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A producer oriented model for programming beef production

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by

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INTRODUCTION

The raising of beef cattle has long been an important aspect of Iowa farming. The native prairie grasslands provided lush forage for pioneer cattle. Livestock production made a natural supplementary enterprise as the prairies were plowed and turned to the growing of grain. The feeding of animals made good use of excess labor, particularly when there was little to do in the fields. Also, livestock provided a means to use forage and excess or poor quality grains that might otherwise have gone to waste.

Over the last forty years Iowa farming has slowly changed as new technology and changing demand has brought different opportunities and new challenges. With the development of hybrid corns closely matched to Iowa soils, corn acreage expanded rapidly. Coupled closely to the increased corn production were large increases in swine production and cattle feeding as the major consumers of the expanded corn supply. At the same time horses and mules were being replaced by tractors and trucks on Iowa farms, reducing the labor required for crop production, while freeing large amounts of forages that they had previously consumed. Beef cows were, along with sheep, the logical inheritors of this excess forage.

As Table 1 illustrates, live weight beef production in the United States has more than doubled since 1944, going from nineteen million to over forty-two million pounds, while the value of that production has zoomed from the 1934 depression low of five hundred million dollars, to nearly fifteen billion dollars in 1974. Even

Table 1. Beef production, marketing and income[a]

		Production		
		Value (million $)	Live wt. (million lbs)	Iowa rank among states
1934	U.S.	504	–	–
	Iowa	74	–	–
	%[b]	14.7		
1944	U.S.	2,083	19,012	
	Iowa	203	1,659	1
	%[b]	9.7	8.7	
1954	U.S.	4,138	26,156	
	Iowa	413	2,115	2[c]
	%[b]	10	8.1	
1964	U.S.	6,132	33,937	
	Iowa	601	2,937	2[c]
	%[b]	9.8	8.6	
1974	U.S.	14,907	42,736	
	Iowa	1,102	2,892	3[d]
	%[b]	7.4	6.8	

[a]Source: U.S. Department of Agriculture (45).

[b]Iowa as percentage of U.S.

[c]Texas was #1.

[d]Texas was #1; Nebraska was #2.

Marketing		Gross income	
Cattle 1000 head	Calves 1000 head	Million $	Iowa rank among states
22,696	12,123	717	
2,103			1
9.3	3.4	12.1	
24,330	12,988	2,636	
2,594	373	315	1
10.7	2.9	11.9	
30,563	15,464	5,195	
3,079	325	617	1
10.1	2.1	11.9	
40,532	12,145	7,920	
4,278	148	957	1
10.6	1.2	12.1	
48,496	9,454	18,387	
4,362	126	1,787	2[c]
9	1.3	9.7	

after adjusting the 1974 dollar figure for inflation the increase is tremendous. While Iowa's percentage of that production has slipped somewhat, Iowa is still one of the top three producers of beef and ranks second in gross income from beef production. Only Texas and Nebraska produce more beef than Iowa and only Texas has a higher gross income from that production.

To produce the ever increasing amount of beef produced in the last forty years, major changes were necessary, both in the technology of beef production and in the organizational structure. The technological changes were numerous and widespread, but were mainly of the labor substitution variety. Capital, in the form of machines and buildings, was substituted for labor. In addition, cattle of superior genetic types were introduced.

The major change in the organizational structure has been in the area of specialization, particularly in the grain fed cattle phase of beef production. Taking advantage of a favorable physical and financial climate and given an established feeder calf supply, huge feedlots were built in the Southwestern United States during the 1950's and 1960's. These were little less than beef factories that mass produced meat using many of the management techniques developed for factories. Their production efficiencies and economics of size, forced out of business many of the smaller producers within their areas and offered strong competition to the more traditional cattle finishing areas of the Midwest. However, their continual expansion was limited by the available supply of inexpensive feeds and feeder calves in the Southwestern region.

The onslaught of competition in cattle feeding forced Midwestern producers to seek greater efficiency in production. Nonetheless, due to the restraint imposed by a harsher climate, that efficiency was not to be found in simple imitation of the giant feedlots of the Southwest. Rather, continued and expanded production in the Midwest was based on the integration of traditional cattle raising within the total farm operation.

