SOYBEAN STOCKS
      C(I,157)=C(I,43)-C(I,156) - C(I,211)
      C(I,134)=C(I,35) + C(I,39)
C     SOYBEAN CALL TO GOVT STOCKS SUB-ROUTINE
      IF (IFLAG.EQ.0 .OR. SUPSOY.EQ.0) GO TO 445
      CALL GOVSTK
      GO TO 431
  445 CONTINUE
      C(I,23)=C(J,211) +C(I,23)+  C(J,156)
     1 -B(J,211) - B(J,156)
      RETURN
      END
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C***************************************************************************
C                               SUBROUTINE COTTON
C***************************************************************************
      SUBROUTINE COTTON
C---- LATEST REVISION 9-02-77.
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
      COMMON /CRLOAN/ FGEXP1, SYEXP1, WHEXP1, CTEXP1
12345 FORMAT(1H0, 'SUBROUTINE COTTON ENTERED')
      WRITE(8,12345)
      IP=28
C     PREDETERMINED DEMANDS
      IF(C(I,40).EQ.0) CTEXP1 = B(I,40)
      IF(C(I,40).NE.0) CTEXP1 = C(I,40)
C     PRICE FLEXIBILITY SCHEDULE FOR COTTON
      EXPCAR = C(I,24) - (B(I,36) + CTEXP1)
      RELCOV = EXPCAR / (B(I,36) +  CTEXP1)
      IF(RELCOV.LT.0.15)                               E(35)=-5.0
      IF(RELCOV.GE.0.15  .AND. RELCOV.LT.0.20)   E(35)=-4.0
      IF(RELCOV.GE.0.20  .AND. RELCOV.LT.0.25)   E(35)=-3.0
      IF(RELCOV.GE.0.25  .AND. RELCOV.LT.0.35)   E(35)=-2.25
      IF(RELCOV.GE.0.35  .AND. RELCOV.LT.0.55)   E(35)=-1.75
      IF(RELCOV.GE.0.55)                               E(35)=-1.00
C     COTTON PRICE
      IF(C(I,28).NE.0.0) GO TO 160
      C(I,28) =  B(I,28) *   (1.0 + E(35) *(((C(I,24)-B(I,24)) -(CTEXP1-
     1B(I,40))) / B(I,24) ) )
      IF (C(I,28).LT.0.0) WRITE(6,1) I,C(I,28)
    1 FORMAT ( ' ' ,I4,      F10.5)
  160 CONTINUE
      FPRIC=C(I,28)
C     GOVT STOCKS
      IF(LOAN.EQ.0) C(I,152) = B(I,152)
      IF(LOAN.EQ.0) C(I,212) = B(I,212)
C     COTTON CALL SUPPORT
      CALL SUPPRT
      IFLAG = 1
  396 CONTINUE
C     COTTON MILL CONSUMPTION
      IF(C(I,32).NE.0.0) GO TO 350
      C(I,32)=(B(I,32)*(1.0+(E(48)*((C(I,28)-B(I,28))/B(I,28))))+(1.0-A
     1DJ(16))*(C(J,32)-B(J,32))
  350 CONTINUE
C     COTTON TOTAL DOMESTIC UTILIZATION
      C(I,36)=C(I,32)
C     COTTON EXPORTS
      IF(CTEXP1.NE.B(I,40) .AND. C(I,212).EQ.0.0) GO TO 400
      C(I,40)= CTEXP1 *(1.0+(E(49)*((C(I,28)-B(I,28))/B(I,28)))) +(1.0-A
     1DJ(17))*(C(J,40)-B(J,40))
  400 CONTINUE
C     COTTON ENDING YEAR INVENTORY
      C(I,44)=C(I,24)-C(I,32)-C(I,40) +C(J,152) +C(J,212)
     1 -B(J,212) - B(J,152)
      IF(C(I,44)-(C(I,152)+1.0+C(I,212))) 450,450,455
  450 C(I,44)=C(I,44) -C(I,152) -1.0 - C(I,212)
      C(I,32)=C(I,32)+((C(I,32)/(C(I,32)+C(I,40)))*C(I,44))
      C(I,40)=C(I,40)+((C(I,40)/(C(I,32)+C(I,40)))*C(I,44))
      C(I,36)=C(I,32)
      C(I,44)=C(I,152) + 1.0 + C(I,212)
  455 CONTINUE
C     PRIVATE CARRYOVERS
      C(I,155)= C(I,44)- C(I,152) - C(I,212)
      C(I,160)=C(I,36) + C(I,40)
C     COTTON CALL TO GOVT STOCKS SUB-ROUTINE
      IF (IFLAG.EQ.0 .OR. SUPCOT.EQ.0) GO TO 460
      CALL GOVSTK
      GO TO 396
  460 CONTINUE
      C(I,24)=C(J,212)+ C(I,24)+  C(J,152)
     1 -B(J,212) - B(J,152)
      RETURN
      END
```

```
C*****************************************************************************
C                                SUBROUTINE FED2
C*****************************************************************************
      SUBROUTINE FED2
C---- LATEST REVISION 9-02-77.
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
12345 FORMAT(1H0, 'SUBROUTINE FED2   ENTERED')
      WRITE(8,12345)
C     INDEX OF PRICES RECEIVED BY FARMERS
      C(I,107) = B(I,107) *(0.069 *((C(I,26)-B(I,26))/B(I,26))+ 0.080 *
     1 ((C(I,25)-B(I,25))/B(I,25))+ 0.084 * ((C(I,28)-B(I,28))/B(I,28))
     2+((C(I,27)-B(I,27))/B(I,27))*0.031  + ((C(I,70)-B(I,70))/B(I,70))*
     30.176 + 0.104 * ((C(I,71)-B(I,71))/B(I,71))  + 0.011* ((C(I,72)-B(
     4I,72))/B(I,72))+((C(I,73)-B(I,73))/B(I,73))  * 0.036+ ((C(I,74)-B(
     5I,74))/B(I,74))* 0.011 + 0.060 * ((C(I,75)-B(I,75))/B(I,75)) +
     6 0.126 * ((C(I,76)-B(I,76))/B(I,76)) + 1.0 )
C     PRICE HAY $/TON T
      C(I,117) = B(I,117) * (1.0+ ((C(I,70)-B(I,70))/B(I,70)) *E(50)
     1 + E(51) * ((C(I,102)-B(I,102)) / B(I,102)) )
C      INDEX OF PRICE PAID FOR FEED GRAIN & HAY
      C(I,101) = B(I,101) * (1.0 +((C(I,102)-B(I,102))/B(I,102)) * 0.851
     1 + 0.148936 * ((C(I,117)-B(I,117))/B(I,117)) )
C     TOTAL CONCENTRATES FED TO LIVESTOCK
      IF(C(I,95).NE.0.0) GO TO 100
      C(I,95)   = C(I,94)    + EXOG(I,22) +(60.0 * C(I,30)) / 2000.0
     1 + C(I,29)
 100    CONTINUE
C     FRACTION OF FEED GRAINS SOLD
      C(I,115) = B(I,115) * (1.0 + 0.0266 *((C(I,106)-B(I,106))/B(I,106)
     1)+ 0.02625 *((C(I,25)-B(I,25))/B(I,25)) - 0.01758 * ((C(I,70)-B(I,
     270)) /B(I,70)) )
C     FRACTION OF HAY SOLD
      C(I,116) =B(I,116) * (1.0 + 0.063 *((C(I,117)-B(I,117))/B(I,117))-
     1 0.019 * ((C(I,70) -B(I,70)) / B(I,70)) )
C     PROTEIN COST TO LS
      C(I,119) = C(I,94)   * C(I,193)
C     FG COST TO LS
      C(I,120) =C(I,29) *C(I,115)* C(I,25) + C(I,29)* (1.0 -C(I,115))*
     1(C(I,13)/C(I,5))
C     ROUGHAGE COST
      C(I,118)=B(I,118)
      C(I,122)=C(I,161)*C(I,116) * C(I,117)* 1.30 +C(I,161)*(1.0-C(I,
     1116))*C(I,118)
C     NON-FEED COST FOR LIVESTOCK-IN $/LIVEWT. PROD.
      C(I,123) = B(I,123) * (1.0  + E(128)* (C(I,70)-B(I,70))/B(I,70) )
      C(I,124) = B(I,124) * (1.0  + E(129)* (C(I,71)-B(I,71))/B(I,71) )
      C(I,125) = B(I,125) * (1.0  + E(130)* (C(I,72)-B(I,72))/B(I,72) )
      C(I,126) = B(I,126) * (1.0  + E(131)* (C(I,73)-B(I,73))/B(I,73) )
      C(I,127) = B(I,127) * (1.0  + E(132)* (C(I,74)-B(I,74))/B(I,74) )
      C(I,128) = B(I,128) * (1.0  + E(133)* (C(I,75)-B(I,75))/B(I,75) )
      C(I,129) = B(I,129) * (1.0  + E(134)* (C(I,76)-B(I,76))/B(I,76) )
C     NON-FEED  COST
      C(I,121) =(C(I,49) / CONST(42))* C(I,123) +(C(I,50) / CONST(43))*
     1C(I,124) +(C(I,51) / CONST(44))* C(I,125) +(C(I,52) / CONST(60))*
     2C(I,126) +(C(I,53) / CONST(61))* C(I,127) + C(I,54) *
     3C(I,128) + C(I,55)              * C(I,129)
      RETURN
      END
C*****************************************************************************
C                                SUBROUTINE RECPTS
C*****************************************************************************
      SUBROUTINE RECPTS
C---- LATEST REVISION 6-1-77
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
12345 FORMAT(1H0, 'SUBROUTINE RECPTS ENTERED')
      WRITE(8,12345)
C     BASELINE VALUES FOR  CASH RECEIPTS
      FGBI =B(I,25)*B(I,09)*B(I,115)
      FGBJ =B(J,25)*B(J,09)*B(J,115)
      WHBI =B(I,26)*B(I,10)*CONST(2)
      WHBJ =B(J,26)*B(J,10)*CONST(2)
      SYBI =B(I,27)*B(I,11)*CONST(3)
      SYBJ =B(J,27)*B(J,11)*CONST(3)
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      CTBI =B(I,28)*B(I,12)*480.0
      CTBJ =B(J,28)*B(J,12)*480.0
C     FEED GRAIN CASH RECEIPTS
      C(I,45) = ((C(I,25)/B(I,25)) *(C(I,09)/B(I,09)))* FGBI* CONST(52)
     1   +       ((C(J,25)/B(J,25)) *(C(J,09)/B(J,09)))* FGBJ
     2          *(1.0-CONST(52))
C     WHEAT CASH RECEIPTS
      C(I,46) = ((C(I,26)/B(I,26)) *(C(I,10)/B(I,10)))* WHBI*CONST(53)
     1   +       ((C(J,26)/B(J,26)) *(C(J,10)/B(J,10)))* WHBJ
     2          *(1.0-CONST(53))
C     SOYBEAN CASH RECEIPTS
      C(I,47) = ((C(I,27)/B(I,27)) *(C(I,11)/B(I,11)))* SYBI*CONST(54)
     1   +       ((C(J,27)/B(J,27)) *(C(J,11)/B(J,11)))* SYBJ
     2          *(1.0-CONST(54))
C     COTTON CASH RECEIPTS
      C(I,48) = ((C(I,28)/B(I,28)) *(C(I,12)/B(I,12)))* CTBI*CONST(55)
     1   +       ((C(J,28)/B(J,28)) *(C(J,12)/B(J,12)))* CTBJ
     2          *(1.0-CONST(55))
C     CATTLE & CALVES CASH RECEIPTS
      C(I,77)=((C(I,49)/B(I,49))*(C(I,70)/B(I,70)))*B(I,77)
C     HOG CASH RECEIPTS
      C(I,78)=((C(I,50)/B(I,50))*(C(I,71)/B(I,71)))*B(I,78)
C     SHEEP CASH RECEIPTS
      C(I,79)=((C(I,51)/B(I,51))*(C(I,72)/B(I,72)))*B(I,79)
C     CHICKEN CASH RECEIPTS
      C(I,80)=((C(I,52)/B(I,52))*(C(I,73)/B(I,73)))*B(I,80)
C     TURKEY CASH RECEIPTS
      C(I,81)=((C(I,53)/B(I,53))*(C(I,74)/B(I,74)))*B(I,81)
C     EGG CASH RECEIPTS
      C(I,82)=((C(I,54)/B(I,54))*(C(I,75)/B(I,75)))*B(I,82)
C     MILK CASH RECEIPTS
      C(I,83)=((C(I,55)/B(I,55))*(C(I,76)/B(I,76)))*B(I,83)
C     TOTAL CROP RECEIPTS
      C(I,87)=C(I,45)+C(I,46)+C(I,47)+C(I,48)+EXOG(I,30)
C     TOTAL LIVESTOCK RECEIPTS
      C(I,88)=C(I,77)+C(I,78)+C(I,79)+C(I,80)+C(I,81)+C(I,82)+C(I,83)+EX
     1OG(I,31)
C     TOTAL CASH RECEIPTS
      C(I,89)=C(I,87)+C(I,88)
C     BEEF VALUE HOME CONSUMPTION
      C(I,63)=(C(I,70)/B(I,70))*B(I,63)
C     PORK VALUE OF HOME CONSUMPTION
      C(I,64)=(C(I,71)/B(I,71))*B(I,64)
C     MUTTON VALUE OF HOME CONSUMPTION
      C(I,65)=(C(I,72)/B(I,72))*B(I,65)
C     CHICKENS VALUE OF HOME CONSUMPTION
      C(I,66)=(C(I,73)/B(I,73))*B(I,66)
C     TURKEYS VALUE OF HOME CONSUMPTION
      C(I,67)=0.0
C     EGGS VALUE OF HOME CONSUMPTION
      C(I,68)=(C(I,75)/B(I,75))*B(I,68)
C     MILK VALUE OF HOME CONSUMPTION
      C(I,69)=(C(I,76)/B(I,76))*B(I,69)
      RETURN
      END
C***********************************************************************
C                                SUBROUTINE GOVP
C***********************************************************************
      SUBROUTINE GOVP
C---- LATEST REVISION 8-26-77
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON /CMAING/ NBC, NE, NADJ, NEX, NPRE, NERD, NESTOR, NFACT,
     1  NADJST, KING, NPRDM, NDIVAC, NOTARG, NOALL, NLOAN, NDIV, NEXP,
     2 NOACRE, NYIELD, NPROD, IVARE, INDXX, NFSTST, NPART, NCONST
    1 FORMAT(' ',T20,'PRICE FLEXIBILITIES FOR THE MODEL CROPS',/,T5,
     1 'YEARS',T14,'FEEDGRAINS', T28,'WHEAT', T37,'SOYBEANS', T48,'COTTO
     2N',/)
    2 FORMAT (' ',T5,F5.0,T17,F4.1,T29,F4.1,T38,F4.1,T49,F4.1)
12345 FORMAT(1H0, 'SUBROUTINE GOVP   ENTERED')
      WRITE(8,12345)
      IF(FREMKT.NE.0) GO TO 470
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      C(I,202) = C(I,199) + C(I,198) + C(I,201) + C(I,200)
      IF (TARGET.EQ.0) GO TO 470
      IF (TARGET.EQ.073) GC TO 410
C     NATIONAL PROGRAM ACREAGE
      IF(EXOG(I,48).NE.OLDEXO(I,48)) GO TO 100
      EXOG(I,48) = (B(I,158)-EXOG(I,2)-EXOG(I,90)  )/ B(I,5)
      EXOG(I,68) = EXOG(I,48) * (OLDEXO(I,68) / OLDEXO(I,48))
      EXOG(I,69) = EXOG(I,48) * (OLDEXO(I,69) / OLDEXO(I,48))
      EXOG(I,70) = EXOG(I,48) * (OLDEXO(I,70) / OLDEXO(I,48))
  100 IF(EXOG(I,49).NE.OLDEXO(I,49)) GO TO 110
      EXOG(I,49) = (B(I,159)-EXOG(I,4)-EXOG(I,91)  )/ EXOG(I,66)
  110 IF(EXOG(I,50).NE.OLDEXO(I,50)) GO TO 120
      EXOG(I,50) = (B(I,160)-EXOG(I,7)-EXOG(I,92))/(EXOG(I,67)/480.0)
      IF(EXOG(I,50).LT.10.0) EXOG(I,50) = 10.0
  120 CONTINUE
C     PROGRAM ALLOCATION FACTOR.
      IF(EXOG(I,93).NE.OLDEXO(I,93)) GO TO 130
      EXOG(I,93) = EXOG(I,48) / B(I,1)
  130 IF(EXOG(I,94).NE.OLDEXO(I,94)) GO TO 140
      EXOG(I,94) = EXOG(I,49) / B(I,2)
  140 IF(EXOG(I,95).NE.OLDEXO(I,95)) GO TO 150
      EXOG(I,95) = EXOG(I,50) / B(I,4)
  150 CONTINUE
      DO  400 NF=93,94
      IF(EXOG(I,NF).LT.0.80) EXOG(I,NF) = 0.80
      IF(EXOG(I,NF).GT.1.00) EXOG(I,NF) = 1.00
  400 CONTINUE
      IF(EXOG(I,95).GT.1.00) EXOG(I,95) = 1.00
      GO TO 420
  410 CONTINUE
C     USING THE 1973 AG ACT.
      EXOG(I,93) = 1.00
      EXOG(I,94) = 1.00
      EXOG(I,95) = 1.00
  420 CONTINUE
C     CORN DIFICIENCY PAYMENTS
C--CORNDF IS RELEVANT DIFFERENCE IN TARGET PRICE,LOAN RATE AND MKT.PRICE
C FOR DEFICIENCY PAYMENT  CALCULATION.
      IF (EXOG(I,54).GE.EXOG(I,51)) GO TO 451
      IF (C(I,102) .GE. EXOG(I,51)) GO TO 451
      IF (C(I,102) .LT. EXOG(I,54)) CORNDF = EXOG(I,51) - EXOG(I,54)
      IF (C(I,102) .GE. EXOG(I,54)) CORNDF = EXOG(I,51) - C(I,102)
      IORNDF=CORNDF*100.0D0
      CORNDF=IORNDF/100.0D0
      C(I,112) = CORNDF* EXOG(I,86) * EXOG(I,63) * EXOG(I,68)*EXOG(I,93)
  451 CONTINUE
C     GRAIN SORGHUM DIFICIENCY PAYMENT
      IF (EXOG(I,61).GE.EXOG(I,59)) GO TO 456
      IF (C(I,103) .GE. EXOG(I,59)) GO TO 456
      IF (C(I,103) .LT. EXOG(I,61)) GSOGDF = EXOG(I,59) - EXOG(I,61)
      IF (C(I,103) .GE. EXOG(I,61)) GSOGDF = EXOG(I,59) - C(I,103)
      C(I,113)=GSOGDF  * EXOG(I,86) * EXOG(I,64) * EXOG(I,69)*EXOG(I,93)
  456 CONTINUE
C     BARLEY DIFICIENCY PAYMENT
      IF (EXOG(I,62).GE.EXOG(I,60)) GO TO 461
      IF (C(I,104) .GE. EXOG(I,60)) GO TO 461
      IF (C(I,104) .LT. EXOG(I,62)) BARDIF = EXOG(I,60) - EXOG(I,62)
      IF (C(I,104) .GE. EXOG(I,62)) BARDIF = EXOG(I,60) - C(I,104)
      C(I,114)=BARDIF  * EXOG(I,86) * EXOG(I,65) * EXOG(I,70)*EXOG(I,93)
  461 CONTINUE
C     WHEAT DIFIIENCY PAYMENT
      IF (EXOG(I,55).GE.EXOG(I,52)) GO TO 465
      IF (C(I,26)  .GE. EXOG(I,52)) GO TO 465
      IF (C(I,26)  .LT. EXOG(I,55)) WHDIF  = EXOG(I,52) - EXOG(I,55)
      IF (C(I,26)  .GE. EXOG(I,55)) WHDIF  = EXOG(I,52) - C(I,26)
      IWHT = WHDIF * 10000.0D0
      WHDIF = IWHT/ 10000.0D0
      C(I,109)=WHDIF    * EXOG(I,87) * EXOG(I,66) * EXOG(I,49)*EXOG(I,94)
  465 CONTINUE
C     COTTON DIFICIENCY PAYMENTS
      IF (EXOG(I,56).GE.EXOG(I,53)) GO TO 470
      IF (C(I,28)  .GE. EXOG(I,53)) GO TO 470
      IF (C(I,28)  .LT. EXOG(I,56)) COTDIF = EXOG(I,53) - EXOG(I,56)
      IF (C(I,28)  .GE. EXOG(I,56)) COTDIF = EXOG(I,53) - C(I,28)
      C(I,110)=COTDIF  * EXOG(I,88) * EXOG(I,67) * EXOG(I,50)*EXOG(I,95)
  470 CONTINUE
C     TOTAL DIFICIENCY PAYMENTS FOR FEED GRAINS & ALL CROPS
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      C(I,108) = C(I,112) + C(I,113) + C(I,114)
      C(I,111) = C(I,108) + C(I,109) + C(I,110)
C     TOTAL GOVERNMENT PAYMENTS
C-COMPUTE SET-ASIDE PAUMENT ON ACREAGE SET-ASIDE.
      IF (DUM(I,1).NE.0.0) GO TO 200
      EXOG(I,32)=EXOG(I,1)* EXOG(I,75)
  200 IF (DUM(I,2).NE.0.0) GO TO 210
      EXOG(I,33)=EXOG(I,3)* EXOG(I,76)
  210 IF (DUM(I,3).NE.0.0) GO TO 220
      EXOG(I,34)=EXOG(I,6)* EXOG(I,77)
  220 CONTINUE
C-TOTAL GOV'T PAYMENTS ALL MODEL CROPS PLUS OTHER.
      C(I,96)=EXOG(I,32)+EXOG(I,33)+EXOG(I,34)+EXOG(I,35)+C(I,111)
C-TOTAL GOV'T PAYMENTS TO FG,TO WHEAT,AND TO COTTON.
      C(I,162)=EXOG(I,32)+C(I,108)
      C(I,163)=EXOG(I,33)+C(I,109)
      C(I,164)=EXOG(I,34)+C(I,110)
C     INCOME SUPPORT THROUGH LOAN ACTION
      C(I,205)= (C(I,25)-B(I,25))*((C(I,150)+C(I,209))-(C(J,150)+C(J,209
     1)))
      C(I,206)= (C(I,26)-B(I,26))*((C(I,151)+C(I,210))-(C(J,151)+C(J,210
     1)))
      C(I,207)= (C(I,27)-B(I,27))*((C(I,156)+C(I,211))-(C(J,156)+C(J,211
     1)))
      C(I,208)= (C(I,28)-B(I,28))*((C(I,152)+C(I,212))-(C(J,152)+C(J,212
     1)))
      C(I,204) = C(I,205) + C(I,206) + C(I,207) + C(I,208)
      IF (FREMKT.NE.0) C(I,96)=EXOG(I,35)
C-ZERO OUT THE LOAN,TARGET,ALLOTTMENT AND SET-ASIDE FOR A FREE MARKET
C ALSO ZERO OUT DEFIC & SETASIDE PAYMENTS.
      IF (FREMKT.EQ.0) GO TO 490
      EXOG(I,1) =0.0
      EXOG(I,3) =0.0
      EXOG(I,5) =0.0
      EXOG(I,6) =0.0
      DO 475 K=48,88
  475 EXOG(I,K)=0.0
      DO  480 K=108,114
  480 C(I,K)=0.0
      DO  495 K=32,34
  495 EXOG(I,K)=0.0
      DO 500K=162,164
  500 C(I,K)=0.0
  490 CONTINUE
      IF(IKEY1 .NE. 0) GO TO 550
      IF(IHOLD1.GT.1) GO TO 550
      IF(NPRE.EQ.0) GO TO 550
      IF(I.EQ.3) WRITE(6,1)
      WRITE(6,2) C(I,106) ,E(27), E(30), E(33), E(35)
  550 CONTINUE
      RETURN
      END
C*********************************************************************
C                               SUBROUTINE TOTALS
C*********************************************************************
      SUBROUTINE TOTALS
C---- LATEST REVISION 6-1-77
      COMMON /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
12345 FORMAT(1H0, 'SUBROUTINE TOTALS ENTERED')
      WRITE(8,12345)
C     TOTAL RECEIPTS INCLUDING GOVERNMENT PAYMENTS
      C(I,90)=C(I,89)+C(I,96)
C      REAL VALUE OF HOME CONSUMPTION & OTHER PREQ.
      C(I,97)=EXOG(I,36)+C(I,63)+C(I,64)+C(I,65)+C(I,66)+C(I,67)+C(I,68)
     1+C(I,69)
C     REALL GROSS INCOME
      C(I,91)=C(I,90)+C(I,97)
C     OTHER CROP EXPENSE
      EXL=EXG
      EXG = EXOG(I,37)
      EXPD=EXOG(J,37)
      EXOG(I,37)=(EXOG(I,37)*(1.0+(E(63)*EXOG(I,38))))+(1.0-ADJ(28))*(EX
     1PD-EXL)
C     WHEAT COST TO LS
      WHCOST  = C(I,30) * C (I,26)
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C     TOTAL VARIABLE COSTS FOR LIVESTOCK
      C(I,86) = C(I,122) +C(I,121) +C(I,120) +C(I,119) +WHCOST
C     VARIABLE PROD COST MODEL CROPS
      C(I,98)=C(I,17)+C(I,18)+C(I,19)+C(I,20)
C     DOUBLE COUNTING ADJUSTMENT
C-CPLSDO IS CROP AND LIVESTOCK IS TOTAL CROP AND LIVSTK.PROD EXPENSE INC
C LUDING DOUBLE COUNTING.
      CPLSDO=C(I,86)+C(I,98)
C-FGDOUB IS AMOUNT OF DOUBLE COUNTING IN FEED GRAIN ALONE.
      FGDOUB=(C(I,13)/C(I,5)) * C(I,29)
C-SYDOUB IS DOUBLE COUNTING IN SOYBEANS
      SYDOUB=          ((C(I,15)/C(I,7)) * (C(I,94)* 1.263D0*33.3334D0))
C-EXPNOD IS TOTAL EXPENSE OF PRODUCTION WITH DOUBLE COUNTING REMOVED.
C     WHEAT DOUBLE COUNTING ADJ.
      WHDOUB  =  (C(I,14) / C(I,6)) * C(I,30)
      EXPNOD=CPLSDO -(FGDOUB + SYDOUB + WHDOUB)
C     TOTAL PROD COSTS ALL LS + CROPS ,NO DOUBLE COUNTING
      C(I,92)=EXOG(I,37) + EXPNOD
C      REAL NET INCOME
      C(I,93)=C(I,91)-C(I,92)
      RETURN
      END
C************************************************************************
C                                SUBROUTINE CONS
C************************************************************************
      SUBROUTINE CONS
C---- LATEST REVISION 6-1-77
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      REAL MILKSH
12345 FORMAT(1H0, 'SUBROUTINE CONS   ENTERED')
      WRITE(8,12345)
C     FARMERS SHARE OF CONSUMERS DOLLARS
C-BEEFSH,HOGSSH,ETC.ARE THE COMPUTED FARMERS SHARE OF CONSUMERS DOLLAR
C OF THE 7 LIVESTOCK CLASSES.
      BEEFSH=(CONST(018)+CONST(019)*C(I,70)+CONST(020)*C(I,106))*0.01D0
      HOGSSH=(CONST(021)+CONST(022)*C(I,71)+CONST(023)*C(I,106))*0.01D0
      SHEPSH=(CONST(024)+CONST(025)*C(I,72)+CONST(026)*C(I,106))*0.01D0
      CHIKSH=(CONST(067)+CONST(068)*C(I,73)+CONST(069)*C(I,106))*0.01D0
      TURKSH=(CONST(070)+CONST(071)*C(I,74)+CONST(072)*C(I,106))*0.01D0
      EGGSSH=(CONST(073)+CONST(074)*C(I,75)+CONST(075)*C(I,106))*0.01D0
      MILKSH=(CONST(076)+CONST(077)*C(I,76)+CONST(078)*C(I,106))*0.01D0
C--TOTAL CONSUMER EXPENDITURES  -----
      C(I,100)= B(I,100) + (C(I,77)-B(I,77))/BEEFSH+(C(I,78)-B(I,78))/HO
     1GSSH +(C(I,79)-B(I,79))/SHEPSH +(C(I,80)-B(I,80))/CHIKSH + (C(I,81
     2)-B(I,81))/TURKSH + (C(I,82)-B(I,82))/EGGSSH+ (C(I,83)-B(I,83))/
     3MILKSH
      RETURN
      END
C************************************************************************
C                                SUBROUTINE TAB1
C************************************************************************
      SUBROUTINE TAB1
C---- LATEST REVISION 9-4-77
      COMMON  /CMAIN3/ SIMNAM(20), NEXOG(180), NFILE(300), DM(7,7),
     1EE(200)
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
      COMMON /CMAING/ NBC, NE, NADJ, NEX, NPRE, NERD, NESTOR, NFACT,
     1  NADJST, KING, NPRDM, NDIVAC, NOTARG, NOALL, NLOAN, NDIV, NEXP,
     2 NOACRE, NYIELD, NPROD, IVARE, INDXX, NFSTST, NPART, NCONST
      COMMON /CMAINH/ NOPOL, NEPOL, NRO, IDROP, LASTYR ,ACRE(14,12)
      DIMENSION AA(36)
12345 FORMAT(1H0, 'SUBROUTINE TAB1   ENTERED')
      WRITE(8,12345)
      IF (DIVAC.EQ.0) GO TO 700
      DO 701 J=1,4
      READ (10' NFILE(J)) (AA(I),I=1,IDROP),(B(K,J),K=1,NOBS)
  701 CONTINUE
  700 CONTINUE
      DO 715 I=1,NBC
```