Table 2 delineates, on a district basis, what changes in production levels have occurred in Iowa in the last fifteen years. It is readily apparent that on a statewide basis, grain fed cattle marketings have increased very little.

In spite of the lack of change in the "Grain Fed Cattle Marketed" statistic for the total state between 1962 and 1975, there have been changes within the cattle finishing phase of beef production. The most significant of these changes are two interrelated trends. One trend is the shift in cattle feeding from the central districts of the state to the peripheral districts. The second trend is the increasing size of the individual finishing enterprise. As can be seen in Table 2, the central districts of the state are producing less fed cattle, while the peripheral districts are producing more. The North Central district suffered a 29 percent reduction in production, the Central district, a 20 percent reduction and the East Central district a 13 percent reduction in fed cattle marketings. At the same time, the Northwest district increased production 21 percent, the North Central district 23 percent and the South Central district increased production 25 percent.

Table 2. Production levels and percentage change in each of Iowa's crop reporting districts in 1962 and 1975[a]

District	Beef cows (1,000 hd.)			Grain fed cattle marketed (1,000 hd.)		
	1962	1975	% change	1962	1975	% change
Northwest	62	153	147	693	839	21
North Central	58	84	45	287	203	-29
Northeast	80	193	141	140	172	23
West Central	113	261	131	561	605	8
Central	117	182	56	394	317	-20
East Central	122	214	75	421	368	-13
Southwest	111	218	96	354	363	3
South Central	161	331	106	69	86	25
Southeast	104	199	91	137	145	6
State total	929	1835	96	3055	3097	1

[a]Source: Division of Agricultural Statistics (11), (12).

During the same period that the finishing of cattle has shifted to the periphery of the state, the size of the individual enterprise has increased. As illustrated in Table 3, the total number of feedlots in Iowa has decreased 47 percent between 1960 and 1974, while maintaining the same level of cattle fed. This decrease in feedlot numbers has occurred because small lots, especially "less than 100 head," and "100 to 300 head" size have gone out of business, while larger lots have been built. Feedlots with a "greater than 500 head" capacity,

Table 3. Feedlot size groupings of farms marketing fed cattle in Iowa[a]

Size groups (head capacity of feedlot)	1960		1970		1974		% change	
	No.	% of total	No.	% of total	No.	% of total	1960-1974	1970-1974
Less than 100 hd.	48,611	86.2	27,808	71.6	23,584	73.7	-49	-15
100-300 hd.	6,824	12.1	8,156	21.0	5,696	17.8	-17	-30
300-500 hd.	677	1.2	1,748	4.5	1,474	4.6	118	-16
Greater than 500	282	0.5	1,126	2.9	1,248	3.9	343	111
Total	56,393	100	38,838	100	32,092	100	-43	-17

[a]Source: Division of Agricultural Statistics (11), (12).

have been the fastest growing group, with an increase of 343 percent, between 1960 and 1974.

Beef cows which have nearly doubled in number in the same fifteen year period, are not subject to the same competitive pressure as feeder cattle. While they must compete with crop production for labor and management time during certain periods of the year, they do not compete for the feed grains raised. Their expansion is based mainly upon an expanded forage supply.

Improved pastures and harvested corn stover have made possible an expansion of beef cow numbers, even with a recent decline in total acres of forage crops. Beef cow expansion has also been facilitated by their low labor requirements during the crucial crop harvesting period and the prestige attached to cattle raising.

Today's Iowa beef producer is thus faced with both a great opportunity and a serious challenge. The opportunity comes with an expanding demand for beef, coupled with the producer's long experience in beef production, and a land base capable of producing both forage for cow-calf herds and the feed grains necessary for fed cattle. The challenge is to meet both the interregional competition of huge factory-like feedlots and the added local competition of other opportunities for the producer's time, money and managerial ability.

The first challenge can only be met by reducing the total cost of producing beef in Iowa. The second challenge can be met by integrating beef raising with other farm activities to take advantage of slack labor periods, cheap but nontransportable feeds, crop nutrient value of manure, etc. To accomplish these goals requires planning. Planning that will help reduce the cost of all phases of beef production and at the same time take advantage of any savings resulting from the complementary and supplementary nature of beef production as practiced in the Midwest.

One form of planning that can be used to minimize costs while choosing among several alternate production possibilities is computer modeling using a linear programming framework. That is the subject of this study.

REVIEW OF OTHER PRODUCER ORIENTED MODELS

There have been several models built in the past that allow beef producers to use their own data in developing optimum production plans to maximize profits from their limited resources and production constraints. In general these models tend to concentrate on one phase of production, either cow-calf or feedlot and tend to focus on a particular key problem within that phase.

Model for Programming Forage Supplies

In 1974 Craig Dobbins developed a forage planning model (13) at Iowa State University that is designed to help the beef cow producer maximize his net income from calf production. It is designed to minimize feed costs given his land base and other resources.

Since there are several different classes of land with many types of forages that can be grown on each, and various production methods for each forage type, Dobbins used a linear programming model to choose the best forage growing plan to meet the feed requirements of the beef cow herd. The linear programming model allows the farmer to define many different forage production systems that are possible on his land. Each forage system is individualized by the insertion of the farmers own costs for field preparation, seed, fertilizer and insecticide, harvesting, etc. The farmer also can define corn, soybean and grain sorghum production systems for the land classes suitable for their production. The model thus compares the profitability of using the land for grain production versus using the land for forage production. The computer also chooses whether the grain raised should be sold or fed to the beef cow herd. The nutritional needs of the cow herd are expressed in terms of monthly Total Digestible Nutrients (TDN) and Digestible Protein (DP). The model then solves for the maximum profit by minimizing feed costs throughout the year for as large a cow herd as fits the constraints of labor and feed availability, and managerial preferences.

Forage production, both costs and timing, is a major factor in beef cow herd profitability, while also being a major alternate use of land. This model is an attempt to optimize this key factor of production.

The model has the advantage of concentrating on a particular area where it can exhaustively choose among the possible options. In this way if the input form is carefully filled out, the producer can be confident that the results reflect the best option and because of the narrow focus most of the possible options within the area of study have been considered. However, because of the intense focus of the study the input form is quite long and requires a large amount of data to specify all the available options. This also makes the linear programming matrix large and hence increases the computer run time and costs. Also, since the focus is narrow, the program does not consider the integrative relationships between the cow herd and other beef phases or other livestock production systems. This tends to limit the programs use to those farmers whose situation or inclination excludes all options but feed grains and beef cow production.

Michigan State Teleplan

Michigan State University at East Lansing, Michigan has developed a series of computer models that can be used by farmers or researchers to solve a wide range of problems. The programs are accessible by specially equipped Touch-tone telephones. An authorization code and instruction manual may be obtained from the university. Several of the available computer programs are of use to beef producers, especially Teleplan 26: "Beef Feeder-Ration Selection Guide" (6a) Teleplan 30: "Beef Cow Herd Planning Guide" (5) and Teleplan 55: "Feeder Enterprise Planning Guide" (6b).

The Teleplan system has several advantageous features, foremost of which is its accessibility. Once you have learned how to use it and acquired the necessary instructions and forms, the computer is as near as your phone. This not only allows the user to control the input and check for obvious errors as the data is entered, but allows for quick correction if an inadvertent or unforeseen problem arises. The output is also returned immediately while you are still thinking about the problem and remember what assumptions you made and why. Normally this allows for a quicker review of the output for logical correctness and usability. If the answer does not seem logical or indicates that your original plan is not as good as you had hoped, you can make one or more adjusted analyses immediately, enhancing your plan or at least giving you more information as to why it should be abandoned or changed.

In a New York State study (32) that compared the Michigan State Teleplan System using Touch-tone phones, versus a mail-in system, it was this immediate turn around with opportunity for adjusted analysis that was considered the major advantage of the Touch-tone method.