```
      SUM1=0.0
      SUM2=0.0
      DO 710 J=3,NOBS
      SUM1=SUM1+B(J,I)
  710 SUM2=SUM2+C(J,I)
      B(NOBS+2,I)=SUM1/(NOBS-2)
      C(NOBS+2,I)=SUM2/(NOBS-2)
  715 CONTINUE
      DO 720 I=1,NBC
      IF(B(NOBS,I).EQ.0.0) GO TO 720
C-----PERCENTAGE CHANGE IN CAL. AND BASE FOR LAST YEAR OF SIMULATION---
      C(NOBS+1,I)=((C(NOBS,I)-B(NOBS,I))/B(NOBS,I))*100.0
      IF(B(NOBS+2,I).EQ.0.0) GO TO 720
C-----PERCENTAG CHANGE IN CAL. AND BASE AVERAGE VALUES FOR SIMUL PERIOD-
      C(NOBS+2,I)=(C(NOBS+2,I)-B(NOBS+2,I))/(B(NOBS+2,I))*100.0
  720 CONTINUE
      DO 815  I=1,90
      SUM1=0.0
      SUM2=0.0
      DO 810  J=3,NOBS
      SUM1 = SUM1 + OLDEXO(J,I)
  810 SUM2 = SUM2 +     EXOG(J,I)
      OLDEXO (NOBS+2,I)= SUM1 / (NOBS-2)
      EXOG    (NOBS+2,I)= SUM1 / (NOBS-2)
  815 CONTINUE
      DO 820  I=1,90
      IF (OLDEXO (NOBS,I).EQ.0.0) GO TO 820
C*****PERCENTAGE CHANGE IN CAL. & BASE FOR LAST YEAR SIMULATED
      EXOG(NOBS+1,I) = (( EXOG(NOBS,I)- OLDEXO(NOBS,I)) /  OLDEXO(NOBS,I
     1))  * 100.0
      IF (OLDEXO(NOBS+2,I).EQ.0.0) GO TO 820
C*****PERCENTAGE CHANGE IN CAL. & BASE AVERAGE VALUES FOR SIMULATED PERD
      EXOG(NOBS+2,I) =(( EXOG(NOBS+2,I)- OLDEXO(NOBS+2,I)) / OLDEXO (NOB
     1S+2,I) )* 100.00
  820 CONTINUE
      RETURN
      END
C***********************************************************************
C                                SUBROUTINE TAB2
C***********************************************************************
      SUBROUTINE TAB2
C---- LATEST REVISION 6-1-77
      COMMON  /CMAIN3/ SIMNAM(20), NEXOG(180), NFILE(300), DM(7,7),
     1EE(200)
      INTEGER FT(90), TITLE(20,20), LABEL(84,33), SKIP(8)
      COMMON  /CMAIN5/ FT, TITLE, LABEL, SKIP, JUMP
      COMMON  /CMAIN7/ NFILEE(40), NCFILE(180), NDUM(180), ICFILE(200)
      COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      INTEGER BEG   ,END
      DATA BLK/'    '/
   21 FORMAT ('0',T026, 20A4,/)
   22 FORMAT (' ',33A4)
   23 FORMAT (' ',3X,A4, 3X, F8.2, 2X, 8(F8.2, 5X))
   41 FORMAT(' ',3X,A4,3X,12F10.2)
   56 FORMAT (' ',3X,A4,4X,F9.2,6X,6(F10.2,4X))
   57 FORMAT( ' ',3X,A4,4X,F9.4,6X,6(F10.4,4X))
   95 FORMAT (' ',T2,'% CHANGE CALCULATED FROM BASE FOR  ',A4)
   96 FORMAT (' ',T2,'% CHANGE CALCULATED FROM BASE FOR  ',A4,' TO ',A4)
   97 FORMAT ('1',T2,20A4,/)
12345 FORMAT(1H0, 'SUBROUTINE TAB2   ENTERED')
      IF(NPRC.NE.0) GO TO 800
      WRITE(8,12345)
      NRO=NOBS+2
      LASTYR=NRO-2
      NYRO=NRO-1
      AY(NYRO)=BLK
      AY(NRO)=BLK
C     WRITE  TABLES FOR ALL OUTPUT (IF PRINT BASE NPRB.NE.0)
      IF (NPRB.NE.0) NRO=NOBS
      BEG =1
      END=12
      L1=1
      L2=4
C    COMPUTE THE NO. OF TABLES TO PRINT PER PAGE  TO MINIMIZE BLANK SPAC
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C    E AT BOTTOM OF PAGE....
       N1= 58 / (NRO+7)
       IF(JUMP.NE.0) N1=JUMP
       NN=N1
       WRITE(6,97) SIMNAM
       DO 795 M=1,20
C     PRINT A ONE LINE TITLE FOR EACH TABLE......
                     WRITE (6,21)  (TITLE(M,J),J=1,20 )
C     WRITE 4 LINES OF LABEL FOR EACH TABLE....
       DO 735 I=L1,L2
  735                WRITE(6,22)(LABEL(I,J),J=1,33)
       L1=L2+1
       L2=L1+3
C     THIS IS THE LOOP THAT DOES THE ACTUAL PRINTING....
  740 DO 745  I=1,NRO
C     LIVESTOCK PRICES  IS TH SIXTH TABLE TO BE PRINTED,ETC.
       IF (M.EQ.6.AND. NPRB.NE.0) WRITE(6,57) AY(I),(B(I,NCFILE(J)),J=BEG
      1,END)
       IF (M.EQ.6.AND. NPRB.EQ.0) WRITE(6,57) AY(I),(C(I,NCFILE(J)),J=BEG
      1,END)
       IF(M.EQ.6) GO TO 744
C     PRINT FOUR CROP TABLES...
       IF (M.LE.4.AND.NPRB.NE.0) WRITE(6,41) AY(I),(B(I,NCFILE(J)),J=BEG,
      1END)
       IF (M.LE.4.AND.NPRB.EQ.0) WRITE(6,41) AY(I),(C(I,NCFILE(J)),J=BEG,
      1END)
       IF (M.GE.5.AND.M.LE.14          .AND.NPRB.NE.0) WRITE(6,56) AY(I)
      1,(B(I,NCFILE(J)),J=BEG,END)
       IF (M.GE.5.AND.M.LE.14          .AND.NPRB.EQ.0) WRITE(6,56) AY(I)
      1,(C(I,NCFILE(J)),J=BEG,END)
       IF (M.EQ.15.OR.M.EQ.16 ) WRITE(6,56) AY(I),(EXOG(I,NCFILE(J)),J=
      1BEG,END)
       IF (M.GE.17) WRITE(6,23) AY(I),(EXOG(I,NCFILE(J)),J=BEG,END)
  744  CONTINUE
C     PRINT THE PERCENTAGE CHANGE STATS.....
       IF (I.EQ.(NRO-2).AND.NPRB.EQ.0) WRITE(6,95) AY(LASTYR)
  745 IF (I.EQ.(NRO-1).AND.NPRB.EQ.0) WRITE(6,96) AY(3),AY(LASTYR)
       IF (M.EQ.20)  GO TO 795
       IF (M.EQ.NN) WRITE (6,97) SIMNAM
C     THIS IS THE PAGE COUNTER TO DETER. WHEW TO SKIP TO A NEW PAGE....
       IF (M.EQ.NN) NN=NN+N1
       BEG=END+1
C      NFILEE HOLDS INTERGERS TO DETER. HOW MANY COLUMNS ARE PRINTED IN E
  795 END=BEG + (NFILEE(M+1)-1)
       NPRB=0
  800 CONTINUE
       RETURN
       END
C***********************************************************************
C                                SUBROUTINE TAB3
C***********************************************************************
       SUBROUTINE TAB3
C---- LATEST REVISION 6-1-77
       COMMON  /CMAIN3/ SIMNAM(20), NEXOG(180), NFILE(300), DM(7,7),
      1EE(200)
       INTEGER SUMFIL(160), SUMTAB(160,6), SUMF( 160)
       COMMON  /CMAIN4/ SUMFIL, SUMTAB, SUMF, NOEXC
       INTEGER FT(90), TITLE(20,20), LABEL(84,33), SKIP(8)
       COMMON  /CMAIN5/ FT, TITLE, LABEL, SKIP, JUMP
       COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
       COMMON  /CMAINF/ IFSTYR, NOB, ISIMND, IMONTH, IDAY, IBASYR, IOBJT
       COMMON /CMAING/ NBC, NE, NADJ, NEX, NPRE, NERD, NESTOR, NFACT,
      1  NADJST, KING, NPRDM, NDIVAC, NOTARG, NOALL, NLOAN, NDIV, NEXP,
      2 NOACRE, NYIELD, NPROD, IVARE, INDXX, NFSTST, NPART, NCONST
       COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
      1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
      2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
       DIMENSION STAR (130)
       DATA  STAR/130*'*'/,            BA/'BASE'/,CA/'SIM.'/
   31 FORMAT (' ',2X,6A4,10(F9.2,1X))
   52 FORMAT ('0',T2,20A4)
   90 FORMAT (' ',130A1,T45,'TO OBTAIN A CLEAN SET OF TABLES'/1X,130A1,
     1T45,'    FOR THIS SIMULATION USE      '/1X,130A1,T45,'      PROGRAM
     2TABLE. THE        '/1X,130A1,T45,'         FIRST COLUMN FOR        /
     3 1X,130A1,T45,'          STORED DATA IS',2X,I4,6X)
   91 FORMAT (' ',10(     130A1/))
   99 FORMAT('1')
```

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  942 FORMAT ('0',T29,5(8X,A4,8X))
  943 FORMAT (' ',T29,5(4X,A4,5X,A4,3X))
12345 FORMAT(1H0, 'SUBROUTINE TAB3   ENTERED')
      WRITE(8,12345)
      IF(NPRC. NE . 0) WRITE (6,99)
      DO 116 I=2,NOBS
      B(I,76)=B(I,76)*100.00000D0
  116 C(I,76)=C(I,76)*100.00000D0
C-WRITE          SUMMARY TABLE FOR OUTPUT CALCULATED & BASE DATA
C-- NOEXC IS THE NO. OF FILE  CARDS READ FOR THE VARIABLE TABLE OUTPUT..
      IROWS=91 + NOEXC
 1930 CONTINUE
      NNNS=NOBS
      IKK=3
      IF((NOBS-2) .GT. 5) NNNS=7
  951 IF(IKK.GT.2) WRITE(6,99)
      DO 791 M=1,IROWS
      IF(M.EQ.47) WRITE(6,99)
      IF(M.EQ.1.OR.M.EQ.47) WRITE (6,52)SIMNAM
      IF(M.EQ.1.OR.M.EQ.47) WRITE (6,942) (AY(J),J=IKK,NNNS)
      IF(M.EQ.1.OR.M.EQ.47) WRITE (6,943) (BA,CA,J=IKK,NNNS)
C--  SUMTAB HAS TABLE STUBS ,,,, SUMFIL HAS FILE NOS.,,,,,SUMF  INDEXES E
      IF ( SUMFIL(M).EQ. 0) WRITE (6,31)( SUMTAB(M,J),J=1,6)
      IF ( SUMFIL(M).EQ. 0) GO TO  791
C WRITE ENDOGENOUS DATA
      IF (SUMF(M).EQ.1) WRITE (6,31)(SUMTAB(M,J),J=1,6),( B(I,SUMFIL(
     1 M)), C(I,SUMFIL(M)), I=IKK,NNNS)
C WRITE EXOGENOUS DATA FILES
      IF (SUMF(M).EQ.2) WRITE(6,31) (SUMTAB(M,J),J=1,6), (OLDEXO(I,
     1 SUMFIL(M)), EXOG(I, SUMFIL(M)), I=IKK,NNNS)
  791 CONTINUE
      IF (NOBS.LE.NNNS) GO TO 1750
      IKK = IKK + 5
      NNNS = NNNS + 5
      NO22 = NOBS
      IF (NNNS.GT.NO22) NNNS = NO22
      GO TO 951
 1750 CONTINUE
      DO 716 I=2,NOBS
      B(I,76)=B(I,76)/100.000D0
  716 C(I,76)=C(I,76)/100.000D0
C     CONVERT B & C VALUES TO BASE 100.0 & PRINT FIRST TABLE
      IF(INDXX.EQ.0) GO TO 1920
C  ADD A FOOT NOTE THAT ENDOG. VARIABLES ARE INDEX AND EXOG. VAR ARE REA
      DO  1910 J=1,IROWS
      IF(    J.GT.44 .AND.     J.LT.62) GO TO 1910
      DO 1905  I=1,NOBS
      IF (B(I,SUMFIL(J)).LE.0.001) GO TO 1940
      IF(C(I,SUMFIL(J)) .LE. 0.010) GO TO  1940
      C(I,SUMFIL(J))= ((C(I,SUMFIL(J))/B(I,SUMFIL(J)))  )    *100.00
      GO TO 1905
 1940 C(I,SUMFIL(J))=C(I,SUMFIL(J))* 100.00
      IF(C(I,SUMFIL(J)).EQ.0.0) C(I,SUMFIL(J))=100.0D0
 1905 B(I,SUMFIL(J))=100.0D0
 1910 CONTINUE
      INDXX=0
      GO TO 1930
 1920 CONTINUE
      IF (NFSTST.EQ.0) RETURN
C-HERE IS WHERE WE STORE BASE AND CALCULATED DATA ON STORAGE DISK IN
C THE BEGINNING FILE INDICATED ----NFSTST.
      IFSTST=NFSTST
      NFSTTT = NFSTST
      DO 1815 II= 1,NOBS
      WRITE (11' NFSTST) (C(II,J),J=1,208), (B(II,J),J=1,208), (EXOG(II,
     1J),J=1,135),IFSTYR,ISIMND,IMONTH,IDAY,IBASYR,NBC,NEX,NOB,SIMNAM
      IFSTYR=IFSTYR+1
 1815 NFSTST = NFSTST + 1
      WRITE (11' NFSTST) (E(I),I=1,150),(EE(I),I=1,150),(ADJ(I),I=1,45),
     1((DM(I,J),I=1,7),J=1,7)
      DO 1825 I=1,10
 1825 WRITE (6,91) STAR
       WRITE(6,90) STAR,STAR,STAR,STAR,STAR,IFSTST
      DO 1820 I=1,10
 1820 WRITE (6,91) STAR
      WRITE (6,99)
      RETURN
      END
```

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C***********************************************************************
C                               SUBROUTINE WPLCP
C***********************************************************************
      SUBROUTINE  WPLCP
C---- LATEST REVISION 8-26-77
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      IF(C( I,26).NE. 0.0) GO TO 100
C---------PRICE OF CORN---------
      C(I,102)=C(I,25)/ ( 35.714D0*(CONST(27) + CONST(79) * CONST(28) +
     1CONST(80)*CONST(29) + CONST(81) * CONST(30)))
C     PRICE FLEXIBILITY SCHEDULE FOR WHEAT
      EXPCAR = C(I,22) - (B(I,34) + C(I,38) )
      RELCOV = EXPCAR / (B(I,34) + C(I,38) )
      IF(RELCOV.LT.0.10)                             E(30)=-6.0
      IF(RELCOV.GE.0.10   .AND.  RELCOV.LT.0.15)   E(30)=-4.0
      IF(RELCOV.GE.0.15   .AND.  RELCOV.LT.0.20)   E(30)=-3.0
      IF(RELCOV.GE.0.20   .AND.  RELCOV.LT.0.30)   E(30)=-2.4
      IF(RELCOV.GE.0.30   .AND.  RELCOV.LT.0.50)   E(30)=-2.0
      IF(RELCOV.GE.0.50   .AND.  RELCOV.LT.0.60)   E(30)=-1.5
      IF(RELCOV.GE.0.60)                             E(30)=-1.0
      IF(C( I,38).EQ.0.0) EXPORT=B(I,38)
      IF(C( I,38).NE.0.0) EXPORT=C(I,38)
C     WHEAT PRICE $/BU.
      WPRICE =  B(I,26) *  (1.0 + (E(30) * ((C(I,22)-B(I,22)) -(EXPORT -
     1B(I,38)) ) / B(I,22)) + (E(32) * ((C(I,21) - B(I,21)) / B(I,21))))
      IF(WPRICE.GE.(1.05 * C(I,102))) RETURN
      WRITE(8,1)
C     CONVERT WHEAT PRICE TO $/TON.
      FACT = 2000.0 / 60.0
      C(I,26)= WPRICE* FACT
C     COMPUTE SECOND SET OF PRICES
      X=20.0
      Y=20.0*FACT
      WHTPRC =(B(I,26)*FACT) * (1.0 + (E(30) * ((C(I,22)-Y-B(I,22)) - (
     1EXPORT -B(I,38)) )/ B(I, 22) ) )
      IF(C( I,37).EQ.0.0) EXPOR =B(I,37)
      IF(C( I,37).NE.0.0) EXPOR =C(I,37)
      FGPRC  = B(I,25)*        (1.0 + (E(27) * ((C(I,21)+X-B(I,21)) - (
     1EXPOR  -B(I,37)) )/ B(I,21) ) )
C     DIFFERENCES IN PRICES #1 & #2, ON UNIT BASIS.
      DIFWHU = (WHTPRC-C(I,26)) /  20.0
      DIFFGU = (C(I,25)-FGPRC ) /  20.0
      CHPRIC = DIFWHU + DIFFGU
C     TONNAGE TO BE MOVED FROM FG TO WHEAT.
      WPLCP1 =((1.12 * C(I,25))- C(I,26)) / CHPRIC
      WPLBU =(WPLCP1 * FACT )/ 1.12
C     COMPUTE FINAL PRICES.
      C(I,26) = B(I,26)* (1.0 +(E(30) * ((C(I,22)-WPLBU-B(I,22))  -
     1(EXPORT -B(I,38))) / B(I,22)) )
      C(I,25) = B(I,25)* (1.0 +(E(27) * ((C(I,21)+WPLCP1-B(I,21)) -
     1(EXPOR  -B(I,37))) / B(I,21)) )
      WRITE(8,2) WPLBU,WPLCP1   ,C(I,106)
    1 FORMAT (' ','ENTERED SUBROUTINE WPLCP')
    2 FORMAT(' ','WPLCP ADJUSTED WHEAT FED UP BY ',F10.2,'M. BU.     FG
     1FED DOWN BY ',F10.2,'M. TONS, IN YEAR ',F5.0)
      C(I,102) = C(I,25) / 34.9559
      RATIO = C(I,26) / C(I,102)
      WRITE(8,3) C(I,26),C(I,102), RATIO
    3 FORMAT (' ',' PRICES: WHEAT , CORN RATIO',3F10.3)
  100 RETURN
      END
C***********************************************************************
C                               SUBROUTINE SUPPRT
C***********************************************************************
      SUBROUTINE SUPPRT
C---- LATEST REVISION 8-26-77
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
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   10  FORMAT(' ',5X,'CROP NO. ',I4, ' IN YEAR ',A4, ' NEW PRICE IS,',
     1F7.2, ' NEW CCC LOANS ARE,',F10.2)
   20  FORMAT(' ',5X,'CROP NO. ',I4, ' IN YEAR ',A4, ' NEW PRICE IS,',
     1F7.2, ' GOV STOCKS RELEASED, ',F10.2)
   25  FORMAT(' ',5X,'CROP NO. ',I4, ' IN YEAR ',A4, ' NEW PRICE IS,',
     1F7.2, ' CCC LOANS RELEASED, ',F10.2)
   30 FORMAT (' ','LOAN PROGRAM SUPPORT ',' CROP=',I4,' PRICE=',F8.3,' S
     1UPPORT PRICE=',F8.3,' GOV RELEASE PRICE=',F8.3,' YEAR=',F5.0)
   35 FORMAT (' ','LOAN PROGRAM SUPPORT ',' CROP=',I4,' PRICE=',F8.3,' S
     1UPPORT PRICE=',F8.3,' CCC RELEASE PRICE=',F8.3,' YEAR=',F5.0)
   40 FORMAT(' ','TREASURY COSTS(IN-OUT, STORAGE, NET LOSS, INTEREST)=',
     1F10.2,' CURRENT VALUE GOVT STOCKS',F10.2)
12345 FORMAT(1H0, 'SUBROUTINE SUPPRT ENTERED')
      IF(I.EQ.3 .AND. LOAN.EQ.5) GO TO 500
      IF(LOAN.EQ.0) GO TO 500
      IF (SUPFG .NE.0) GO TO 500
      IF (SUPWHT.NE.0) GO TO 500
      IF (SUPSOY.NE.0) GO TO 500
      IF (SUPCOT.NE.0) GO TO 500
      WRITE(8,12345)
C     INDEX OF SUBSCRIPTS
C     IP      IS      LO      IE      IG      JJ      IT      KK      LL      IC
C     25      21      58      27      150     8       57      198     194     209
C     26      22      55      30      151     9       52      199     195     210
C     27      23      12      33      156     10              200     196     211
C     28      24      56      35      152     11      53      201     197     212
C     IPART
C      86
C      87
C      89
C      88
      IS=IP-4
      IG=IP+125
      IF(IP.EQ.27) IG=156
      IF(IP.EQ.28) IG=152
      IE=(3*IP)-48
      IF(IP.EQ.28) IE=35
      IF(IP.EQ.25) LO=58
      IF(IP.EQ.26) LO=55
      IF(IP.EQ.27) LO=12
      IF(IP.EQ.28) LO=56
      IT=LO-3
      IF(IP.EQ.25) IT=57
      JJ=IP-17
      IPART=61+IP
      IF(IP.EQ.28 ) IPART=88
      IF(IP.EQ.27) IPART = 89
      KK=173 + IP
      LL=169 + IP
      IC=184 + IP
      UVAL  =0.0
      COST1 =0.0
      COST2=0.0
      COST3=0.0
      COST4=0.0
      BUY   =0.0
      SELL  =0.0
      SEL2=0.0
C     DEFAULT VALUES FOR STORAGE, INTEREST & IN-OUT CHARGES.
      IF(EXOG(3,JJ).EQ.0.0) EXOG(3,JJ)  = CONST(IP+57)
      IF(EXOG(4,JJ).EQ.0.0) EXOG(4,JJ)  = CONST(IP+61)
      IF(EXOG(5,JJ).EQ.0.0) EXOG(5,JJ)  = CONST(90)
C     SELECT A SELLING PRICE
C     IF LOAN = 1  USE 1.15 * LOANRATE AS SPECIFIED IN 1973 ACT.
      SELPRC  = 1.15 * EXOG(I,LO)
C     IF LOAN = 2  USE 1.75 * LOANRATE AS SPECIFIED IN 1977 ACT.
      IF(LOAN.EQ.2)   SELPRC=1.75 * EXOG(I,LO)
C     IF LOAN=3 WILL USE 1.15 * TARGET PRICE FOR SELL PRICE
      IF (LOAN.NE.3) GO TO 60
      IF (IP.EQ.25) SELPRC = 1.150 * EXOG(I,IT)
      IF (IP.EQ.26) SELPRC = 1.15 * EXOG(I,IT)
      IF (IP.EQ.27) SELPRC=EXOG(I,LO) * 1.75
      IF (IP.EQ.28) SELPRC  = EXOG(I,IT)  * 1.15
C    IF LOAN = 4 WILL USE 1.30 OF TAGGET FOR RELEASE PRICE
   60 IF(LOAN.NE.4) GO TO 70
      IF (IP.EQ.25) SELPRC  = 1.300 * EXOG(I,IT)
      IF (IP.EQ.26) SELPRC  = 1.30 * EXOG(I,IT)
```

```
      IF (IP.EQ.27) SELPRC=EXOG(I,LO) * 1.75
      IF (IP.EQ.28) SELPRC = EXOG(I,IT) * 1.30
   70 CONTINUE
C     IF LOAN=5 WILL USE 150% OF LOAN RATE FOR RELEASE PRICE.
      IF(LOAN.NE.5) GO TO 80
      SELPRC=1.50 * EXOG(I,LO)
   80 CONTINUE
C     RELEASE THE CCC LOANS AT 140 - 160% OF LOAN IN 1977 ACT SO USE 150
      RPCCCL = EXOG(I,LO) * 1.50
      IF(RPCCCL.GT.SELPRC) RPCCCL = SELPRC
      WRITE(8,35) IP,C(I,IP),EXOG(I,LO),RPCCCL,C(I,106)
      WRITE(8,30) IP,C(I,IP),EXOG(I,LO),SELPRC,C(I,106)
C     UVAL IS AVERAGE VALUE OF GOV STOCKS.
      IF((C(J,IG)+C(J,IC)).NE.0.0) UVAL=C(J,LL)/(C(J,IG)+C(J,IC))
C     COST2 IS THE ANNUAL COST OF INTEREST & STORAGE FOR CURRENT GOV STK
C     (STOCK  THAT HAS BEEN THE PROPERTY OF THE GOVT FOR THE PAST YEAR)
C     NOTE THAT IN THE FIRST YEAR WHEN STOCKS ARE TURNED OVER TO THE
C      GOV'T THE ONLY COST FOR TREASURY TO THIS POINT IS THE INTEREST.
      COST2= C(J,LL) * EXOG(05,JJ) + C(J,IG) * EXOG(04,JJ)
C     IF PRICE IS ABOVE LOAN & BELOW RELEASE PRICES.
      IF(FPRIC.GE.EXOG(I,LO) .AND. FPRIC.LE.RPCCCL) GO TO 300
C     IF PRICE IS BELOW LOAN RATE
      IF(FPRIC.LT.EXOG(I,LO) ) GO TO 100
C     IF PRICE IS ABOVE RELEASE PRICE FOR CCC LOANS.
      IF(FPRIC.GT.RPCCCL) GO TO 200
      GO TO 500
C     ACQUIRE CCC LOANS.
C     ASSUMES THAT THE FARMER STANDS ALL COSTS OF PUTTING STOCKS INTO
C     CCC LOAN, ALL STORAGE AND INEREST COSTS FOR THE FIRST YEAR.
  100 C(I,IP) = EXOG(I,LO)*EXOG(I,IPART)+(1.0-EXOG(I,IPART))*FPRIC
      BUY = C(I,IS) * ((1.0-(C(I,IP) / FPRIC)) / E(IE))
      C(I,IC) = B(I,IC) + BUY
      WRITE(8,10) IP,AY(I),C(I,IP),BUY
      C(I,IG) = C(J,IG) + C(J,IC)
      GO TO 400
C     RELEASE CCC LOANS.
C     ASSUMES FARMER   STANDS ALL COSTS OF REDEEMING LOAN & SELLING
C     THE STOCKS, THE GOV'T. HAS NO COSTS IF THE LOAN IS REDEEMED.
  200 IF(C(J,IC).EQ.0.0) GO TO 230
      C(I,IP) = RPCCCL
      SELL = C(I,IS) * ((1.0-(RPCCCL / FPRIC)) / E(IE))
      C(I,IC) = B(I,IC) + C(J,IC) + SELL
      IF(C(I,IC).GE.0.0) GO TO 210
      C(I,IC) = 0.0
      C(I,IP) = FPRIC * (1.0 + (E(IE) * (C(J,IC) / C(I,IS))))
      SELL = -C(J,IC)
  210 CONTINUE
      WRITE(8,25) IP,AY(I),C(I,IP),SELL
  230 C(I,IG) = C(J,IG) + C(J,IC) + SELL
      STOCK = C(I,IG)
      C(I,IC) = 0.0
C     RELEASE GOVT STOCKS IF NECESSARY.
      IF(C(I,IP).LE.SELPRC) GO TO 400
      IF(C(I,IG).LE.0.0) GO TO 400
C     NOW RELEASE GOVT OWNED STOCKS.
      FPRIC = C(I,IP)
      C(I,IP) = SELPRC
      SEL2 = C(I,IS) * ((1.0 -(SELPRC / FPRIC)) / E(IE))
      C(I,IG) = C(J,IG) + C(J,IC) + SELL + SEL2
      IF(C(I,IG).GE.0.0) GO TO 240
      C(I,IG) = 0.0
      C(I,IP) = FPRIC * (1.0 + (E(IE) * (STOCK  /C(I,IS))))
      SEL2 = - STOCK
  240 CONTINUE
      WRITE(8,20) IP,AY(I),C(I,IP),SEL2
C     COST3 IS THE COST OF IN-OUT & REDUCED INTEREST & STORAGE COSTS
C     DUE TO THE SALE
      COST3= SEL2 * UVAL * EXOG(05,JJ)* .5 -.5 * EXOG(03,JJ)*SEL2+ SEL2*
     1EXOG(04,JJ) * .5 + COST3
C     COST4 IS THE PROFIT OR LOSS FROM THE SALE.
      COST4 = (C(I,IP) - UVAL) * SEL2
      GO TO 400
C     THE ACCOUNTING FOR NO BUY OR SELL.
  300 C(I,IC) = 0.0
      C(I,IC) = B(I,IC)
      IF(C(I,IP).GT.(1.02*B(I,IP)    ) ) C(I,IC) = 0.0
      C(I,IG) = C(J,IG) + C(J,IC)
```

```
C     VALUE OF THE STOCKS.
  400 C(I,LL) = EXOG(I,LO) * BUY + SELL * UVAL + SEL2 * UVAL + C(J,LL)
C     C(KK) IS THE TREASURY COSTS:  INTEREST, IN-OUT, STORAGE & NET LOSS
      C(I,KK)= COST1 + COST2 + COST3 + COST4
      WRITE(8,40) C(I,KK),C(I,LL)
  500 RETURN
      END
C***********************************************************************
C                                      SUBROUTINE GOVSTK
C***********************************************************************
      SUBROUTINE GOVSTK
C---- LATEST REVISION 6-1-77
C////  GOVSTK- THIS IS THE STOCK MAINTENANCE SUBROUTINE DESCRIBED
C////           IN THE POLYSIM MANUAL, PAGES 20-22. THE IDEA IS A
C////           SIMPLE PROGRAM OF MAINTAINING A CRITICAL LEVEL OF
C////           STOCKS AND PRICE STABILITY BETWEEN TWO PRICE LEVELS.
C////              3/25/76    JWR
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
    1 FORMAT (1H0, 'SUBROUTINE STOCK  ENTERED')
    2 FORMAT ('0','GOVT SELLS STOCKS: PRICE= ',F8.3,' GREATER THAN UPPER
     1LIMIT OF ',F8.3, ' SOLD STOCKS= ', F8.3,' TOTAL GOVT STOCKS= ',
     2 F8.2,/,' CROP CODE IS ' , I4)
    3 FORMAT ('0','RECOMPUTED GOVT STOCKS SOLD: NEW PRICE= ',F8.3,' SALE
     1S ARE ',F8.2,' GOVT STOCKS= ',F8.2,/, 'CROP CODE IS',I4)
    4 FORMAT ('0','GOVT ACQUIRES STOCKS: PRICE=',F8.3,' LESS THAN SUPPOR
     1T RATE OF ',  F8.3,' ACQUIRED STOCKS OF ',F8.2, 'GOVT STOCKS= ',
     2 F8.2,/,' CROP CODE IS ' , I4)
      WRITE (8,1)
C**** TIE BUY/SELL PRICES TO LOAN RATE OR TARGET PRICE(IT), NP IS NEW PR
      NP=LO
C     NP=IT
      IF (I.NE.3) GO TO 9
      PERCBY= EXOG(3,JJ) / EXOG(I,NP)
      PERCSL= EXOG(4,JJ) / EXOG(I,NP)
      PERCB2= EXOG(5,JJ) / EXOG(I,NP)
      PERCS2= EXOG(6,JJ) / EXOG(I,NP)
    9 CONTINUE
C**** INITIALIZE SOME VALUES USED IN STOCKS.
      QSELL=0.0
      QBUY =0.0
      STOCK =C(I,IG)
      CALPRC=C(I,IP)
C**** DETERMINE BUY&SELL PRICES BASED ON TOTAL STOCK LEVEL.
      BUYPRC = EXOG(I,NP) * PERCBY
      IF (C(I,IST).GE. EXOG(7,JJ)) BUYPRC= EXOG(I,NP) * PERCB2
      SELPRC = EXOG(I,NP) * PERCSL
      IF (C(I,IST).GE. EXOG(7,JJ)) SELPRC= EXOG(I,NP) * PERCS2
C**** DECISION AREA FOR BUY OR SELL BASED ON RELATIVE PRICE
      IF (C(I,IP).LT. BUYPRC) GO TO 10
      IF (C(I,IP).GT. SELPRC) GO TO 30
      GO TO 50
C**** BUY AREA
   10 CONTINUE
      C(I,IP)= BUYPRC
      QBUY=C(I,IS) * ((1.0-(C(I,IP) / CALPRC)) / E(IE))
      WRITE(8,4) CALPRC,C(I,IP),QBUY, C(I,IG), JJ
      GO TO 40
C**** SELL AREA
   30 CONTINUE
      IF (C(I,IG).LE.0.0) GO TO 50
      C(I,IP)= SELPRC
      QSELL=C(I,IS) *((1.0-(C(I,IP) / CALPRC)) / E(IE))
      WRITE(8,2) CALPRC,C(I,IP), QSELL,C(I,IG),JJ
      GOVST=C(I,IG)+QSELL
      IF (GOVST   .GE. 0.0) GO TO 40
      QSELL= -STOCK
      C(I,IP)= CALPRC * (1.0 +(E(IE) *(STOCK / C(I,IS))))
      WRITE (8,3) C(I,IP),QSELL, C(I,IG),JJ
C**** GOV'T. STOCK TOTAL
   40 C(I,IG)= C(I,IG) + QBUY + QSELL
   50 IFLAG=0
      RETURN
      END
```

APPENDIX C

SUBROUTINES FOR THE STOCHASTIC MODEL AND THE SUPPORT PROGRAMS

The stochastic version of the model is quite similar to the deterministic model. The MAIN has been modified and several subroutines and support programs have been added to the original model to make it stochastic. The first section of this Appendix describes the changes in the MAIN and the subroutines that were added to the model, while the support programs are described in the second section of this Appendix.

Special Procedures and Subroutines for the Stochastic Model

To make the model run stachastically the number of iterations or replication to be simulated is punched in card columns 54-56 of the Option Card. If these card columns are left blank (or a one is punched in column 56), the model runs deterministically.

MAIN PROGRAM

The MAIN program for the stochastic version differs from the deterministic version, in that it contains two additional subroutine call statements which are activated only in stochastic runs (Figure 1). One call statement is for subroutine STORE and the other is for a random number generating subroutine, such as: RYLDEX, RCOEXY, CORNEY, CURAN, or TRIRAN.

SUBROUTINE STORE

The function of subroutine STORE is to write the simulation results on disk at the end of each iteration (Figure 2). These values than can be read from disk with the statistical analysis support programs to compute explanatory statistics and to estimate the experimental probability density functions. This is done to reduce the amount of printed output from the stochastic model and to facilitate a more complete statistical analysis of the results with separate programs. On the final interation, subroutine STORE computes the expected values for all of the endogenous variables in the model and places these values in array storage. These expected values or means are printed in the usual POLYSIM output tables. Subroutine STORE requires no inputs from the user directly; but utilizes (from disk storage) the file numbers for the user selected values stored on disk by support program AGSTORE. (AGSTORE is discussed later.)

RANDOM NUMBER GENERATING SUBROUTINES

The subroutines to calculate random deviates for the model crop yields and exports are called from the MAIN program singularly or in pairs. For example: if the user wants different distributions in particular years, and IW statements that call the subroutines can be written to provide this flexibility. Three different basic probability distributions are available. Subroutines RYLDEX, RCOEXY, and CORNEY assume a normal distribution for each of the model crops. Subroutine CURAN uses a cumulative distribution for each of the crops and subroutine TRIRAN uses a triangular distribution. The particular differences and data requirements for each of these subroutines is discussed below.

Subroutine RYLDEX

When random crop yields and export demands are assumed to be independent and normally distributed with a mean μ and standard deviation γ the subroutine RYLDEX should be used. The mean and standard deviations are required to completely identify a normal probability density function (p.d.f.). The subroutine uses the baseline values for crop yield and export demand, as the mean for each of the probability density functions. The standard deviations needed to define the p.d.f.'s are provided by the user and are held constant for all years simulated. The user must provide the standard deviations for each of the eight p.d.f.'s (four yields and four exports). The instructions for coding the one data card for the standard deviations are provided in the subroutine (Figure 3). The standard deviation card follows the regular POLYSIM data cards and is separated from these data cards by one blank card.

Subroutine RCOEXY

Subroutine RCOEXY is used when one assumes that yields for the model crops are normally distributed and correlated, and that exports for the model crops are normally distributed and correlated. The baseline values for yields and exports are used as the means for the normal distributions. The standard deviations for the distributions are provided in the form of two variance-covariance matrices, which allow the program to draw correlated random values (Figure 4). The default variance-covariance matrices are presented in Tables 28 and 29. No additional data cards are required by the subroutine; however, a support program, MFACTOR, must be run to factor the variance-covariance matrices and store the results on disk. (The program MFACTOR is described in the second section of this Appendix.) Subroutine CORNEY can be used when the user assumes that yields and exports are correlated with one another across the four model crops (Figure 5). The default variance-

Table 28. **Default Variance-Covariance Matrices for Feed Grain, Wheat Soybean, and Cotton Yields and Exports Using RCOEXY.**[1]

	Variance-Covariances for Crop Yields			
	Feed Grains (t./ac.)	**Wheat (b./ac.)**	**Soybeans (b./ac.)**	**Cotton (lbs./ac.)**
Feed Grains	0.012	0.061	0.066	—0.293
Wheat		2.822	0.892	0.724
Soybeans			1.464	—4.351
Cotton				225.000

	Variance-Covariances for Crop Exports			
	Feed Grains (m. t.)	**Wheat (m. bu.)**	**Soybeans (m. bu.)**	**Cotton (m. n. b.)**
Feed Grains	40.960	527.486	102.477	2.135
Wheat		12100.000	406.965	44.886
Soybeans			1600.000	8.334
Cotton				0.562

[1] These matrices were obtained by calculating the variances and covariances from detrended data for average national values of crop yields and exports, 1960-1974.

covariance matrix used by CORNEY is changed by modifying MFACTOR and running it according to instructions included in this Appendix.

Subroutine CURAN

The subroutine CURAN allows the user to use a cummulative distribution function to draw random yields and export values. The user can provide a different distribution for each year simulated. Each cummulative distribution is entered by segmenting it into one to ten segments. The user then provides data for the beginning and ending values (yield or export quantities) for each segment, as well as, the cummulative probability (a fraction as, 0.19) associated with the end value of each segment. The coding instructions for the necessary data cards are provided in the comment cards of this subroutine (Figure 6). The CURAN data cards follow the normal POLYSIM data cards and are separated from these cards by one blank card.

Subroutine GAUSS

The pseudo-random number generator GAUSS is used in RYLDEX, RCOEXY, and CORNEY to develop normally distributed random distributed random deviates. The pseudo-random generator RANG is used in CURAN and TRIRAN (Figure 7) to generate uniformly distributed

Table 29. Default Variance-Covariance Matrices for Feed Grain, Wheat, Soybean, and Cotton Yields and Exports Used in CORNEY.[1]

	Variance-Covariances for Crop Yields				Variance-Covariances for Crop Exports			
	Feed Grain (t./ac.)	Wheat (bu./ac.)	Soybeans (bu./ac.)	Cotton (lbs./ac.)	Feed Grain (m. t.)	Wheat (m. bu.)	Soybeans (m. bu.)	Cotton (m. n. b.)
Feed Grains Yield	0.028	0.068	0.079	—0.304	0.588	8.760	2.890	0.051
Wheat Yield		1.470	0.498	0.353	2.396	32.471	24.467	0.064
Soybean Yield			0.878	—2.275	1.876	37.421	19.512	0.124
Cotton Yield				102.567	—8.926	207.665	—79.504	4.921
					23.365	529.668	82.816	2.100
Feed Grain Exports						21386.810	578.938	77.710
Wheat Exports							1831.926	11.613
Soybeans Exports								0.953
Cotton Exports								

[1] These matrices were obtained by calculating the variances and covariances from detrended data for average national values of crop yields and exports, 1960-1974.

random numbers. Both of these programs were documented in the literature by Marsaglia and Bray (1964) and written by Chandler at Oklahoma State University (Figure 8).

Support Programs

Five support programs are included to make the output more manageable and to assist the user in analyzing the results. These programs are: MFACTOR, AGSTORE, AGTRAN, AGSTAT1, and AGSTAT3. MFACTOR is used when subroutine RCOEXY (or CORNEY) is being used. The other four programs may be used each time the stochastic model is run. All five programs are described below.

Table 30 lists the disk storage work spaces used by the model and the support programs. Tthe table provides the names and dimensions of the five work spaces used by the stochastic model along with a brief description of how the data sets are used in the various support programs.

SUPPORT PROGRAM MFACTOR

MFACTOR is a FORTRAN program that factors a variance-covariance matrix into an upper triangular matrix, using the square root method. This procedure is described by Clements, Mapp and Eidman (1971). The original program for factoring a variance-covariance matrix was written by Spence (1974) and has been modified by the authors for use by POLYSIM (Figure 9). The variance-covariance matrices for crop yields and crop export demands are used in MFACTOR as input. (Default variance-covariance matrices are presented in Tables 28 and 29. The listing of MFACTOR includes the coding instructions for the data cards (Figure 9). The matrices are factored and then stored on disk to be used by subroutine RCOEXY. (MFACTOR is demonstrated for factoring two 4x4 matrices; to factor an 8x8 matrix for subroutine CORNEY, the dimensions must be changed.) Several sets of correlated random values for yields and exports are calculated and printed by the program, to test the factored matrices, prior to storing them on disk.

SUPPORT PROGRAM AGSTORE

The expected value of each endogenous variable in the model is printed in the normal output tables at the conclusion of a stochastic analysis. However, due to the volume of numbers generated by the stochastic model it is not feasible to statistically analyze every variable in the model. In lieu of analyzing every variable, provisions have been made to analyze up to 100 user specified variables. The file numbers for the user selected variables are stored on disk with support program, AG-

STORE. The file numbers are then used by POLYSIM (in subroutine STORE) and by two support programs AGSTAT1 and AGSTAT2 (Table 30). The user specifies the selected variables by the variable file numbers in the POLYSIM User's Manual, B file numbers for endogenous variables and EXOG file numbers for exogenous variables.

The 100 (or less) selected file numbers must be organized with all endogenous variables preceeding the exogenous variables and there must be at least one exogenous variable. The coding instructions for AGSTORE are provided in the listing of this program (Figure 10). Output for the program is a list of the file numbers and the name of each variable selected by the user. This program must be run each time the user changes the variables to be statistically analyzed.

SUPPORT PROGRAM AGTRAN

The simulated values for the user selected variables, are stored on disk (unit 13) by subroutine STORE with each direct access file containing the information for one iteration (Table 30). This is an inexpensive way to store the data; however, it is very expensive to analyze the data stored in this form. To resolve the problem, the data is transposed into another work space on the same disk with support program, AGTRAN (Table 30). AGTRAN must be run immediately after each stochastic analysis with POLYSIM, to prevent erasing the data with the next running of POLYSIM. As indicated in Table 30, this program transposes the data into a primary workspace (unit 4) and makes a permanent copy on a backup work space (unit 15). The coding instructions for the program are provided in the listing of AGTRAN (Figure 11).

SUPPORT PROGRAMS AGSTAT1 and AGSTAT2

Once the output data for the user's 100 selected files are transposed, a statistical analysis can be performed. Two statistical analysis programs, AGSTAT1 and AGSTAT2 are provided for this purpose. AGSTAT1 calculates the mean, the standard deviation, the minimum, the maximum, and the coefficient of variation for each of the variables selected by the user. AGSTAT2 provides, in addition to these statistics, values for the experimental probability density function. Both programs analyze the simulated results for each of the years simulated and for the combined total of all years simulated. The coding instructions for the data cards used by AGSTAT1 and AGSTAT2 are included as comment cards in the respective programs (Figures 12 and 13). AGSTAT1 and AGSTAT2 utilize several of the International Mathematical and Statistical subroutines [1975] to sort the data and calculate means and standard deviations. These FORTRAN subroutines are available at most computer facilities.

Table 30. **Summary of Direct Access Disk Workspaces Used by the Stochastic Version of POLYSIM and the Support Programs.**

Programs	RAY. YAR (90,999)	TEMP. STORE. STOC. (600,301)	STOC. EXPVALUE (1000,14)	TRANSP. STO1 (300,600)	BACKUP. STO1 (300,600)
	Workspace Name and Uses				
MFACTOR	Store the factored variance-covariance matrices on Unit 10.				
AGSTORE	Store the user selected file numbers on Unit 10.				
POLYSIM	Access baseline data, factored variance-covariance matrices, user selected file numbers, other input-output information from Unit 10.	Store the stochastic results for user selected files on Unit 13.	Store values of all variables and calculate the means on Unit 14.		
AGTRAN		Read the stochastic results from Unit 13.		Store transposed stochastic results on Unit 14.	Backup for TRANSP. STO1 on Unit 15.
AGSTAT1 & AGSTAT2	Read user selected numbers and names from Unit 11.			Read stochastic results for analyses from Unit 10.	

```
C***********************************************************************
C     Figure 1.                 STOCHASTIC POLYSIM MAIN
C***********************************************************************
C---- LATEST REVISION 9-4-77
      COMMON  /CMAIN3/ SIMNAM(20), NEXOG(180), NFILE(300), DM(7,7),
     1EE(200)
      INTEGER SUMFIL(160), SUMTAB(160,6), SUMF(160)
      COMMON  /CMAIN4/ SUMFIL, SUMTAB, SUMF, NOEXC
      INTEGER FT(90), TITLE(20,20), LABEL(84,33), SKIP(8)
      COMMON  /CMAIN5/ FT, TITLE, LABEL, SKIP, JUMP
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CMAIN7/ NFILEE(40), NCFILE(180), NDUM(180), ICFILE(200)
      COMMON  /CMAINB/ IFI(100),IF2(50), A(20), TREND(80), NAR,
     1FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDEV
      COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
      COMMON  /CMAIND/ LOAN, FGEXP, FPRIC, WPLCP1, IEN, DUM(14,3)
      COMMON  /CMAINF/ IFSTYR, NOB, ISIMND, IMONTH, IDAY, IBASYR, IOBJT
      COMMON /CMAING/ NBC, NE, NADJ, NEX, NPRE, NERD, NESTOR, NFACT,
     1  NADJST, KING, NPRDM, NDIVAC, NOTARG, NOALL, NLOAN, NDIV, NEXP,
     2 NOACRE, NYIELD, NPROD, IVARE, INDXX, NFSTST, NPART, NCONST
      COMMON /CMAINH/ NOPOL, NEPOL, NRO, IDROP, LASTYR ,ACRE(14,12)
      COMMON /CMAINI/ YIELD(16,4),IAJLOT, ADJTG, IZ, IT, IX, IST
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CSTOC/  YIELDX(4,4), EXPORT(4,4), AMIN(80), AMODE(80),
     1AMAX(80), PERC(80), IDATA(3,50), CDATA(14,50), INTER, NTER,AMATRX(
     28,8) ,IEND1, IEND2,IST1,IST2,IEX2
      COMMON /CUMUL/ PVAL(80,22) ,ISTART,IEND
      COMMON /CSTAL/ TALM(17,14)
      DEFINE FILE 10(999,90,U,JNEXT)   ,11(999,580,U,JNEX)
      DEFINE FILE  13(301,600,U,JN1),14(14,1000,U,JN2)
    2 FORMAT(' ','ITERATION NO. ' , I4)
12345 FORMAT(1HO, 'POLYSIM    MAIN   BEGUN')
      WRITE(8,12345)
      NAR=999997
      CALL INT1
      DO 1900  LFM=1,100
  200 CALL INITAL
      IF(NPRB.NE.0) CALL TAB2
      NPRB=0
      CALL INT2
      IF (IFLAG.EQ.5) GO TO 200
      DO 2000 INTER=1,IHOLD1
      NTER=INTER
      WRITE(6,2) NTER
C-----SIMULATION LOOP FOR AS MANY YEARS AS SPECIFIED BY NOB
      DO 1000 I= 3   ,NOBS
      J=I-1
      CALL SETUP
      CALL LVSK
      CALL TGTP
      CALL ADJLOT
C/////// INSERT THE CALL FOR THE SUB YOU WANT FOR NO. GENERATOR....
C///////  ACCORDING TO THIS FORMAT      ' IF(IHOLD1.GT.1) CALL XXXXXX
      CALL CROPQ
      CALL FDGR
      CALL WHEAT
      CALL SOY3
      CALL COTTON
      CALL FED2
      CALL RECPTS
      CALL GOVP
      CALL TOTALS
      CALL CONS
```

```
1000 CONTINUE
     IF (IHOLD1.NE.1) CALL STORE
2000 CONTINUE
     CALL TAB1
     CALL TAB2
     CALL TAB3
1900 CONTINUE
       STOP
      END

C*************************************************************************
C     Figure 2.                  SUBROUTINE STORE
C*************************************************************************
      SUBROUTINE  STORE
C---- LATEST REVISION 9-4-77
C/////   STORE PERFORMS THE STORAGE FUNCTIONS IN THE STOCHASTIC MODEL
C/////   THE PROGRAM WRITES ON DISK THE RESULTS FOR THE USER SELECTED
C/////   DATA FILES,  AND THE DATA FOR THE MEANS OF ALL ENDOGENOUS VAR.
C/////       JWR  6/5/77
      INTEGER SUMFIL(160), SUMTAB(160,6), SUMF(160)
      COMMON  /CMAIN4/ SUMFIL, SUMTAB, SUMF, NOEXC
      INTEGER DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT, SUPSOY, A73
      COMMON  /CMAIN6/ DIVAC, TARGET, FREMKT, SUPFG, SUPWHT, SUPCOT,
     1SUPSOY, A73, IKEY1, IKEY2
      COMMON  /CMAINB/ IFI(100),IF2(50), A(20), TREND(80), NAR,
     1FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDEV
      COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
      COMMON /CMAING/ NBC, NE, NADJ, NEX, NPRE, NERD, NESTOR, NFACT,
     1  NADJST, KING, NPRDM, NDIVAC, NOTARG, NOALL, NLOAN, NDIV, NEXP,
     2 NOACRE, NYIELD, NPROD, IVARE, INDXX, NFSTST, NPART, NCONST
      COMMON /CMAINH/ NOPOL, NEPOL, NRO, IDROP, LASTYR ,ACRE(14,12)
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CSTOC/  YIELDX(4,4), EXPORT(4,4), AMIN(80), AMODE(80),
     1AMAX(80), PERC(80), IDATA(3,50), CDATA(14,50), INTER, NTER,AMATRX(
     28,8) ,IEND1, IEND2,IST1,IST2,IEX2
      DOUBLE PRECISION  D(500)
      IF ( NTER. NE . 1)  GO TO 20
      DO 10 I=1,480
   10 D(I)= 0.0D0
      DO 15 I= 1,14
   15 WRITE (14' I)  D
      READ (10' 564)  IEND1, IEND2
      IST1 = IEND1 + 1
      READ(10' 549) (IFI(I),I=1,90)
      READ(10' 557) (IFI(I),I=91,100)
   20 CONTINUE
C///// WRITE THE SELECTED FILES ON DISK
      WRITE(13' NTER) ( (C(I,IFI(J)),J=1,IEND1),  (EXOG(I,IFI(J)), J=
     1 IST1,IEND2), I=3,NOBS)
C///// THIS ADDS THE DATA FOR ANY PREVIOUS ITERATIONS TO NEW DATA & STOR
      DO  40  I=3,NOBS
      READ (14' I) D
      DO  30  J=1,300
   30 D(J)  = D(J)  +   C(I,J)
      DO  35  J=301,480
      JJ=J-300
   35 D(J)=  D(J)  +   EXOG(I,JJ)
      WRITE (14' I) D
   40 CONTINUE
C///// LAST ITERATION PUT THE DATA INTO C & EXOG MATRICES FOR PRINTING.
      IF ( NTER. LT . IHOLD1) GO TO  70
      DO  60   I= 3,NOBS
      READ (14' I) D
      DO 45  J=1,480
   45 D(J)= D(J) / FLOAT(IHOLD1)
      DO 50  J=1,300
   50 C(I,J) = D(J)
      DO 55  J=301,480
      JJ=J-300
   55 EXOG(I,JJ)= D(J)
   60 CONTINUE
   70 CONTINUE
C//// ZERO OUT C MATRIX, SET EXOG= OLD EXOG AND RETURN PREDETER. VALUES
C//// TO  C MATRIX
      IF ( NTER.EQ.IHOLD1) GO TO 100
```

```
      DO 80  J=1,NBC
      DO 75  I=3,14
   75 C(I,J)=0.0
   80 CONTINUE
      IF (NOPOL.EQ.0) GO TO 81
      DO 79 J=1,NOPOL
      KOD=IDATA(1,J)
      ISTART=IDATA(2,J)
      IEND= IDATA(3,J)
      DO 76  I=ISTART,IEND
   76 C(I,KOD)=CDATA(K,J)
   79 CONTINUE
   81 CONTINUE
      DO 90  J=1,NEX
      DO 85  I=3,14
   85 EXOG(I,J)=OLDEXO(I,J)
   90 CONTINUE
      EXG = EXOG(2,37)
  100 RETURN
      END

C*****************************************************************************
C     Figure 3.                    SUBROUTINE RYLDEX
C*****************************************************************************
      IF(IHOLD1.GT.1) CALL RYLDEX
      SUBROUTINE RYLDEX
C---- LATEST REVISION 6-1-77
C----     THIS SUB. ASSUMES YIELDS & EXPORTS FOR THE MODEL CROPS ARE
C----     INDEPENDENT AND DISTRIBUTED NORMALLY.      JWR 6/5/77
C----   CODE THE ONE DATA CARD AS 8F10.0 FOR THE STANDARD DEVIATIONS
C----   IN THIS ORDER:    FG YIELD, FG EXPORT; WHT YLD, WHT EXPORT;
C----   SOY YIELD, SOY EXPORT; COTT YIELD, COTT EXPORT....
      COMMON   /CMAINB/ IF1(100),IF2(50), A(20), TREND(80), NAR,
     1FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDEV
      COMMON   /CGOVS/   ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LD, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON   /CSTOC/   YIELDX(4,4), EXPORT(4,4), AMIN(80), AMODE(80),
     1AMAX(80), PERC(80), IDATA(3,50), CDATA(14,50), INTER, NTER,AMATRX(
     28,8) ,IEND1, IEND2,IST1,IST2,IEX2
    1 FORMAT (8F10.0)
    2 FORMAT (' ',T10, 8F10.3)
    3 FORMAT (' ',T10, 'SUBROUTINE RANYLD IS BEING USED')
      IF (NAR.EQ.0) GO TO 10
C     READ THE STD. DEV. FOR YIELD & EXPORT
      READ(5,1)    FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDE
     1V
      WRITE (6,3)
      WRITE (6,2) FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDE
     1V
   10 CONTINUE
C     FEED GRAINS
      CALL GAUSE(GAUSF,NAR)
      C(I,05)= B(I,05)+ FGYDEV * GAUSF
      IF(C(I,05) .LE.0.0) GO TO 10
   20 CONTINUE
      CALL GAUSE(GAUSF,NAR)
      C(I,37)= B(I,37)+ FGEDEV * GAUSF
      IF(C(I,37) .LE.0.0) GO TO 20
C     WHEAT
   30 CONTINUE
      CALL GAUSE(GAUSF,NAR)
      C(I,06)= B(I,06)+ WHYDEV * GAUSF
      IF(C(I,06) .LE.0.0) GO TO 30
   40 CONTINUE
      CALL GAUSE(GAUSF,NAR)
      C(I,38)= B(I,38)+ WHEDEV * GAUSF
      IF(C(I,38) .LE.0.0) GO TO 40
C     SOYBEANS
   50 CONTINUE
      CALL GAUSE(GAUSF,NAR)
      C(I,07)= B(I,07)+ SYYDEV * GAUSF
      IF(C(I,07) .LE.0.0) GO TO 50
   60 CONTINUE
      CALL GAUSE(GAUSF,NAR)
      C(I,39)= B(I,39)+ SYEDEV * GAUSF
      IF(C(I,39) .LE.0.0) GO TO 60
C     COTTON
```

```
   70 CONTINUE
      CALL  GAUSE(GAUSF,NAR)
      C(I,08)= B(I,08)+ CTYDEV * GAUSF
      IF(C( I,08) .LE.0.0) GO TO 70
   80 CONTINUE
      CALL GAUSE(GAUSF,NAR)
      C(I,40)= B(I,40)+ CTEDEV * GAUSF
      IF(C(I,40) .LE.0.0) GO TO 80
      RETURN
      END

C**************************************************************************
C     Figure 4.                SUBROUTINE RCOEXY
C**************************************************************************
      IF(IHOLD1.GT.1) CALL RCOEXY
      SUBROUTINE  RCOEXY
C---- LATEST REVISION 6-1-77
C     RCOEXY IS A SUBROUTINE TO DRAW RANDOM NUMBERS FOR MODEL CROPS
C     YIELD + EXPORTS, ASSUMING APPROPRIATELY CORRELATED NORMAL DISTRIB.
C     THE YIELDS ARE INDEPENDENT OF EXPORTS.    JWR 6/5/77
      COMMON  /CMAINB/ IFI(100),IF2(50), A(20), TREND(80), NAR,
     1FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDEV
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CSTOC/  YIELDX(4,4), EXPORT(4,4), AMIN(80), AMODE(80),
     1AMAX(80), PERC(80), IDATA(3,50), CDATA(14,50), INTER, NTER,AMATRX(
     28,8) ,IEND1, IEND2,IST1,IST2,IEX2
      DIMENSION RANNO(4),RANNO2(4), SUM(4),SUM2(4),D(16),DD(16)
    3 FORMAT (' ',T10,' SUB RCOEXY IS BEING USED')
    5 FORMAT(' ',8F10.3)
C     READ THE A MATRICES STORED ON DISK BY MFACTOR
      IF(NAR.EQ .0) GO TO 80
      READ(10' 515)(D(L),L=1,16),(DD(L),L=1,16)
      LL=0
      DO  75 K=1,4
      DO  70 L=1,4
      LL = LL + 1
      YIELDX(L,K) = D(LL)
   70 EXPORT(L,K) =DD(LL)
   75 CONTINUE
      WRITE(6,3)
      DO 50  K=1,4
   50 WRITE(6,5) (YIELDX(K,L),L=1,4),(EXPORT(K,L),L=1,4)
   80 CONTINUE
C     SELECT  8   RANDOM NUMBERS AS THE DRIVER
      DO 100 K=1,4
      CALL GAUSE(GAUSF,NAR)
      CALL GAUSE(GAS  ,NAR)
      RANNO(K) = GAUSF
  100 RANNO2(K)= GAS
C     DO THE MATRIX MULT FOR YIELD  &  EXPORTS
      DO 150 L=1,4
      SUM2(L)=0.0
      SUM(L)=0.0
      DO 125 K=1,4
      SUM(L) = SUM(L) +YIELDX(L,K) * RANNO(K)
  125 SUM2(L)= SUM2(L)+ EXPORT(L,K) *RANNO2(K)
  150 CONTINUE
C     PUT RANDOM VALUES FOR YIELD & EXPORT IN C MATRIX
      DO 175  L=1,4
      LEX=  L + 36
      LYD=  L + 4
      C(I,LYD) = B(I,LYD)     + SUM(L)
  175 C(I,LEX) = B(I,LEX)     + SUM2(L)
      RETURN
      END

C**************************************************************************
C     Figure 5.                SUBROUTINE CORNEY
C**************************************************************************
      IF(IHOLD1.GT.1) CALL CORNEY
      SUBROUTINE  CORNEY
C---- LATEST REVISION 6-1-77
C//////  CORNEY ASSUMES THE YIELDS & EXORTS FOR ALL 4 CROPS ARE CORRELAT
C//////  AS THE 8X8 VAR-COV MATRIX SPECIFIES, CORNEY USES THE NORMAL
C//////  DISTRIBUTION.      JWR 6/5/77
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      COMMON  /CMAINB/ IFI(100),IF2(50), A(20), TREND(80), NAR,
     1FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDEV
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY(16), C(14,300),B(14,300),
     1EXUG(14,180), OLDEXU(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LU, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CSTOC/  YIELDX(4,4), EXPORT(4,4), AMIN(80), AMODE(80),
     1AMAX(80), PERC(80), IDATA(3,50), CDATA(14,50), INTER, NTER,AMATRX(
     28,8) ,IEND1, IEND2,IST1,IST2,IEX2
      DIMENSION RANNO(8),SUM(8),D(64)
    3 FORMAT (' ',T10,' SUB CORNEY IS BEING USED')
    5 FORMAT(' ',8F10.3)
C     READ THE A MATRIX   STORED ON DISK BY MFACTOR
      IF(NAR.EQ .0) GO TO 80
      READ(10' 513)(D(L),L=1,64)
      LL=0
      DO  75 K=1,8
      DO  70 L=1,8
      LL = LL + 1
   70 AMATRX(L,K) = D(LL)
   75 CONTINUE
      WRITE(6,3)
      DO 50  K=1,8
   50 WRITE(6,5) (AMATRX(K,L),L=1,8)
   80 CONTINUE
C     SELECT  8   RANDOM NUMBERS AS THE DRIVER
      DO 100 K=1,8
      CALL GAUSE(GAUSF,NAR)
  100 RANNO(K) = GAUSF
C     DO THE MATRIX MULT FOR YIELD  &  EXPORTS
      DO 150 L=1,8
      SUM(L)=0.0
      DO 125 K=1,8
  125 SUM(L) = SUM(L) +AMATRX(L,K) * RANNO(K)
  150 CONTINUE
C     PUT RANDOM VALUES FOR YIELD & EXPORT IN C MATRIX
      DO 160  L=1,4
      LEX=  L + 36
      LYD=  L + 4
      C(I,LYD) = B(I,LYD)     + SUM(L)
  160 C(I,LEX) = B(I,LEX)     + SUM(LYD)
      RETURN
      END

C************************************************************************
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Figure 6. SUBROUTINE TRIRAN

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C************************************************************************
      IF(IHOLD1.GT.1) CALL TRIRAN
      SUBROUTINE TRIRAN
C---- LATEST REVISION 9-11-77.
C----- THIS IS THE STD. TRIRAN PROGRAM FOR TRIANGULAR DISTRIBUTIONS OF
C----- YIELDS & EXPORTS FOR ALL 4 CROPS.     JWR 6/05/77.
C-----   CODE THE DATA CARDS FOR TRIRAN AS FOLLOWS:
C-----     CARD ONE:
C-----           COLUMNS 1-3  ='001' IF PROVIDING VALUES FOR MIN, MOD,MAX
C-----                               FOR EACH CROP BY YEAR FOR YIELD & EXP
C-----                               ORTS.
C-----           COLUMNS 1-3  ='002' IF PROVIDING FIXED PERCENTAGES FOR
C-----                               THE MIN & MAX WITH RESPECT TO THE MOD
C-----                               AS FG YIELD MIN IS .95 OF THE MODE
C-----                               AND THE MAX IS 1.08 OF THE MODE.
C-----           COLUMNS 4-80 = BLANK.
C-----     PARAMETER CARDS:   (3F10.0)
C-----           COLUMNS 1-10 = NAME OF THE CARD , AS FGYIELD'77.
C-----           COLUMNS 11-20= MINIMUM VALUE OR PERCENTAGE WRT THE MODE.
C-----           COLUMNS 21-30= MODE VALUE, BLANK IF USING % OPTION.
C-----           COLUMNS 31-40= MAXIMUM VALUE OR PERCENT WRT THE MODE.
C-----           COLUMNS 41-80= BLANK.
C-----                          (8* NO. YEARS SIMULATED) FOR THE NO. OF
C-----                          PARAMETER CARDS FOR OPTION 001.
C-----                          8 PARAMETER CARDS FOR OPTION 002
C-----           ARRANGE THE PARAMETER CARDS IN THIS ORDER:
C-----    FG   YIELD   FOR   1977
C-----    WHT  YIELD   FOR   1977
C-----    SOY  YIELD   FOR   1977
C-----    COTT YIELD   FOR   1977
C-----    FG   EXPORT  FOR   1977
C-----    WHT  EXPORT  FOR   1977
C-----    SOY  EXPORT  FOR   1977
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C-----   COT  EXPORT  FOR   1977
C-----   FG   YIELD   FOR 1978
C-----   AND  SO ON ....
      COMMON  /CMAINB/ IFI(100),IF2(50), A(20), TREND(80), NAR,
     1FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDEV
      COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY( 16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CSTOC/  YIELDX(4,4), EXPORT(4,4), AMIN(80), AMODE(80),
     1AMAX(80), PERC(80), IDATA(3,50), CDATA(14,50), INTER, NTER,AMATRX(
     28,8) ,IEND1, IEND2,IST1,IST2,IEX2
      COMMON /CUMUL/ PVAL(80,22) ,ISTART,IEND
      DIMENSION P1(8),P2(8)
    1 FORMAT(10X,3F10.0)
    2 FORMAT(' ',I4,3F10.2)
    3 FORMAT (' ',T10,' SUBROUTINE TRIRAN IS BEING USED ')
    6 FORMAT(3I3)
      IF (NAR.EQ.0) GO TO 10
      WRITE(6,3)
      NOMIN = 8*(NOBS-2)
      READ(5,6) NOM1
      IF(NOM1.NE.1) GO TO 56
      DO 4  K=1,NOMIN
      READ(5,1) AMIN(K),AMODE(K),AMAX(K)
    4 WRITE(6,2) K,AMIN(K),AMODE(K),AMAX(K)
      GO TO 70
   56 I1=0
      DO 57 K=1,8
   57 READ(5,1) P1(K),AN01,P2(K)
      DO 60 K=3,NOBS
      DO 59 L=1,8
      I1=I1 + 1
      IF(L.LE.4) N=L+4
      IF(L.GE.5) N=L+32
      AMODE(I1)=B(K,N)
      AMIN(I1) = AMODE(I1) * P1(L)
      AMAX(I1) = AMODE(I1) * P2(L)
   59 WRITE(6,2) I1,AMIN(I1), AMODE(I1), AMAX(I1)
   60 CONTINUE
   70 CONTINUE
C---- FIRST TIME:SETUP PERCENT ON LEFTHAND SIDE OF TRIANGLE
      DO 5 K=1,NOMIN
    5 PERC(K)=  (AMODE(K)-AMIN(K)) / (AMAX (K) -AMIN(K))
   10 CONTINUE
C---- LOOP TO DRAW THE RANDOM  YIELDS   & EXPORTS FROM TRIANGLE DIST.
      IF(I.EQ.3) IEND=0
      ISTART = IEND + 1
      IEND   = IEND + 8
      K2=4
      DO 50 K=ISTART,IEND
      K2 = K2 + 1
      RAN1 = RANG(NAR)
      RAN2 = RANG(NAR)
      RAN3 = RANG(NAR)
      IF(RAN2.LE.RAN3) RAN2= 1.0 - RAN2
      IF (RAN1-PERC(K)) 20,20,30
   20 RANNO = AMIN(K) + RAN2 * (AMODE(K) - AMIN(K))
      GO TO 40
   30 RANNO = AMODE(K)+(1.0-RAN2)*(AMAX(K)-AMODE(K))
   40 C(I,K2) = RANNO
      IF(K2. EQ. 8) K2 = 36
   50 CONTINUE
      RETURN
      END

C*************************************************************************
C      Figure 7.            SUBROUTINE CURAN
C*************************************************************************
      IF(IHOLD1.GT.1) CALL CURAN
      SUBROUTINE CURAN
C-----  CURAN IS A POLYSIM SUBROUTINE THAT GENERATES RANDOM NUMBERS
C----- FOR CROP YIELDS & EXPORTS, BASED ON A CUMMULATIVE DISTRIBUTION
C----- (CDF) WHICH HAS BEEN SEGMENTED INTO 1 TO 10 SEGMENTS.
C-----  TWO DATA CARDS ARE USED FOR EACH CROP, IN EACH YEAR; THE FIRST
C----- CARD CONTAINS THE PROBABILITY VALUES FOR THE SEGMENTS AND THE
C----- SECOND CARD CONTAINS THE YIELD (OR EXPORT) VALUES FOR THE
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C----- SEGMENTS.  THE ORDER OF DATA CARDS IS:  (8 SETS/YEAR SIMULATED)
C-----       FG YLD T, WHT YLD T, SOY YLD T, COT YLD T, FG EX T, WHT EXT
C-----       SOY EX T, COT EX T;  FG YLD T+1, WHT YLD T+1, AND SO ON....
C-----   CARD FORMAT IS:
C-----      CARD 1-  COLUMNS  1 -8   :THE CARD IDENTIFICATION, AS FGY77C1
C-----                        9-10   :BLANK.
C-----                       11-15   :THE PROBILITY FOR BEGINNING THE
C-----                                FIRST SEGMENT, ALWAYS 0.0
C-----                       16-20   :PROB FOR THE END OF SEGMENT 1
C-----                                FOR EX: 0.19
C-----                       21-25   ;PROB FOR THE END OF SEGMENT 2
C-----                       26-30   ;PROB FOR THE END OF SEGMENT 3
C-----                       31-35   ;PROB FOR THE END OF SEGMENT 4
C-----                       36-40   ;PROB FOR THE END OF SEGMENT 5
C-----                       41-45   ;PROB FOR THE END OF SEGMENT 6
C-----                       46-50   ;PROB FOR THE END OF SEGMENT 7
C-----                       51-55   ;PROB FOR THE END OF SEGMENT 8
C-----                       56-60   ;PROB FOR THE END OF SEGMENT 9
C-----                       61-66   ;PROB FOR THE END OF SEGMENT 10
C-----                       67-80   ;BLANK
C-----
C-----      CARD 2-  COLUMNS  1- 8   :CARD IDENTIFICATION, AS FGX77C2
C-----                        9-10   :BLANK
C-----                       11-15   :THE X VALUE FOR BEGINNING THE FIRST
C-----                                SEGMENT, FOR EX: 2.11
C-----                       16-20   :X VALUE FOR THE END OF SEGMENT 1
C-----                       21-25   :X VALUE FOR THE END OF SEGMENT 2
C-----                       26-30   :X VALUE FOR THE END OF SEGMENT 3
C-----                       31-35   :X VALUE FOR THE END OF SEGMENT 4
C-----                       36-40   :X VALUE FOR THE END OF SEGMENT 5
C-----                       41-45   :X VALUE FOR THE END OF SEGMENT 6
C-----                       46-50   :X VALUE FOR THE END OF SEGMENT 7
C-----                       51-55   :X VALUE FOR THE END OF SEGMENT 8
C-----                       56-60   :X VALUE FOR THE END OF SEGMENT 9
C-----                       61-66   :X VALUE FOR THE END OF SEGMENT 10
C-----                       67-80   :BLANK.
C-----     HERE IS A SAMPLE SET OF CARDS FOR FG YIELD IN 1977:
CFGY77C1   0.0  0.1  0.2  0.3  0.45 0.55 0.65 0.70 0.75 0.80 1.0
CFGY77C2   1.7 1.8  1.85 1.9  2.0  2.05 2.10 2.15 2.20 2.23 2.3
C----- WRITTEN BY JAMES RICHARDSON 6/9/77
C-----
      COMMON /CUMUL/ PVAL(80,22) ,ISTART,IEND
      COMMON  /CMAINB/ IFI(100),IF2(50), A(20), TREND(80), NAR,
     1FGYDEV,FGEDEV,WHYDEV,WHEDEV,SYYDEV,SYEDEV,CTYDEV,CTEDEV
      COMMON  /CMAINC/ LFM, NOSIM, NPRB, NOBS, NPRC, NH1, NH2, NH3, NH4
      COMMON  /CGOVS/  ADJ(65), CONST(110), AY( 16), C(14,300),B(14,300),
     1EXOG(14,180), OLDEXO(14,180), E(200), EXG, IFLAG, JJ, IP, IG, IE,
     2IS, LO, J, I, IHOLD1, IHOLD2, AHOLD1, AHOLD2, AHOLD3, AHOLD4
      COMMON  /CSTOC/  YIELDX(4,4), EXPORT(4,4), AMIN(80), AMODE(80),
     1AMAX(80), PEPC(80), IDATA(3,50), CDATA(14,50), INTER, NTER,AMATRX(
     28,8) ,IEND1, IEND2,IST1,IST2,IEX2
      INTEGER CNB,CNE,CPB,CPE
      IF(NAR.EQ.0) GO TO 99
C     READ (8 * NO. YEARS TO SIMULATE) SETS OF CARDS ON FIRST ITERATION.
      NOCARD = 8 *(NOBS-2)
      DO 90 L=1,NOCARD
      READ (5,1) AN1,AN2, (PVAL(L,K),K=1,22)
      PVAL(L,1) = 0.0
   90 WRITE(6,2) AN1,AN2, (PVAL(L,K),K=1,22)
    1 FORMAT(2A4,2X,11F5.0,/,10X,11F5.0)
    2 FORMAT(' ',2A4,5X,11F9.3,/, 14X,11F9.3,/)
   99 CONTINUE
      IF(I.EQ.3) IEND = 0
      IF(I.EQ.3) ISTART = 0
      LC=4
      ISTART =IEND+1
      IEND =ISTART +7
C     REPEAT THIS LOOP FOR 8 TIMES EACH YEAR SIMULATED.
      DO 70  LL=ISTART,IEND
      LC=LC+1
C     DRAW ONE UNIFORMLY DISTRIBUTED NO.
      RAN1=RANG(NAR)
C     DECIDE WHICH SEGMENT ON F(X) THE RAN1 IS IN.
      IF(RAN1.LE.PVAL(LL,2)) GO TO 100
      IF(RAN1.LE.PVAL(LL,3)) GO TO 200
      IF(RAN1.LE.PVAL(LL,4)) GO TO 300
      IF(RAN1.LE.PVAL(LL,5)) GO TO 400
      IF(RAN1.LE.PVAL(LL,6)) GO TO 500
```

```
      IF(RAN1.LE.PVAL(LL,7)) GO TO 600
      IF(RAN1.LE.PVAL(LL,8)) GO TO 700
      IF(RAN1.LE.PVAL(LL,9)) GO TO 800
      IF(RAN1.LE.PVAL(LL,10))GO TO 900
      IF(RAN1.LE.PVAL(LL,11))GO TO 950
C FIRST SEGMENT
  100 CNB=12
      GO TO 1000
C     SECOND SEGMENT
  200 CNB=13
      GO TO 1000
C     THIRD  SEGMENT
  300 CNB=14
      GO TO 1000
C     FOURTH SEGMENT
  400 CNB=15
      GO TO 1000
C     FIFTH  SEGMENT
  500 CNB=16
      GO TO 1000
C SIXTH SEGMENT
  600 CNB=17
      GO TO 1000
C SEVENTH SEGMENT
  700 CNB=18
      GO TO 1000
C EIGHT SEGMENT
  800 CNB=19
      GO TO 1000
C NINTH SEGMENT
  900 CNB=20
      GO TO 1000
C TENTH SEGMENT
  950 CNB=21
C SET UP THE OTHER INDICES.
 1000 CNE=CNB+1
      CPB=CNB-11
      CPE=CPB+1
C DEVELOP  THE RANDOM NO. FROM THE BEGINNING X VALUE AND THE SLOPE OF TH
C DISTRIBUTION AT THIS POINT.
      RANNO = PVAL(LL,CNB) + (PVAL(LL,CNE)-PVAL(LL,CNB)) * ((RAN1 -
     1PVAL(LL,CPB)) / (PVAL(LL,CPE)-PVAL(LL,CPB)) )
C     NOW THAT HAVE A RANDOM NO. FOR OUR INTERVALS USE IT IN C(I,J).
      IF(LC.EQ.9) LC=37
      C(I,LC) = RANNO
   70 CONTINUE
      RETURN
      END

C*************************************************************************
C  Figure 8.                     SUBROUTINE GAUSE
C*************************************************************************
      SUBROUTINE GAUSE(GAUSF,NARG)
C
C  GENERATES RANDOM NORMAL DEVIATES...  RANDOM NUMBERS FROM A GAUSSIAN
C  DISTRIBUTION WITH ZERO MEAN AND UNIT VARIANCE.
C  J. P. CHANDLER, PHYSICS DEPT., INDIANA UNIVERSITY
C  G. MARSAGLIA AND T. A. BRAY, S.I.A.M. REVIEW 6 (1964) 260.
C  FOR A RANDOM NUMBER FROM THE GAUSSIAN DISTRIBUTION WITH MEAN VALUE
C  EQUAL TO 'AMEAN' AND STANDARD DEVIATION EQUAL TO 'SIGMA', USE....
C        RNG=AMEAN+SIGMA*GAUSF(DUMMY)
      NARGA=NARG
      RJUMP=RANG(NARG)
      IF(RJUMP-.1362)20,10,10
   10 A=(RJUMP-.1362)/.8638
C                                DEFEAT THE IDIOTIC EMR F4 OPTIMIZATION.
      B=RANG(NARG)
      GAUSF=2.*(A+B+RANG(NARGA)-1.5)
      GO TO 150
   20 IF(RJUMP-.0255)40,30,30
   30 A=(RJUMP-.0255)/.1107
      GAUSF=1.5*(A+RANG(NARG)-1.)
      GO TO 150
   40 IF(RJUMP-.0026997961)110,50,50
   50 X=6.*RANG(NARG)-3.
      Y=.358*RANG(NARGA)
      EX=17.49731196*EXP(-.5*X**2)
```

```
      ABX=ABS(X)
      IF(ABX-1.)60,70,70
   60 G=EX-4.73570326*(3.-X**2)-2.15787544*(1.5-ABX)
      GO TO 90
   70 G=EX-2.36785163*(3.-ABX)**2
      IF(ABX-1.5)80,90,90
   80 G=G-2.15787544*(1.5-ABX)
   90 IF(Y-G)100,100,50
  100 GAUSF=X
      GO TO 150
  110 VA=2.*RANG(NARG)-1.
      VB=2.*RANG(NARGA)-1.
      SUMSQ=VA**2+VB**2
      IF(SUMSQ-1.)120,120,110
  120 IF(SUMSQ)110,110,130
  130 FAC=SQRT((9.-2.*ALOG(SUMSQ))/SUMSQ)
      GAUSF=VA*FAC
      IF(ABS(GAUSF)-3.)140,150,150
  140 GAUSF=VB*FAC
      IF(ABS(GAUSF)-3.)110,150,150
  150 RETURN
      END
C
      FUNCTION RANG(NARG)
C
C  GENERATES PSEUDO-RANDOM NUMBERS, UNIFORMLY DISTRIBUTED ON (0,1).
C  THIS VERSION IS FOR THE IBM 360.
C  J. P. CHANDLER, COMPUTER SCIENCE DEPT., OKLA. STATE U.
C  METHOD...  COMPOSITE OF THREE MULTIPLICATIVE CONGRUENTIAL GENERATORS
C  G. MARSAGLIA AND T. A. BRAY, COMM. A.C.M. 11 (1968) 757
C  IF RANF IS CALLED WITH NARG=0, THE NEXT RANDOM NUMBER IS RETURNED.
C  IF RANF IS CALLED WITH NARG.NE.0, THE GENERATOR IS RE-INITIALIZED
C  USING IABS(2*NARG+1), AND THE FIRST RANDOM NUMBER FROM THE NEW
C  SEQUENCE IS RETURNED.
      EQUIVALENCE (RAN,JRAN)
      DIMENSION N(128)
C     DATA NFIRST/7/,K/7654321/,L/7654321/,M/7654321/
      DATA NFIRST/7/,K/7654321/,L/3141593/,M/271828183/
C  MULTIPLIERS USED BY VAN GELDER....
C     DATA MK/105005B/,ML/10405B/,MM/20005B/
C     DATA MK/282629/,ML/34821/,MM/65541/
C                                  CHANDLER-S MULTIPLIERS....
      DATA MK/231525/,ML/282629/,MM/253125/
      IF(NARG)20,10,20
   10 IF(NFIRST)30,60,30
C                                  RE-INITIALIZE USING NARG.
   20 KLM=IABS(2*NARG+1)
      K=KLM
      L=KLM
      M=KLM
      NARG=0
C                                  INITIALIZE.
   30 NFIRST=0
C                                  2**24 ....
      NDIV=16777216
C                                  EXACT REAL REPRESENTATION OF 2**31 ....
      RDIV=32768.*65536.
C                                  FILL THE TABLE.
      DO 50 J=1,128
      K=K*MK
   50 N(J)=K
C                                  COMPUTE THE NEXT RANDOM NUMBER.
   60 L=L*ML
      J=1+IABS(L)/NDIV
      M=M*MM
      NR=IABS(N(J)+L+M)
      RAN=FLOAT(NR)/RDIV
C                                  FIX UP THE LEAST SIGNIFICANT BIT.
C
      IF(J.GT.64  .AND.  RAN.LT.1.)  JRAN=JRAN+1
      RANG=RAN
C                                  REFILL THE J-TH PLACE IN THE TABLE.
      K=K*MK
      N(J)=K
      RETURN
      END
```

```
C*************************************************************************
C    Figure 10.                         AGSTORE
C*************************************************************************
C//////   AGSTORE IS A FORTRAN PROGRAM THAT STORES ON DISK THE USER
C////// SELECTED DATA FILE  NUMBERS  FOR THE VARIABLES THAT ARE TO BE
C////// STATISTICALLY ANALYZED.  THE USER SELECTED VARIABLES MUST BE
C////// CODED ACCORDING TO THE FOLLOWING FORMAT:
C//////          FIRST CARD:
C//////             COLUMNS  1- 4     THE NO. OF ENDOGENOUS VARIABLES
C//////             COLUMNS  5- 8     THE NO. OF TOTAL VARIABLES.
C//////             COLUMNS  9-80     BLANK.
C//////          CARDS 2-6 :
C//////          SECOND THROUGH  SIXTH DATA CARDS HOLD THE FILE NOS.
C//////          FOR THE SELECTED VARIABLES.    CODE THESE AS
C//////          A 20I4 FORMAT, 20 ON EACH CARD, WITH ALL ENDOGENOUS (B)
C//////          FILES GROUPED FIRST AND ALL EXOGENOUS (EXOG) FILES
C//////          GROUPED AT THE END.
C//////          ALL VALUES ARE RIGHT  JUSTIFIED INTERGERS.
C////// WRITTEN BY JAMES RICHARDSON 7/21/76.
      DIMENSION  IFI(100),NFILE(300),NEXOG(200),IOSU(100),ANAM(5)
      DIMENSION  IF2(50) ,IOS2(50)
      DEFINE FILE 10(999,90,U,JNEXT)
    1 FORMAT (20I4)
    2 FORMAT  (' ',T10, 3(I4,2X), 5A4)
    3 FORMAT (' ','FILE NOS. & NAMES OF THE SELECTED FILES')
   99 FORMAT('1')
      READ (10'  527) (NFILE(I),I= 1,90)
      READ (10'  528) (NFILE(I),I=91,180)
      READ (10'  529) (NFILE(I),I=181,250)
      READ (10'  530) (NEXOG(I),I= 1,90)
      READ (10'  531) (NEXOG(I),I=91,135)
      DO 361 I=209,300
  361 NFILE(I)=205
      DO 362 I=135,200
  362 NEXOG(I) = 205
      READ (5,1) IEND1, IEND2
      IST1 = IEND1 + 1
C     READ THE DATA CARDS
      READ (5,1) (IFI(J),J=1,100)
      DO 10 J=1,IEND1
   10 IOSU(J) = NFILE(IFI(J))
      DO 20 J=IST1,IEND2
   20 IOSU(J)=  NEXOG(IFI(J))
      WRITE(6,99)
      WRITE(6,3)
      DO 30  I=1,IEND2
      L=IOSU(I)
      READ (10' L)  AA, (ANAM(K),K=1,5)
      WRITE (6,2)  I, IFI(I),IOSU(I), (ANAM(K),K=1,5)
   30 CONTINUE
C     STORE THE SELECTED FILES AND THE CROSS REFERENCE FILES ON DISK.
      WRITE (10' 549) (IFI(J),J=1,90)
      WRITE (10' 557) (IFI(J),J=91,100)
      WRITE (10' 550) (IOSU(I),I=1,90)
      WRITE (10' 558) (IOSU(I),I=91,100)
      WRITE(10' 564)  IEND1, IEND2
      WRITE(6,99)
      STOP
      END
C*************************************************************************
C    Figure 9.                          MFACTOR
C*************************************************************************
C        MFACTOR   IS A FORTRAN PROGAM TO FACTOR A VAR-COV MATRIX.
C     A MATRIX WHICH IS SYMMETRICAL ABOUT ITS DIAGONAL CAN BE FACTORED I
C     UPPER AND A LOWER TRIANGULAR MATRIX "A" AND"APRIME" WHERE APRIME I
C     TRANSPOSE OF A.  THIS COMPUTER ROUTINE IS DESIGNED TO GENERATE THE
C     APRIME MATRICES FOR A SYMMETRICAL MATRIX OF 4X4.
C
C     THE FOLLOWING MUST BE PROVIDED BY THE USER AS INPUT:
C         SIG(M,M)=THE INPUT MATRIX (ACTUALLY, ONLY THE UPPER TRIANGLE I
C                  NEEDED, NOT THE FULL MATRIX.)
C                  CODE THE YIELD VAR-COV MATRIX FIRST, USE FOUR CARDS:
C                     PUNCH THE FIRST  ROW ON CARD 1 USING 4F10.0 FORMAT
C                     PUNCH THE SECOND ROW ON CARD 2 USING 4F10.0 FORMAT
C                     PUNCH THE THIRD  ROW ON CARD 3 USING 4F10.0 FORMAT
C                     PUNCH THE FOURTH ROW ON CARD 4 USING 4F10.0 FORMAT
C                  CODE THE EXPORT VAR-COV MATRIX NEXT, ON 4 CARDS:
```

```
C                    PUNCH THE FIRST  ROW ON CARD 1 USING 4F10.0 FORMAT
C                    PUNCH THE SECOND ROW ON CARD 2 USING 4F10.0 FORMAT
C                    PUNCH THE THIRD  ROW ON CARD 3 USING 4F10.0 FORMAT
C                    PUNCH THE FOURTH ROW ON CARD 4 USING 4F10.0 FORMAT
C
C        MFACTOR WAS WRITTEN BY LYLE SPENCE AND SINCE THEN MODIFIED BY
C        JAMES RICHARDSON  7/30/76.
C
      REAL*8 SIG,A,SUM,DSQRT,AP,CHEK11
      DIMENSION SIG(12,12), A(12,12), AP(12,12)
      COMMON /MFACT/ YIELD(4,4) , EXPORT(4,4)
      DEFINE FILE  10(999,90,U,JNEXT)
   20 FORMAT(8F10.0)
  250 FORMAT(' ',' THE UPPER TRIANGLE A MATRIX')
  301 FORMAT(' ',4F20.6)
  350 FORMAT(' ',5(/))
  401 FORMAT('1',' YOUR VAR-COV MATRIX FOR YIELDS')
  402 FORMAT('1',' YOUR VAR-COV MATRIX FOR EXPORTS')
  501 FORMAT(' ','    LOWER TRIANGULAR "APRIME"MATRIX')
  650 FORMAT(' ',' MULT     THE FIRST ROW OF "A" BY THE FIRST COLUMN OF
     1"APRIME" YIELDS',F10.5,/,' THIS SHOULD BE THE SAME AS ELEMENT (1,1
     2) OF YOUR INPUT MATRIX',/,' CHECK TO SEE')
  900 FORMAT(' SIG AND SUM:',2F12.4,2I5)
  901 FORMAT(' IN LOOP SUM',F12.4)
  902 FORMAT(' ','DIAGNOST  ON THE CALCULATION OF THE DIAGONAL ELEMENTS.
     1'/'  IF "SUM" EXCEEDS "SIG", THE PROGRAM ABORTS.'/'  IT HAS ATTEMP
     2TED TO TAKE THE SQUARE ROOT OF A NEGATIVE NUMBER.')
  903 FORMAT('0 TERMINATION REACHED',10(/))
  904 FORMAT('0 PREMATURE TERMINATION REACHED WHEN CALCULATING ELEMENT',
     1I3,',',I3)
      M = 4
      ICOUNT = 2
      DO  1000 I11=1,ICOUNT
      ICOL=M
      IROW=M
      ISTOP=M-1
      CHEK11=0.
      DO 10 I=1,M
      DO 10 J=1,M
      SIG(I,J)=0.
      A(I,J)=0.
      AP(I,J)=0.
   10 CONTINUE
      DO 30 I=1,M
   30 READ(5,20)(SIG(I,J),J=1,8)
      IF(I11.EQ.1) WRITE(6,401)
      IF(I11.EQ.2) WRITE(6,402)
      DO 35 K=1,4
   35 WRITE(6,301) (SIG(K,I),I=1,4)
C     CALCULATE THE M TH COLUMN
      A(M,M)=DSQRT(SIG(M,M))
      DO 50 I=1,ISTOP
   50 A(I,M)=SIG(I,M)/A(M,M)
C     NEXT DIAGONAL ELEMENT
      WRITE(6,350)
      WRITE(6,902)
   90 ICOL=ICOL-1
      IROW=ICOL
      IROWP1=IROW+1
      SUM=0.
      DO 100 K=IROWP1,M
      WRITE(6,901) SUM
  100 SUM=SUM+A(IROW,K)**2
      WRITE(6,900) SIG(IROW,ICOL),SUM, IROW,ICOL
      IF(SUM.GT.SIG(IROW,ICOL))WRITE(6,904)IROW,ICOL
      IF(SUM.GT.SIG(IROW,ICOL)) GO TO 220
      A(IROW,ICOL)=DSQRT(SIG(IROW,ICOL)-SUM)
      IF(ICOL.EQ.1)WRITE(6,903)
      IF(ICOL.EQ.1)GO TO 220
C     COMPLETE THE COLUMN
      ICOLP1=ICOL+1
      ISTOP=ISTOP-1
      DO 200 J=1,ISTOP
      IROW=IROW-1
      IF(IROW.EQ.0)GO TO 210
      SUM=0.
      DO 150 K=ICOLP1,M
  150 SUM=SUM+A(IROW,K)*A(ICOL,K)
```

```
      A(IROW,ICOL)=(SIG(IROW,ICOL)-SUM)/A(ICOL,ICOL)
  200 CONTINUE
  210 GO TO 90
  220 CONTINUE
      DO 500 I=1,M
      DO 500 J=1,M
      AP(I,J)=A(J,I)
  500 CONTINUE
      DO 600 I=1,M
  600 CHEK11=CHEK11+A(1,I)*AP(I,1)
      WRITE(6,250)
      DO 610 K=1,4
  610 WRITE(6,301) (A (K,I),I=1,4)
      WRITE(6,501)
      DO 620 K=1,4
  620 WRITE(6,301) (AP(K,I),I=1,4)
      WRITE(6,650)CHEK11
      WRITE(6,350)
      IF( I11  .EQ.1) GO TO 110
      IF( I11  .EQ.2) GO TO 120
  110 CONTINUE
      DO 115 I=1,4
      DO 115 J=1,4
  115 YIELD(I,J) = A(I,J)
      GO TO 1000
  120 CONTINUE
      DO 125 I=1,4
      DO 125 J=1,4
  125 EXPORT(I,J) = A(I,J)
 1000 CONTINUE
      CALL TEST
      STOP
      END
      SUBROUTINE TEST
      COMMON /MFACT/ YIELD(4,4) , EXPORT(4,4)
      DIMENSION  RANNO(4),YLDMEN(4),EXPMEN(4),
     1SUM(4),SUM2(4),RANNO2(4),YLD(4),EXP(4)    ,D(16),DD(16)
      DATA YLD(1)/2.0/,YLD(2)/32.0/ , YLD(3)/28.0/, YLD(4)/490.0/,
     1 EXP(1)/50.0/,EXP(2)/1050.0/, EXP(3)/525.0/, EXP(4)/4.4/
    4 FORMAT(' ',5(/),' THE A MATRICES STORED ON DISK')
    5 FORMAT (' ',8F10.4)
    6 FORMAT(' ','THE A MATRICES FOR YIELDS & EXPORTS ARE STORED ON
     1UNIT 10 IN FILE, ',I4)
   90 FORMAT('1')
   91 FORMAT (' ',' CHECK OF THE A MATRICES ABILITY TO SELECT RANDOM
     1NUMBERS')
      NARG=999999
      DO 99 I=1,4
      YLDMEN(I) = YLD(I)
   99 EXPMEN(I) = EXP(I)
      WRITE(6,90)
      WRITE(6,91)
      DO 500 L=1,20
C     SELECT FOUR RANDOM NUMBERS AS THE DRIVER
      DO 100 I=1,4
      CALL GAUSE(GAUSF,NARG)
      CALL GAUSE(GAS   ,NARG)
      RANNO(I) = GAUSF
  100 RANNO2(I)= GAS
C     DO THE MATRIX MULT FOR YIELD
      DO 150 J=1,4
      SUM2(J)=0.0
      SUM(J)=0.0
      DO 125 I=1,4
      SUM(J) = SUM(J) + YIELD(J,I) * RANNO(I)
  125 SUM2(J)= SUM2(J)+ EXPORT(J,I) *RANNO2(I)
  150 CONTINUE
C     COMPUTE RANDOM NOS.
      DO 175 I=1,4
      YLD(I) = YLDMEN(I) + SUM(I)
  175 EXP(I) = EXPMEN(I) + SUM2(I)
      DO 200 I=1,4
  200 WRITE(6,2)L,YLD(I),SUM(I),RANNO(I),YLDMEN(I), EXP(I),SUM2(I),
     1RANNO2(I),EXPMEN(I)
    2 FORMAT (' ',I4, 8(3X,F10.4))
  500 CONTINUE
C     STORE THE A MATRICES ON DISK
```

```
      LL=0
      DO  300 K=1,4
      DO  290 L=1,4
      LL = LL + 1
      D(LL) = YIELD (L,K)
  290 DD(LL)= EXPORT(L,K)
  300 CONTINUE
C///////////// JFF IS THE FILE THE A MATRICES ARE STORED IN ////////////
      JFF = 515
      WRITE(10' JFF)(D(L),L=1,16), (DD(L),L=1,16)
      READ(10' JFF)(D(L),L=1,16),(DD(L),L=1,16)
      LL=0
      DO  75 K=1,4
      DO  70 L=1,4
      LL = LL + 1
      YIELD (L,K) = D(LL)
   70 EXPORT(L,K) =DD(LL)
   75 CONTINUE
      WRITE(6,4)
      DO 600 K=1,4
  600 WRITE(6,5) (YIELD (K,L),L=1,4),(EXPORT(K,L),L=1,4)
      WRITE(6,6) JFF
      WRITE(6,90)
      RETURN
      END
      SUBROUTINE GAUSF(GAUSF,NARG)
C  GENERATES RANDOM NORMAL DEVIATES...  RANDOM NUMBERS FROM A GAUSSIAN
C  DISTRIBUTION WITH ZERO MEAN AND UNIT VARIANCE.
C  J. P. CHANDLER, PHYSICS DEPT., INDIANA UNIVERSITY
C  G. MARSAGLIA AND T. A. BRAY, S.I.A.M. REVIEW 6 (1964) 260.
C  FOR A RANDOM NUMBER FROM THE GAUSSIAN DISTRIBUTION WITH MEAN VALUE
C  EQUAL TO 'AMEAN' AND STANDARD DEVIATION EQUAL TO 'SIGMA', USE....
C        RNG=AMEAN+SIGMA*GAUSF(DUMMY)
      NARGA=NARG
      RJUMP=RANG(NARG)
      IF(RJUMP-.1362)20,10,10
   10 A=(RJUMP-.1362)/.8638
C                                  DEFEAT THE IDIOTIC EMR F4 OPTIMIZATION.
      B=RANG(NARG)
      GAUSF=2.*(A+B+RANG(NARGA)-1.5)
      GO TO 150
   20 IF(RJUMP-.0255)40,30,30
   30 A=(RJUMP-.0255)/.1107
      GAUSF=1.5*(A+RANG(NARG)-1.)
      GO TO 150
   40 IF(RJUMP-.0026997961)110,50,50
   50 X=6.*RANG(NARG)-3.
      Y=.358*RANG(NARGA)
      EX=17.49731196*EXP(-.5*X**2)
      ABX=ABS(X)
      IF(ABX-1.)60,70,70
   60 G=EX-4.73570326*(3.-X**2)-2.15787544*(1.5-ABX)
      GO TO 90
   70 G=EX-2.36785163*(3.-ABX)**2
      IF(ABX-1.5)80,90,90
   80 G=G-2.15787544*(1.5-ABX)
   90 IF(Y-G)100,100,50
  100 GAUSF=X
      GO TO 150
  110 VA=2.*RANG(NARG)-1.
      VB=2.*RANG(NARGA)-1.
      SUMSQ=VA**2+VB**2
      IF(SUMSQ-1.)120,120,110
  120 IF(SUMSQ)110,110,130
  130 FAC=SQRT((9.-2.*ALOG(SUMSQ))/SUMSQ)
      GAUSF=VA*FAC
      IF(ABS(GAUSF)-3.)140,150,150
  140 GAUSF=VB*FAC
      IF(ABS(GAUSF)-3.)110,150,150
  150 RETURN
      END
      FUNCTION RANG(NARG)
C  GENERATES PSEUDO-RANDOM NUMBERS, UNIFORMLY DISTRIBUTED ON (0,1).
C  THIS VERSION IS FOR THE IBM 360.
C  J. P. CHANDLER, COMPUTER SCIENCE DEPT., OKLA. STATE U.
C  METHOD...  COMPOSITE OF THREE MULTIPLICATIVE CONGRUENTIAL GENERATORS
C  G. MARSAGLIA AND T. A. BRAY, COMM. A.C.M. 11 (1968) 757
C  IF RANF IS CALLED WITH NARG=0, THE NEXT RANDOM NUMBER IS RETURNED.
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C  IF RANF IS CALLED WITH NARG.NE.0, THE GENERATOR IS RE-INITIALIZED
C  USING IABS(2*NARG+1), AND THE FIRST RANDOM NUMBER FROM THE NEW
C  SEQUENCE IS RETURNED.
      EQUIVALENCE (RAN,JRAN)
      DIMENSION N(128)
C     DATA NFIRST/7/,K/7654321/,L/7654321/,M/7654321/
      DATA NFIRST/7/,K/7654321/,L/3141593/,M/271828183/
C  MULTIPLIERS USED BY VAN GELDER....
C     DATA MK/105005B/,ML/104058/,MM/20005B/
C     DATA MK/282629/,ML/34821/,MM/65541/
C                               CHANDLER-S MULTIPLIERS....
      DATA MK/231525/,ML/282629/,MM/253125/
      IF(NARG)20,10,20
   10 IF(NFIRST)30,60,30
C                               RE-INITIALIZE USING NARG.
   20 KLM=-IABS(2*NARG+1)
      K=KLM
      L=KLM
      M=KLM
      NARG=0
C                               INITIALIZE.
   30 NFIRST=0
      NDIV=16777216
C                               EXACT REAL REPRESENTATION OF 2**31 ....
      RDIV=32768.*65536.
C                               FILL THE TABLE.
      DO 50 J=1,128
      K=K*MK
   50 N(J)=K
C                               COMPUTE THE NEXT RANDOM NUMBER.
   60 L=L*ML
      J=1+IABS(L)/NDIV
      M=M*MM
      NR=IABS(N(J)+L+M)
      RAN=FLOAT(NR)/RDIV
C                               FIX UP THE LEAST SIGNIFICANT BIT.
      IF(J.GT.64   .AND.  RAN.LT.1.)  JRAN=JRAN+1
      RANG=RAN
C                               REFILL THE J-TH PLACE IN THE TABLE.
      K=K*MK
      N(J)=K
      RETURN
      END

C*****************************************************************************
C     Figure 11.                         AGTRAN
C*****************************************************************************
C//////   AGTRAN    TRANSPOSES THE OUTPUT FROM THE STOCHASTIC
C////// POLYSIM.   THE RESULTS ARE STORED IN UNITS 14 & 15.
C////// THE PROGRAM TRANSPOSES THE DATA ON UNIT 13 TO UNIT 14 & CREATES
C////// A BACKUP ON UNIT 15.
C////// THE AGSTAT PROGRAMS CAN BE RUN AFTER RUNNING THIS PROGRAM
C//////
C//////   CODE THE   DATA CARDS AS:
C//////         CARD 1:
C//////                COLUMNS 1-4  THE NO. OF ITERATIONS SIMULATED
C//////                COLUMNS 5-8  THE NO. OF YEARS SIMULATED
C//////                COLUMNS 9-12 THE NO. OF VARIABLES STORED ON DISK
C//////
C//////  WRITTEN BY JAMES RICHARDSON 8/10/76
C//////
      DIMENSION DA  (600,100), D  (300)
      DEFINE FILE 13(0301,600,U,JNT),14(0600,0300,U,JNT2)
     1,15(0600,0300,U,JNNT3)
    1 FORMAT(20I4)
    2 FORMAT (' ',F10.4,I4)
   98 FORMAT ('1',' THE DATA SET  ON UNIT  13 HAS BEEN TRANSPOSED ')
      READ(5,1)NITER,NOYR,NVAR
      NOBS= NOYR* NVAR
C     FIRST 100
      DO 100 J=1,100
  100 READ(13' J) (DA  (I,J),I=1,NOBS)
      DO 110 J=1,NOBS
  110 WRITE (14' J)  (DA   (J,I),I=1,100)
C     SECOND SET OF 100
      DO 120 J=101,200
      L=J-100
  120 READ(13' J) (DA  (I,L),I=1,NOBS)
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      DO 130 J = 1,NOBS
      READ (14' J) (D(K),K=1,100)
  130 WRITE(14' J) (D(K),K=1,100), (DA(J,L),L=1,100)
      DO 140 J = 201,300
      L=J-200
  140  READ(13' J) (DA(I,L),I=1,NOBS)
      DO 150 J=1,NOBS
      READ (14' J) (D(K),K=1,200)
      WRITE(15' J) (D(K),K=1,200)    ,(DA(J,L),L=1,100)
  150 WRITE(14' J) (D(K),K=1,200)    ,(DA(J,L),L=1,100)
      READ(14' 5) (D  (I),I=1, 300)
      DO 160 I=1,300
  160  WRITE(6,2) D(I),I
      WRITE(6,98)
      STOP
      END

C***********************************************************************
C     Figure 12.                     AGSTAT1
C***********************************************************************
C/////   AGSTAT1  IS A FORTRAN PROGRAM THAT STATISTICALLY ANALYZES THE
C///// TRANSPOSED STOCHASTIC RESULTS GENERATED BY POLYSIM.
C///// THEREFORE THIS PROGRAM CAN ONLY BE RUN AFTER RUNNING AGTRAN.
C///// THIS PROGRAM CALCULATES THE FOLLOWING:  MEAN,  STD. DEV.,  COEF.
C///// OF VARIATION,   MINIMUM,   MAXIMUM,   AND THE NO. OF ZERO OBS.
C/////
C/////   CARD 1:
C/////            COLUMNS 1-4 = 1 IF COMPREHENSIVE STATISTICS,
C/////            COLUMNS 1-4 = 2 IF STATISTICS ON THE INDIVIDUAL YEARS,
C/////            COLUMNS 1-4 = 3 IF STATISTICS ON THE SUMMARY YEARS,
C/////            COLUMNS 1-4 = N IF STATISTICS ON N SPECIFIC COLUMNS.
C/////            COLUMNS 5-80 SELECTED FILE NUMBERS TO BE ANALYZED,(20I4)
C/////                       CONTINUE ON A SECOND CARD IF USED N IN 1-4
C/////
C/////    CARD2:
C/////            COLUMNS 1-4 = THE NO. OF ITERATIONS FOR THIS RUN.
C/////            COLUMNS 5-8 = THE NO. OF YEARS SIMULATED.
C/////            COLUMNS 9-12= THE NO. OF FILES THAT WERE STORED ON DISK
C/////                       FOR EACH ITERATION.
C/////            COLUMNS 13-20= BLANK.
C/////            COLUMNS 21-80= THE CALENDAR YEARS THAT WERE SIMULATED,
C/////                       USE FORMAT 6F10.4, AND 8F10.4 ON A SECOND
C/////                       CARD IF NEEDED.
C/////   WRITTEN BY JAMES RICHARDSON 7/20/76
      REAL FLOAT
      DIMENSION QA(1),QP(1500),QH(1500),DIV(100),TAB(100)
      DIMENSION QRANK(1500),IR(1500),R(1500),IOPT(5),STAT(5),STATIS(15)
      DIMENSION QNAM(5),IOSU(700)   ,AC106(10) ,INOS(700)
      DIMENSION ADJSTD(20),IB( 100),ARGS(02),A(350),ADJST(20)
      DATA  ADJST/ 1.0D0, 2.0D0, 5.0D0, 10.0D0, 25.0D0, 25.0D0,50.0D0,
     1100.0D0, 100.0D0, 250.0D0, 250.0D0, 500.0D0, 750.0D0, 1000.0D0,
     21000.0D0, 2000.0D0, 2000.0D0, 5000.0D0, 5000.0D0, 5000.0D0/
      DATA  ADJSTD/ 1.0D0, 5.0D0  , 10.0D0  , 25.0D0  ,  50.0D0  , 75.0D0
     10   , 100.0D0  , 250.0D0  , 500.0D0  , 750.0D0  , 1000.0D0  , 2500.0
     20D0   , 5000.0D0  , 7500.0D0  , 10000.0D0  , 12500.0D0  , 15000.0D0
     3  , 17500.0D0, 20000.0D0  , 25000.0D0/
      DEFINE FILE 13(0301,250,U,JNT),10(0600,0300,U,JNT2)
      DEFINE FILE 11(999,90,U,JUN)
    1 FORMAT (20I4)
    3 FORMAT(' ',I3,1X,5A4,T45,' IS ALL ZEROS')
    4 FORMAT (4I4,4X,6F10.0,8F10.0)
    9 FORMAT(' ',T2,'NO',T14,'NAME',T27,'YEAR(S)',T45,'MEAN',T58,'STD DE
     1V ',T73,'COEF VAR      ',T88,'MINIMUM',T103,'MAXIMUM',T119,'NO OF
     2ZEROS')
   10 FORMAT(' ',T1,I4,T6,5A4,T27,F5.0,      T40,5F15.6,2X,F9.0)
   11 FORMAT(' ',T1,I4,T6,5A4,T27,F5.0,F5.0, T40,5F15.6,2X,F9.0,//)
   99 FORMAT('1')
       IPRINT=6
      WRITE(6,9)
      DO 101 I=1,310
  101 INOS(I)=0
C//// READ THE FIRST DATA CARD(S).
      READ(5,1) (INOS(I),I=1,20)
      ITYPE = INOS(1)
      IF(ITYPE  .GT.20) READ(5,1) (INOS(I),I=21,ITYPE)
C     READ DATA CARD NO. 2.
      IF(STATIS(2) .LT. 0.00009) STATIS(2) = 0.000000
      READ (5,4) NPMAX, NOYR, NVAR, I50, (AC106(I),I=1,NOYR)
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C//// SET-UP THE VARIABLES FOR INOS(I) AND IOSU(I) BY TYPE OF OUTPUT.
      IHOLD=NRMAX
      NCOL=NOYR * NVAR + NVAR
      NCOL50 = NCOL - NVAR
      NVAR1= NVAR + 1
      NVAR2= NVAR *(NOYR + 1)
      IF(ITYPE.EQ.1) GO TO 100
      IF(ITYPE.EQ.2) GO TO 125
      IF(ITYPE.EQ.3) GO TO 150
      GO TO 175
C//// COMPREHENSIVE OUTPUT, FILES 1-NCOL.
  100 DO 110 I=1,NCOL
  110 INOS(I)= I
      GO TO 175
C//// ANNUAL OUTPUT, FILES 1- NCOL50.
  125 DO 130 I=1,NCOL50
  130 INOS(I) = I
      GO TO 175
C//// SUMMARY OUTPUT, FILES  NCOL50 +1 - NCOL.
  150 NC = NCOL50 + 1
      DO 160 I= NC,NCOL
      J= I - NCOL50
  160 INOS(J) = I
C//// SET-UP MEANS OF INDEXING FILE LABELS.
  175 CONTINUE
      NOYR1=NOYR+1
        L=0
      DO 90 I=1,NVAR
      IE=0
      DO 91   K=1,NOYR1
      L=L+1
      INOS(L)=I+IE
      IE=IE+NVAR
   91 CONTINUE
   90 CONTINUE
C     READ INDEX TO RELATE VARIABLE NAMES TO THE USER SELECTED FILES.
C     THESE FILES WERE DETERMINED BY USER WITH THE AGSTORE PROGRAM.
      READ (11' 550) (IOSU(I), I=1,90)
      READ (11' 558) (IOSU(I),I=91,100)
      DO 180 I= NVAR1,NVAR2
      J=I-NVAR
  180 IOSU(I)=IOSU(J)
      IER=0
      IOPT(1) = 1
      IOPT(2) = 0
      IOPT(3) = 0
      IOPT(4) = 1
      IOPT(5) = 1
      NCOUNT =0
      IF(ITYPE.GT.3)NCOUNT=1
C////
C//// BEGIN THE ACTUAL WORK LOOP, EACH PASS ANALYZE ANOTHER ELEMENT INOS
C////
      J10=0
  200 CONTINUE
      J10=J10+1
      IF(J10.GT.NOYR ) J10=0
      NCOUNT = NCOUNT + 1
      NCO = INOS(NCOUNT)
      NRMAX=IHOLD
C
C//// READ DATA ONE ARRAY AT A TIME
C
      READ (11' IOSU(NCO)) QA, (QNAM(I),I=1,5)
      IF(NCO.LE.NCOL50) READ(10' NCO) (QH(I), I=1,NRMAX)
      IF(NCO.LE.NCOL50) GO TO 225
C//// READ DATA FOR SUMMARY STATS.
      J=0
      IG=1
      IC=NRMAX
      DO 220 I=1,NOYR
      IA= NCO + (NVAR * J) -(NOYR * NVAR)
      READ(10' IA) (QH(ID),ID= IG,IC)
      IG= IC +1
      IC= IC +NRMAX
  220 J=J+1
      NRMAX=IC-NRMAX
  225 CONTINUE
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      NRMA=NRMAX
C
C     DATA IS IN QH(I), TO BE RANKED
C
      CALL VSORTA(QH,NRMA)
C     NO OF ZERO OBS.
      STATIS(8) = 0.0
      DO 330 I=1,NRMAX
      IF(QH(I).NE. 0.0) GO TO 340
  330 STATIS(8) = STATIS(8) + 1.0
  340 CONTINUE
      IF(STATIS(8).EQ.FLOAT(NRMAX)) WRITE (6,3)NCO,(QNAM(I),I=1,5)
      IF(STATIS(8).EQ.FLOAT(NRMAX))GO TO 5000
C
C     OBTAIN BASIC STATISTICS
C
      CALL BEIUGR(QH,NRMA ,IOPT,STAT,IER)
C     MEAN
      STATIS(1) = STAT(1)
C     VARIANCE
      STATIS(4) = STAT(5)
C     STANDARD DEVIATION
      STATIS(2) = SQRT(STATIS(4))
      IF(STATIS(2) .LT. 0.00009) STATIS(2) = 0.000000
C     MINIMUM
      STATIS(5) = QH(1)
C     MAXIMUM
      STATIS(7) = QH(NRMAX)
C     COEF OF VARIATION
      STATIS(6) = 100.000 * ( STATIS(2) / STATIS(1) )
      IF (NCO.LE.NCOL50) WRITE(6,10)NCO,(QNAM(I),I=1,5)      ,AC106(J10)
     1,STATIS(1),STATIS(2),STATIS(6),STATIS(5),STATIS(7),STATIS(8)
      IF (NCO.GE.NCOL50) WRITE(6,11)NCO,(QNAM(I),I=1,5)      ,AC106(1),
     1AC106(NOYR)
     1,STATIS(1),STATIS(2),STATIS(6),STATIS(5),STATIS(7),STATIS(8)
 5000 IF(INOS(NCOUNT+1).EQ.0) GO TO 5100
      GO TO 200
 5100 CONTINUE
      WRITE(6,99)
      STOP
C***********************************************************************
C     Figure 13.                    AGSTAT2
C***********************************************************************
C/////   AGSTAT2  IS A FORTRAN PROGRAM THAT STATISTICALLY ANALYZES THE
C///// TRANSPOSED STOCHASTIC RESULTS GENERATED BY POLYSIM.
C///// THEREFORE THIS PROGRAM CAN ONLY BE RUN AFTER RUNNING AGTRAN.
C///// THIS PROGRAM CALCULATES THE FOLLOWING:  MEAN,  STD. DEV.,  COEF.
C///// OF VARIATION,   MINIMUM,   MAXIMUM,   AND THE NO. OF ZERO OBS.
C///// AS WELL AS THE FREQUENCY DISTRIBUTION FOR EACH FILE.
C/////
C/////    CARD 1:
C/////            COLUMNS 1-4 = 1 IF COMPREHENSIVE STATISTICS,
C/////            COLUMNS 1-4 = 2 IF STATISTICS ON THE INDIVIDUAL YEARS,
C/////            COLUMNS 1-4 = 3 IF STATISTICS ON THE SUMMARY YEARS,
C/////            COLUMNS 1-4 = N IF STATISTICS ON N SPECIFIC COLUMNS.
C/////            COLUMNS 5-80 SELECTED FILE NUMBERS TO BE ANALYZED,(20I4)
C/////                         CONTINUE ON A SECOND CARD IF USED N IN 1-4
C/////
C/////     CARD2:
C/////            COLUMNS 1-4 = THE NO. OF ITERATIONS FOR THIS RUN.
C/////            COLUMNS 5-8 = THE NO. OF YEARS SIMULATED.
C/////            COLUMNS 9-12= THE NO. OF FILES THAT WERE STORED ON DISK
C/////                         FOR EACH ITERATION.
C/////            COLUMNS 13-20= BLANK.
C/////            COLUMNS 21-80=THE CALENDAR YEARS THAT WERE SIMULATED,
C/////                         USE FORMAT 6F10.4, AND 8F10.4 ON A SECOND
C/////                         CARD IF NEEDED.
C/////   WRITTEN BY JAMES RICHARDSON 7/20/76
      REAL FLOAT
      DIMENSION QA(1),QP(1500),QH(1500),DIV(100),TAB(100)
      DIMENSION QRANK(1500),IR(1500),R(1500),IOPT(5),STAT(5),STATIS(15)
      DIMENSION QNAM(5),IOSU(700)   ,QC106(10) ,INOS(700)
      DIMENSION ADJSTD(20),IB(100),ARGS(02),A(350),ADJST(20)
      DATA  ADJST/ 1.0D0, 2.0D0, 5.0D0, 10.0D0, 25.0D0, 25.0D0,50.0D0,
     1100.0D0, 100.0D0, 250.0D0, 250.0D0, 500.0D0, 750.0D0, 1000.0D0,
     21000.0D0, 2000.0D0, 2000.0D0, 5000.0D0, 5000.0D0, 5000.0D0/
      DATA  ADJSTD/ 1.0D0, 5.0D0  , 10.0D0  , 25.0D0  ,  50.0D0  , 75.0D
     10  , 100.0D0  , 250.0D0  , 500.0D0  , 750.0D0  , 1000.0D0  , 2500.
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     2ODO   , 5000.ODO   , 7500.ODO   , 10000.ODO   , 12500.ODO   , 15000.OD0
     3  , 17500.ODO, 20000.ODO   , 25000.ODO/
      DEFINE FILE 13(0301,250,U,JNT),10(0600,0300,U,JNT2)
      DEFINE FILE 11(999,90,U,JUN)
    1 FORMAT (20I4)
    3 FORMAT(' ',4(/),'****** ATTENTION COLUMN ',I4,5X,5A4,' IS ALL ZER0
     1 ******')
    4 FORMAT (4I4,4X,6F10.0,8F10.0)
   10 FORMAT (' ',T05,'STATISTICAL ANALYSIS OF FILE ',I4,5X,5A4,  T74,
     1   'THERE ARE ',I4,' OBSERVATIONS, FOR YEAR(S) ',F5.0,' - ',F5.0)
   60 FORMAT (' ',
     1  T20,'MEAN       =', T31, F15.6, T60,
     2       'STANDARD DEVIATION         =' ,T86, F15.6 ,/
     3 ,T20,'MEDIAN     =', T31, F15.6, T60,
     4       'VARIANCE                   =' ,T86, F15.6 ,/
     5 ,T20,'MINIMUM    =', T31, F15.6, T60,
     6       'COEFFICIENT OF VARIATION =' ,T86, F15.6 ,/
     7 ,T20,'MAXIMUM    =', T31, F15.6, T60,
     9       'NO. OF ZERO OBSERVATIONS =' ,T86, F15.6 ,/
     8 ,T20,'RANGE      =', T31, F15.6,02('/))
   99 FORMAT('1')
 1040 FORMAT(' ',15X,  'FREQUENCY DISTRIBUTION ')
 1041 FORMAT ('0',T2,'INTERVAL',    T10,F9.2,11('-',F9.2))
 1042 FORMAT (' ',T2,'FREQUENCY',T11,11(6X,I4))
 1043 FORMAT (' ',T5,'%',             T12,11(5X,F5.1))
       IPRINT=6
      DO 101 I=1,310
  101 INOS(I)=0
C//// READ THE FIRST DATA CARDS.
      READ(5,1) (INOS(I),I=1,20)
      ITYPE = INOS(1)
      ITYP1 = INOS(1) + 1
      IF(ITYP1  .GT.20) READ(5,1) (INOS(I),I=21,ITYP1)
C//// READ SECOND SET OF DATA CARDS.
      READ (5,4) NRMAX, NOYR, NVAR, I50, (QC106(I),I=1,NOYR)
C//// SET-UP THE VARIABLES FOR INOS(I) AND IOSU(I) BY TYPE OF OUTPUT.
      IHOLD=NRMAX
      NCOL=NOYR * NVAR + NVAR
      NCOL50 = NCOL  - NVAR
      NVAR1= NVAR + 1
      NVAR2= NVAR *(NOYR + 1)
      IF(ITYPE.EQ.1) GO TO 100
      IF(ITYPE.EQ.2) GO TO 125
      IF(ITYPE.EQ.3) GO TO 150
      GO TO 175
C//// COMPREHENSIVE OUTPUT, FILES 1-NCOL.
  100 DO 110 I=1,NCOL
  110 INOS(I)= I
      GO TO 175
C//// ANNUAL OUTPUT, FILES 1- NCOL50.
  125 DO 130 I=1,NCOL50
  130 INOS(I) = I
      GO TO 175
C//// SUMMARY OUTPUT, FILES  NCOL50 +1 - NCOL.
  150 NC = NCOL50 + 1
      DO 160 I= NC,NCOL
      J= I - NCOL50
  160 INOS(J) = I
C//// SET-UP MEANS OF INDEXING FILE LABELS.
  175 CONTINUE
C     READ INDEX TO RELATE VARIABLE NAMES TO THE USER SELECTED FILES.
C     THESE FILES WERE DETERMINED BY USER WITH THE AGSTORE PROGRAM.
      READ (11' 550) (IOSU(I),I=1,90)
      READ (11' 558) (IOSU(I),I=91,100)
      DO 180 I= NVAR1,NVAR2
      J=I-NVAR
  180 IOSU(I)=IOSU(J)
      IER=0
      IOPT(1) = 1
      IOPT(2) = 0
      IOPT(3) = 0
      IOPT(4) = 1
      IOPT(5) = 1
      J10=1
      NCOUNT =0
      IF(ITYPE.GT.3)NCOUNT=1
C////
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C//// BEGIN THE ACTUAL WORK LOOP, EACH PASS ANALYZE ANOTHER ELEMENT INOS
C////
  200 CONTINUE
      NCOUNT = NCOUNT + 1
      NCO = INOS(NCOUNT)
      NRMAX=IHOLD
C
C//// READ DATA ONE ARRAY AT A TIME
C
      READ (11' IOSU(NCO)) QA,(QNAM(I),I=1,5)
      IF(NCO.LE.NCOL50) READ(10' NCO) (QH(I), I=1,NRMAX)
      IF(NCO.LE.NCOL50) GO TO 225
C//// READ DATA FOR SUMMARY STATS.
      J=0
      IG=1
      IC=NRMAX
      DO 220 I=1,NOYR
      IA= NCO + (NVAR * J) -(NOYR * NVAR)
      READ(10' IA) (QH(ID),ID=IG,IC)
      IG= IC +1
      IC= IC +NRMAX
  220 J=J+1
      NRMAX=IC-NRMAX
  225 CONTINUE
      NRMA=NRMAX
C
C     DATA IS IN QH(I), TO BE RANKED
C
      CALL VSORTA(QH,NRMA)
C     NO OF ZERO OBS.
      STATIS(8) = 0.0
      DO 330 I=1,NRMAX
      IF(QH(I).NE. 0.0) GO TO 340
  330 STATIS(8) = STATIS(8) + 1.0
  340 CONTINUE
      IF(STATIS(8).EQ.FLOAT(NRMAX)) WRITE (6,3)NCO,(QNAM(I),I=1,5)
      IF(STATIS(8).EQ.FLOAT(NRMAX))GO TO 5000
C
C     OBTAIN BASIC STATISTICS
C
      CALL BEIUGR(QH,NRMA ,IOPT,STAT,IER)
C     MEAN
      STATIS(1) = STAT(1)
C     MEDIAN
      STATIS(3) = STAT(4)
C     VARIANCE
      STATIS(4) = STAT(5)
C     STANDARD DEVIATION
      STATIS(2) = SQRT(STATIS(4))
C     MINIMUM
      STATIS(5) = QH(1)
C     MAXIMUM
      STATIS(7) = QH(NRMAX)
C     COEF OF VARIATION
      STATIS(6) = 100.0D0 * ( STATIS(2) / STATIS(1) )
C     RANGE
      STATIS(9) = STATIS(7) - STATIS(5)
C     SELECT THE INTERVAL LENGTH BASED ON STD. DEV.
      DELX=0.05
      IF(STATIS(4) .LE. 0.0009) STATIS (2) = 0.0
      IF(STATIS(2) .EQ. 0.0) DELX = 1.0
      IF ( STATIS(2).LE.1.0) GO TO 430
      DELX =0.0
      UPPER = 4
      ALOWER= 0.0
      DO 410 I=2,20
      IF(STATIS(2).LT. 4.0) DELX =ADJST(1)
      ALOWER = UPPER
      UPPER= ADJSTD(I) + (ADJSTD(I) - ALOWER)
      IF (STATIS(2).GE. ALOWER.AND.STATIS(2) .LT. UPPER) DELX =ADJST(I)
      IF (DELX.NE.0.0) GO TO 430
  410 CONTINUE
  430 CONTINUE
C     DETER. THE MINIMUM VALUE TO BE USED FOR FREQUENCY
      AMIN = STATIS(5)
      IF ( ABS(AMIN).GT.0.0  .AND. ABS(AMIN).LE.100.0) IMIN =AMIN *10.0
      IF ( ABS(AMIN).GT.0.0  .AND. ABS(AMIN).LE.100.0) AMIN =IMIN /10.0
      IF ( ABS(AMIN).GT.100.0) IMIN = AMIN
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      IF ( ABS(AMIN).GT.100.0) AMIN = IMIN
C     SET-UP INTERVAL BOUNDARIES FOR FREQUENCY.
      IF((STATIS(9)/DELX) .GE.  50.0) DELX= STATIS(9)/50.0
      NOINCR = 1 + (STATIS(9) / DELX)
      DIV(1) = AMIN
      A(150) = AMIN
      DEL = DELX
      DO 440 I=1,NOINCR
      A(I+150)=AMIN + DEL
      DIV(I) = AMIN + DEL
      DEL = DEL + DELX
  440 CONTINUE
      DO 450 I=1,100
  450 TAB(I) = 0.0
      BU=0.0
      BL=0.0
      IER=0
C     OBTAIN FREQUENCY WITHIN EACH INTERVAL.
      CALL BDCOU1 (QH, NRMA , NOINCR, DIV, BU, BL, TAB, IER)
      SUM = 0.0
      DO 460 I=1,NOINCR
      SUM = SUM + TAB(I)
      IF(I.EQ.NOINCR .AND. SUM.NE.FLOAT(NRMAX)) TAB(I)=TAB(I) + 1
      A(I +250) = (TAB(I) / FLOAT(NRMAX)) * 100.0
  460 IB(I)  =   TAB(I)
C**** START PRINT OUT
      J10=FLOAT(NCO)/ FLOAT(NVAR) +1
      IF (NCO.LE.NCOL50) WRITE(6,10)NCO,(QNAM(I),I=1,5),NRMAX,QC106(J10)
      IF (NCO.GE.NCOL50) WRITE(6,10)NCO,(QNAM(I),I=1,5),NRMAX,QC106(1),
     1QC106(NOYR)
C-----PRINT THE FREQUENCY DIST. TABLE, REPEAT PROCESS FOR EACH 11 INTERV
      IBEG=1
      LOOP= NOINCR
      IF(NOINCR.GT.11) LOOP=11
      WRITE(IPRINT,1040)
  550 CONTINUE
      LOOP1=LOOP+1
      WRITE(IPRINT,1041)(A(LL+149),LL=IBEG,LOOP1)
      WRITE(IPRINT,1042) (IB(LL),LL=IBEG,LOOP)
      WRITE(IPRINT,1043) (A(LL+ 250), LL=IBEG,LOOP)
      IF(NOINCR.EQ.LOOP) GO TO 560
      IBEG= LOOP + 1
      LOOP= LOOP + 11
      IF(LOOP.GT.NOINCR) LOOP = NOINCR
      GO TO 550
  560 CONTINUE
C     PRINT STATISTICS
      WRITE (6,60) (STATIS(I), I = 1 , 9)
C     THESE WRITES IF ACTIVATED WILL PRINT THE ACTUAL DATA STORED ON
C     DISK FOR USER OBSERVATION.
C     DO 561  I = 1,300
C 561 WRITE(6,562) I,QH(I)
C 562 FORMAT (' ',20X,I4,F10.4)
C//// CHECK IF THERE ARE ANY MORE FILES TO ANALYZE.
 5000 IF(INOS(NCOUNT+1).EQ.0) GO TO 5100
      GO TO 200
 5100 CONTINUE
      WRITE(6,99)
      STOP
      END
```

APPENDIX D

NAMES AND SOURCES OF VARIABLES IN POLYSIM

Published sources for the variables used in the model are presented in this Appendix. Generally, two published sources are listed for each variable. The first source provides a historical series on the variable for a number of years while the second citation is a periodically published source for recent data on the variable.

The UPDATE file number and the POLYSIM file name and number are provided for each of the variables listed in this Appendix. For each course the following information is provided: the publication name, year, and page number where the variable can be located, as well as, the particular years of data available in the publication.

Variable Name	File No. in UPDATE	File Name and No. in POLYSIM	Source for the Variable			
			Publication	Date	Page No.	Years
Feed Grains (corn, sorghum, barley and oats)						
Harvested acreage m. ac.	2	B 1	Feed Statistics[1]	1972	9	1965-71
			Feed Situation[1]	May 1977	23	1973-77
Yield per harvested acre t./ac.	4	B 5	Feed Statistics	1972	9	1965-71
			Feed Situation	May 1977	23	1973-77
Total production m. t.	5	B 9	Feed Statistics	1972	4	1963-71
			Feed Situation	Sept. 1977	23	1968-76
Imports m. t.	15	EXOG 2	Feed Statistics	1972	4	1963-71
			Feed Situation	May 1977	14	1973-77
Total supply m. t.	13	B 21	Feed Statistics	1972	4	1963-71
			Feed Situation	May 1977	23	1968-76
Variable production expense per acre $/ac.	6	B 13	Committee Print, Agri. & Forestry, U.S. Senate	1977		1975-77
Corn average price received by farmers $/bu.	27	B 102	Feed Statistics	1972	20	1959-70
			Feed Situation	Sept. 1977	23	1968-76
Sorghum average price received by farmers $/bu.	28	B 103	Feed Statistics	1972	21	1959-71
			Feed Situation	Sept. 1977	23	1968-76
Barley average price received by farmers $/bu.	29	B 104	Feed Statistics	1972	23	1961-71
			Feed Situation	Sept. 1977	23	1968-76
Oats average price received by farmers $/bu.	30	B 105	Feed Statistics	1972	22	1962-71
			Feed Situation	Sept. 1977	23	1968-76
Domestic feed demand m. t.	18	B 29	Feed Statistics	1972	4	1963-70
			Feed Situation	May 1977	14	1973-77
Sum of other domestic demands m. t.	19	EXOG 16	Feed Statistics	1972	4	1963-70
			Feed Situation	May 1977	14	1973-77
Total domestic demands m. t.	20	B 33	Feed Statistics	1972	8	1950-70
			Feed Situation	May 1977	14	1973-77
Total exports m. t.	21	B 37	Feed Statistics	1972	4	1963-70
			Feed Situation	May 1977	14	1973-77
Total disappearance m. t.	16	B 153	Feed Statistics	1972	4	1963-70
			Feed Situation	May 1977	14	1973-77
Ending year stocks, government owned m. t.	24	B 150	Agri. Statistics[1]	1976	508	1963-74
			Feed Situation	May 1977	14	1973-77
Ending year stocks in CCC loan m. t.	360	B 209	Agri. Statistics	1976	509	1963-75
			Feed Situation	May 1977	18	1972-75
Total ending year stocks m. t.	17	B 41	Feed Statistics	1972	4	1963-70
			Feed Situation	May 1977	14	1973-77
Cash receipts (sum of four crops) m. $	11	B 45	Farm Income Stat.[1]	July 1977	27	1974-76

Variable Name	File No. in UPDATE	File Name and No. in POLYSIM	Source for the Variable: Publication	Date	Page No.	Years
Feed Grains (cont.)						
Corn loan rate $/bu.	33	EXOG 54	Feed Statistics	1972	27	1964-71
			Feed Situation	Sept. 1977	13	1973-77
Sorghum loan rate $/bu.	232	EXOG 61	Feed Statistics	1972	27	1964-71
			Feed Situation	Sept. 1977	13	1974-77
Barley loan rate $/bu.	233	EXOG 62	Feed Statistics	1972	27	1964-71
			Feed Situation	Sept. 1977	13	1974-77
Acreage set-aside m. ac.	3	EXOG 1	Agri. Statistics	1976	518	1959-76
Corn target price $/bu.	32	EXOG 51	Feed Situation	Sept. 1977	13	1974-77
Sorghum target price $/bu.	230	EXOG 59	Feed Situation	Sept. 1977	13	1974-77
Barley target price $/bu.	231	EXOG 60	Feed Situation	Sept. 1977	13	1974-77
Corn yield bu./ac.	26		Feed Statistics	1972	9	1965-71
			Feed Situation	Sept. 1977	2	1973-77
Wheat (all wheat)						
Harvested acreage m. ac.	36	B 2	Agri. Statistics	1976	1	1959-75
			Wheat Situation[1]	Aug. 1977	1	1973-77
Yield per harvested acre bu./ac.	38	B 6	Agri. Statistics	1976	1	1959-75
			Wheat Situation	Aug. 1977	1	1973-77
Total production m. bu.	39	B 10	Agri. Statistics	1976	4	1962-75
			Wheat Situation	Aug. 1977	1	1973-77
Imports	50	EXOG 4	Agri. Statistics	1976	4	1962-75
			Wheat Situation	Aug. 1977	1	1973-77
Total supply m. bu.	48	B 22	Agri. Statistics	1976	4	1962-75
			Wheat Situation	Aug. 1977	1	1973-77
Variable production expense per acre $/ac.	41	B 14	Committee Print, Agri. & Forestry, U.S. Senate	1977		1975-77
Average price received by farmers $/bu.	43	B 26	Agri. Statistics	1976	1	1959-75
			Wheat Situation	Aug. 1977	1	1973-77
Domestic feed demand m. bu.	55	B 30	Agri. Statistics	1976	4	1962-74
			Wheat Situation	Aug. 1977	1	1973-77
Domestic food demand m. bu.	53	B 84	Agri. Statistics	1976	4	1962-74
			Wheat Situation	Aug. 1977	1	1973-77
Sum of other domestic demands m. bu.	54	EXOG 18	Agri. Statistics	1976	4	1962-74
			Wheat Situation	Aug. 1977	1	1973-77
Total domestic demands m. bu.	57	B 34	Agri. Statistics	1976	4	1962-74
			Wheat Situation	Aug. 1977	1	1973-77

Variables Name	File No. In UPDATE	File Name and No. in POLYSIM	Source for the Variable: Publication	Date	Page No.	Years
Total exports m. bu.	58	B 38	Agri. Statistics	1976	4	1962-74
			Wheat Situation	Aug. 1977	1	1973-77
Total disappearance m. bu.	51	B 159	Agri. Statistics	1976	4	1962-74
			Wheat Situation	Aug. 1977	1	1973-77
Ending year stocks, government owned m. t.	61	B 151	Agri. Statistics	1976	4	1962-74
			Wheat Situation	Aug. 1977	1	1973-77
Ending year stocks in CCC loan m. bu.	361	B 210	Agri. Statistics	1976	509	1963-75
			Wheat Situation	Aug. 1977	26	1973-77
Total ending year stocks m. bu.	52	B 42	Agri. Statistics	1976	4	1962-74
			Wheat Situation	Aug. 1977	1	1973-77
Cash receipts m. $	46	B 46	Farm Income Stat.	July 1977	27	1974-76
Loan rate $/bu.	65	EXOG 55	Agri. Statistics	1976	8	1963-74
			Wheat Situation	Aug. 1977	1	1973-74
Acreage set-aside m. ac.	37	EXOG 3	Agri. Statistics	1976	518	1959-76
			Wheat Situation	Aug. 1977	1	1973-76
Target price $/bu.	64	EXOG 52	Feed Situation	Sept. 1977	13	1974-77
Soybeans						
Harvested acreage m. ac.	73	B 3	Agri. Statistics	1976	128	1959-75
			Fats & Oil Situation[1]	Feb. 1977	9	1974-76
Yield per harvested acre bu./ac.	75	B 7	Agri. Statistics	1976	128	1959-75
			Fats & Oil Situation	Feb. 1977	9	1974-76
Total production m. bu.	76	B 11	Agri. Statistics	1976	128	1959-75
			Fats & Oil Situation	Feb. 1977	9	1974-76
Total supply m. bu.	85	B 23	Agri. Statistics	1976	129	1962-75
			Fats & Oil Situation	Feb. 1977	9	1955-76
Variable production expense per acre $/ac.	77	B 15	Committee Print, Agri. & Forestry, U.S. Senate	1977		1975-77
Average price received by farmers $/bu.	79	B 27	Agri. Statistics	1976	128	1959-75
			Fats & Oil Situation	Feb. 1977	9	1974-76
Meal price $/t.	94	B 193	Agri. Statistics	1976	132	1962-74
			Agri. Prices Annual Sum.[1]	1977	166	1971-77
Domestic crushing demand m. bu.	91	B 31	Agri. Statistics	1976	129	1962-74
			Fats & Oil Situation	Feb. 1977	9	1955-76

Variable Name	File No. in UPDATE	File Name and No. in POLYSIM	Source for the Variable: Publication	Date	Page No.	Years
Soybeans (cont.)						
Sum of other domestic demands m. bu.	90	EXOG 20	Agri. Statistics	1976	129	1962-74
			Fats & Oil Situation	Feb. 1977	9	1955-76
Total domestic demands m. bu.	99	B 35	Agri. Statistics	1976	129	1962-74
			Fats & Oil Situation	Feb. 1977	9	1955-76
Total exports m. bu.	92	B 39	Agri. Statistics	1976	129	1962-74
			Fats & Oil Situation	Feb. 1977	9	1955-76
Total disappearance m. bu.	88	B 134	Agri. Statistics	1976	129	1962-74
			Fats & Oil Situation	Feb. 1977	9	1955-76
Ending year stocks, government owned m. bu.	95	B 157	Agri. Statistics	1976	508	1963-74
			Fats & Oil Situation	Feb. 1977	9	1955-77
Ending year stocks in CCC loan m. bu.	362	B 211	Agri. Statistics	1976	509	1963-74
			Fats & Oil Situation	Feb. 1977	9	1955-77
Total ending year stocks m. bu.	89	B 43	Agri. Statistics	1976	129	1962-75
			Fats & Oil Situation	Feb. 1977	9	1955-76
Cash receipts m. $	83	B 47	Farm Income Stat.	July 1977	27	1974-76
Loan rate $/bu.	80	EXOG 12	Agri. Statistics	1976	131	1963-76
			Fats & Oil Situation	July 1977	7	1969-77
Cotton (all kinds)						
Harvested acreage m. ac.	104	B 4	Agri. Statistics	1976	57	1959-75
			Cotton Situation[1]	Apr. 1977	34	1965-76
Yield per harvested acre lbs./ac.	106	B 8	Agri. Statistics	1976	57	1959-75
			Cotton Situation	Apr. 1977	34	1965-76
Total production m. net bales	107	B 12	Agri. Statistics	1976	57	1959-75
			Cotton Situation	Apr. 1977	31	1963-76
Imports m. net bales	118	EXOG 7	Agri. Statistics	1976	61	1962-75
			Cotton Situation	Apr. 1977	31	1963-76
Total supply m. net bales	116	B 24	Agri. Statistics	1976	61	1962-75
			Cotton Situation	Apr. 1977	31	1963-76
Variable production expense per acre $/ac.	109	B 16	Committee Print, Agri. & Forestry, U.S. Senate	1977		1965-77
Average price received by farmers $/lb.	111	B 28	Agri. Statistics	1976	57	1959-75
			Agri. Prices Annual Sum.	June 1977	35	1971-76
Domestic mill demand m. net bales	121	B 32	Agri. Statistics	1976	61	1962-75
			Cotton Situation	Apr. 1977	31	1963-76

Variable Name	File No. in UPDATE	File Name and No. in POLYSIM	Source for the Variable: Publication	Date	Page No.	Years
Cotton (cont.)						
Total exports m. net bales	123	B 40	Agri. Statistics	1976	61	1962-75
			Cotton Situation	Apr. 1977	31	1963-76
Total disappearance m. net bales	119	B 160	Agri. Statistics	1976	61	1962-75
			Cotton Situation	Apr. 1977	31	1963-76
Ending year stocks, government owned m. net bales	124	B 152	Agri. Statistics	1976	508	1963-75
Ending year stocks in CCC loan m. net bales	363	B 212	Agri. Statistics	1976	509	1963-75
Total ending year stocks m. net bales	120	B 44	Agri. Statistics	1976	61	1962-75
			Cotton Situation	Apr. 1977	31	1963-76
Cash receipts m. $	114	B 48	Agri. Statistics	1976	57	1959-75
			Farm Income Stat.	July 1977	27	1974-76
Loan rate upland cotton $/lb.	102	EXOG 56	Agri. Statistics	1976	453	1967-76
Acreage set-aside m. ac.	105	EXOG 6	Agri. Statistics	1976	518	1959-76
Cotton target price upland cotton $/lb.	101	EXOG 53	Agri. Food Policy Rev.	1977	16	1974-77
Cattle and Calves						
Production m. lbs. carcass wt.	134	B 49	Livestock & Meat Stat.[1]	1973	196	1950-72
			Livestock & Meat Stat.	1976	106	1970-76
Imports m. lbs. carcass wt.	144	EXOG 23	Livestock & Meat Stat.	1973	294	1960-72
			Livestock & Meat Stat.	1976	148	1967-76
Exports m. lbs. carcass wt.	127	EXOG 40	Livestock & Meat Stat.	1973	293	1960-72
			Livestock & Meat Stat.	1976	147	1967-76
Average price received by farmers $/lb.	161	B 70	Livestock & Meat Stat.	1973	258	1950-72
			Livestock & Meat Stat.	1976	129	1970-76
Cash receipts m. $	168	B 77	Farm Income Stat.	July 1977	40	1950-76
Hogs						
Production m. lbs. carcass wt.	135	B 50	Livestock & Meat Stat.	1973	196	1950-72
			Livestock & Meat Stat.	1976	106	1970-76
Imports m. lbs. carcass wt.	145	EXOG 24	Livestock & Meat Stat.	1973	294	1960-72
			Livestock & Meat Stat.	1976	148	1967-76

Variable Name	File No. In UPDATE	File Name and No. in POLYSIM	Source for the Variable: Publication	Date	Page No.	Years
Hogs (cont.)						
Exports m. lbs. carcass wt.	128	EXOG 41	Livestock & Meat Stat.	1973	293	1960-72
			Livestock & Meat Stat.	1976	147	1967-76
Average price received by farmers $/lb.	162	B 71	Livestock & Meat Stat.	1973	260	1950-72
			Livestock & Meat Stat.	1976	129	1970-76
Cash receipts m. $	169	B 78	Farm Income Stat.	July 1977	40	1950-76
Sheep and Lambs						
Production m. lbs. carcass wt.	136	B 51	Livestock & Meat Stat.	1973	196	1950-72
			Livestock & Meat Stat.	1976	106	1970-76
Imports m. lbs. carcass wt.	146	EXOG 25	Livestock & Meat Stat.	1973	294	1960-72
			Livestock & Meat Stat.	1976	148	1967-76
Exports m. lbs. carcass wt.	129	EXOG 42	Livestock & Meat Stat.	1973	293	1960-72
			Livestock & Meat Stat.	1976	147	1967-76
Average price received by farmers for lambs $/lb.	163	B 72	Agri. Statistics	1976	326	1963-75
			Agri. Prices Annual Sum.	June 1977	56	1971-76
Cash receipts m. $	170	B 79	Farm Income Stat.	July 1977	40	1950-76
Broilers						
Production m. lbs. ready-to-cook wt.	139	B 52	Agri. Statistics	1976	402	1963-75
			Poultry & Egg Situation[1]	June 1977	22	1965-76
Exports m. lbs. ready-to-cook wt.	130	EXOG 43	Agri. Statistics	1976	402	1963-75
			Poultry & Egg Situation	June 1977	22	1965-76
Average price received by farmers $/lb.	164	B 73	Agri. Statistics	1976	402	1963-75
			Poultry & Egg Situation	June 1977	25	1965-76
Cash receipts m. $	172	B 80	Farm Income Stat.	July 1977	40	1950-76

Variable Name	File No. in UPDATE	File Name and No. in POLYSIM	Source for the Variable			
			Publication	Date	Page No.	Years
Turkeys						
Production m. lbs. ready-to-cook wt.	140	B 53	Agri. Statistics	1976	408	1963-75
			Poultry & Egg Situation	June 1977	22	1965-76
Exports m. lbs. ready-to-cook wt.	131	EXOG 44	Agri. Statistics	1976	408	1963-75
			Poultry & Egg Situation	June 1977	22	1965-76
Average price received by farmers $/lb.	165	B 74	Agri. Statistics	1976	408	1963-75
			Poultry & Egg Situation	June 1977	25	1965-76
Cash receipts m. $	173	B 81	Farm Income Stat.	July 1977	40	1950-76
Eggs						
Production m. doz.	141	B 54	Agri. Statistics	1976	414	1963-75
			Poultry & Egg Situation	June 1977	21	1965-76
Imports m. doz.	149	EXOG 28	Agri. Statistics	1976	414	1963-75
			Poultry & Egg Situation	June 1977	21	1965-76
Exports m. doz.	132	EXOG 45	Agri. Statistics	1976	414	1963-75
			Poultry & Egg Situation	June 1977	21	1965-76
Average price received by farmers $/doz.	166	B 75	Agri. Statistics	1976	412	1960-75
			Poultry & Egg Situation	June 1977	26	1965-76
Cash receipts m. $	174	B 82	Farm Income Stat.	July 1977	40	1950-76
Milk						
Production m. lbs. milk equiv.	142	B 55	Agri. Statistics	1976	364	1960-75
			Dairy Situation[1]	July 1977	5	1976-77
Imports m. lbs. milk equiv.	150	EXOG 29	Dairy Situation	May 1973	26	1960-72
			Dairy Situation	May 1977	22	1966-76
Exports m. lbs. milk equiv.	133	EXOG 46	Dairy Situation	May 1973	26	1960-72
			Dairy Situation	May 1977	27	1965-76
Average price received by farmers $/lb.	167	B 76	Agri. Statistics	1976	373	1963-75
			Agri. Prices Annual Sum.	June 1977	63	1971-76
Cash receipts m. $	171	B 83	Farm Income Stat.	July 1977	40	1950-76

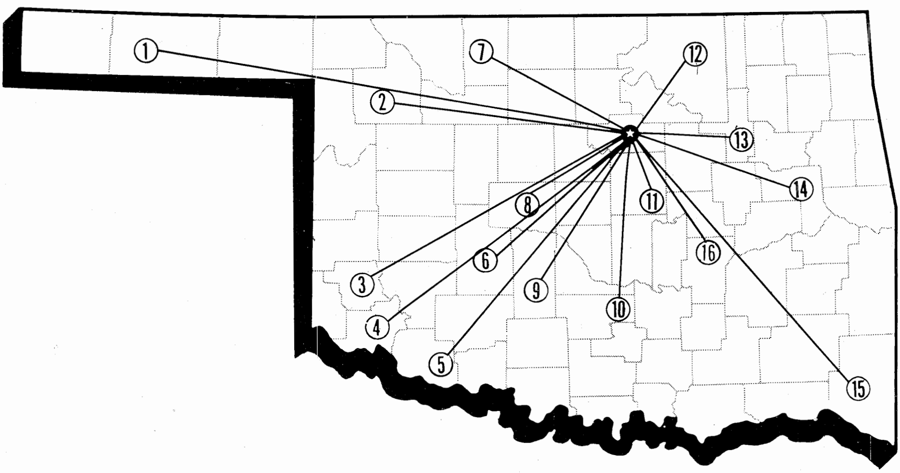
Variable Name	File No. in UPDATE	File Name and No. in POLYSIM	Source for the Variable: Publication	Date	Page No.	Years
Aggregate Livestock and Feed Variables						
Total cash receipts for all livestock m. $	176	B 88	Farm Income Stat.	July 1977	40	1950-76
Index of prices received by farmers for livestock and livestock product, 1910-14=100	240	B 99	Agri. Prices Annual Sum.	June 1977	7	1965-76
Livestock production numbers based on total concentrates fed m. units	143	B 85	Livestock & Feed Relation.[1]	1975	91	1952-74
Total concentrates fed m. t.	196	B 95	Feed Statistics	1972	2	1965-70
			Feed Situation	Sept. 1977	12	1975-77
High protein and other by-products fed m. t.	193	B 94	Feed Statistics	1972	40	1963-70
			Feed Situation	May 1977	34	1970-76
Rye fed to livestock m. t.	195	EXOG 22	Agri. Statistics	1976	17	1963-74
			Wheat Situation	Aug. 1977	32	1971-76
Hay and harvested roughage m. t.	255	B 161	Livestock & Feed Relation.	1975	98	1960-74
Average price of hay received by farmers $/t.	253	B 117	Feed Statistics	1972	58	1963-71
			Feed Situation	May 1977	29	1972-76
Index of prices paid by farmers for feed, 1910-14=100	239	B 101	Agri. Statistics	1976	456	1965-75
			Agri. Prices Annual Sum.	June 1977	19	1965-76
Aggregate Crop Variables						
Total crop cash receipts m. $	222	B 87	Farm Income Stat.	July 1977	41	1950-76
Government payments for non-model crops m. $	219	EXOG 35	Farm Income Stat.	July 1977	51	1950-76
Index of prices received for all crops 1910-14=100	246	--	Agri. Statistics	1976	454	1959-75
			Agri. Prices Annual Sum.	June 1977	7	1965-76
Index of prices received for all farm products 1910-14=100	256	B 107	Agri. Statistics	1976	454	1959-75
			Agri. Prices Annual Sum.	June 1977	6	1965-76
Index of prices paid for all production items 1910-14=100	257	--	Agri. Statistics	11976	456	1965-75
			Agri. Prices Annual Sum.	June 1977	19	1965-76
Aggregate Receipts and Expenses						
Total crop and livestock cash receipts m. $	224	B 89	Farm Income Stat.	July 1977	38	1950-76
Total government payments m. $	220	B 96	Farm Income Stat.	July 1977	51	1950-76
Total cash receipts and government payments m. $	225	B 90	Farm Income Stat.	July 1977	38	1950-76
Total realized non-money and other farm income m. $	227	B 97	Farm Income Stat.	July 1977	39	1950-76
Total realized gross farm income m. $	226	B 91	Farm Income Stat.	July 1977	30	1950-76
Total production expenses m. $	217	B 92	Farm Income Stat.	July 1977	30	1950-76
Realized net farm income m. $	228	B 93	Farm Income Stat.	July 1977	30	1950-76

[1]Additional historical data can be obtained from earlier issues.

OKLAHOMA

Agricultural Experiment Station

System Covers the State



Main Station — *Stillwater, Perkins and Lake Carl Blackwell*

1. Panhandle Research Station — *Goodwell*
2. Southern Great Plains Field Station — *Woodward*
3. Sandyland Research Station — *Mangum*
4. Irrigation Research Station — *Altus*
5. Southwest Agronomy Research Station — *Tipton*
6. Caddo Research Station — *Ft. Cobb*
7. North Central Research Station — *Lahoma*
8. Southwestern Livestock and Forage Research Station — *El Reno*
9. South Central Research Station — *Chickasha*
10. Agronomy Research Station — *Stratford*
11. Pecan Research Station — *Sparks*
12. Veterinary Research Station — *Pawhuska*
13. Vegetable Research Station — *Bixby*
14. Eastern Research Station — *Haskell*
15. Kiamichi Field Station — *Idabel*
16. Sarkeys Research and Demonstration Project — *Lamar*

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