At the present stage of communication technology this major advantage which makes the Teleplan system so attractive is also the limiting factor which reduces the effectiveness of the Teleplan models. Because all of the data must be laboriously keyed in on a telephone and all communication and output from the computer must come via audio the models have to be relatively simple with minimum output. Also since the user must be connected to the computer via telephone lines all the time he is inputing data, receiving results, deciding on changes and adjusting the analysis, the telephone costs tend to mount rapidly.

The result of this communication limitation is that the programs available tend to be either sufficiently simple that they can be solved quicker and cheaper with the new programmable hand calculators or they are too simple to realistically handle complex planning situations. Thus, while the Teleplan system is a valuable experiment and harbinger of future development, its full flowering must await the development of complementary communication equipment. Such equipment would reduce the time required and per unit cost, to send and receive data from individual remote terminals.

Least-Cost-Gain Ration and Profit Projection Program

Early in 1976 the Agricultural Economics and Animal Science Departments of the University of California, Davis developed a computer model (9) designed to help the beef feedlot operator minimize his cost of production by formulating a least-cost-gain ration given available feeds, their prices and other variable costs associated with fattening cattle in feedlots. Ration formulation plays a central role in profitable beef production. The model, by considering a daily charge for other variable costs not only optimizes for the least cost ration, but also that which gives the optimal rate of gain. It then utilizes the calculated optimal feed ration along with feed consumption and rate of gain to project weight gain, feed costs and other useful management information over specified intervals of the feeding period.

This information is useful for coordinating the marketing of the fat cattle for slaughter and for financing the feeding operation.

While this is an excellent program for solving least-cost ration problems, it is mainly designed for large feedlot operations where a major interest is ration composition and optimal feeding rates. For most Midwest beef producers with their land base and alternate uses for their labor and managerial ability, plus the wider options available to feed other types of beef or even other livestock, it is not a wide enough based planning tool.

STRUCTURE OF BEEF-OPT MODEL

The majority of beef producers in Iowa are looking for a broad based planning tool that considers all phases of their beef enterprise, while integrating them into their total farm plan. With this in mind the following model was developed. It considers beef cow-calf systems, calf backgrounding and feedlot finishing.

Objectives of the Model

The development of the Beef-Opt model required objectives to be established and priorities to be determined. The primary objectives considered in development of the Beef-Opt model are as follows:

1. Substitute computer time for human labor to minimize the cost, the number of computational errors and the reruns required.

2. Develop a program which is flexible, capable of handling fairly generalized data, and relatively easy to error check if computational problems such as singularities, cycling or unbounded or infeasible solutions should develop.

3. Minimize the amount of machine core required because of restricted access to the computer when core requirements exceed 128 K.

4. Minimize the amount of programming time and development costs.

5. Develop a system that is accurate and reliable.

6. Minimize the cost of an individual optimization.

The multi-stepped program as developed for processing is a three step program, consisting of source programs written in Fortran, MPSX and Fortran respectively (Figure 1). The "Phase 1" Fortran performs three functions:

1. Reads the input data from IBM cards and if requested by the "debug" card prints the input data in a format similar to the input form for comparison purposes.

2. Calculates and prints on temporary disk file the data-set which revises the original model to reflect the individual beef producers resources, costs, price and alternate production plans.

3. Sets up a temporary disk file to pass the input data to the third phase.

The "Phase 2" MPSX program performs three functions:

1. Check for infeasible or unbounded solutions.

2. Optimizes the alternate production activities using the original model revised with the individual producers data.

3. Prints the optimum solution in standard format on a temporary file to be passed to the third phase.

The "Phase 3" Fortran performs four functions:

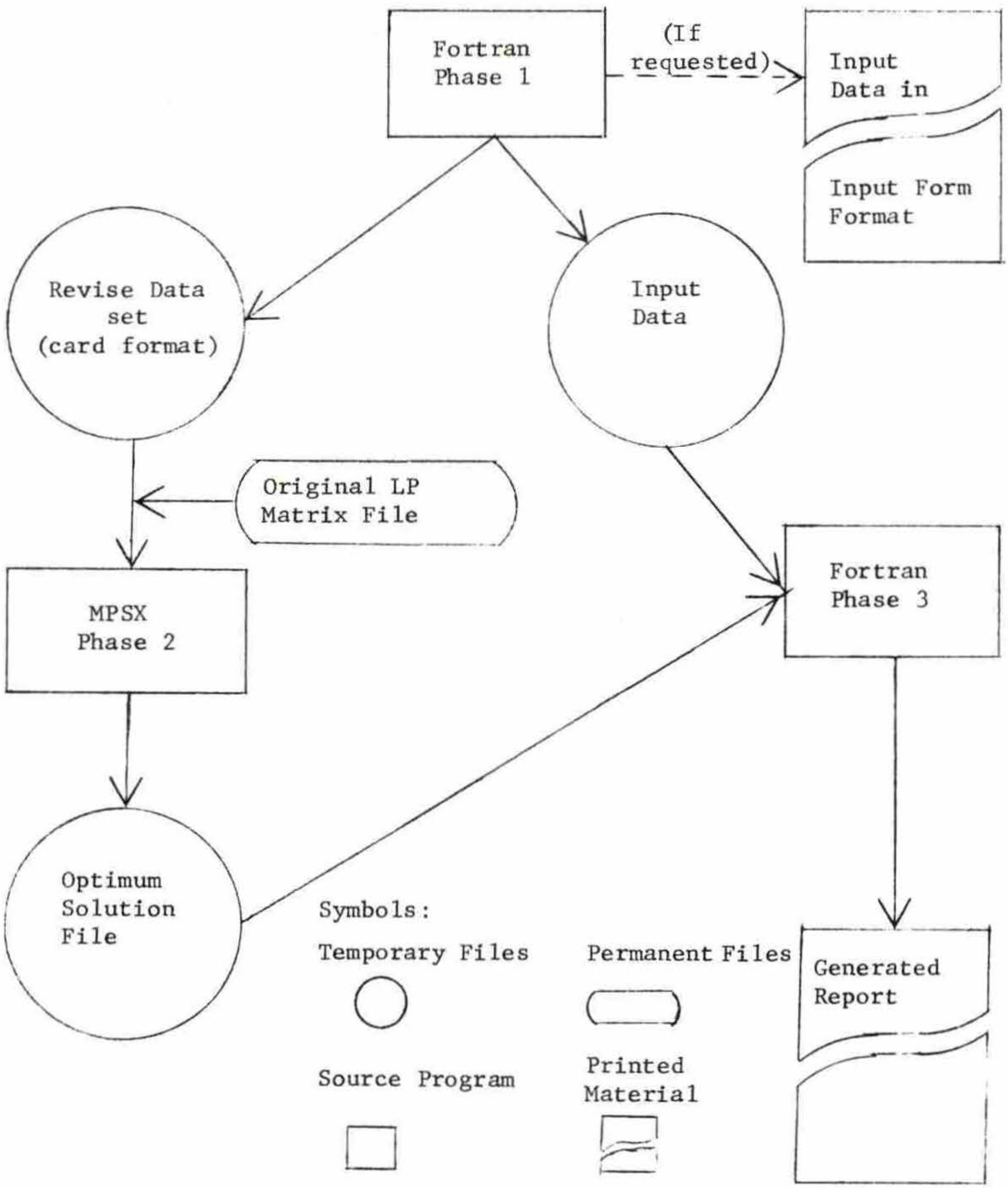
1. Reads the data passed from phases one and two.

2. Calculates and prints costs and returns information in a report format for each production activity that is in the optimal solution.

3. Calculates and prints the level of resource use and the associated costs.

4. Calculates and prints a summary of returns to management and investment.

Figure 1. Flow chart


Fortran
Phase 1
(If
requested)
Input
Data in
Input Form
Format
Revise Data
set
(card format)
Input
Data
Original LP
Matrix File
MPSX
Phase 2
Fortran
Phase 3
Optimum
Solution
File
Symbols:
Temporary Files
Permanent Files
Source Program
Printed
Material
Generated
Report

The first Fortran source program permits the substitution of computer time for human labor by reading the input data (keypunch on IBM computer cards from the input form) and developing the 500 to 1,000 cards needed to revise the original linear programming model to reflect the individual beef producer's data. Using the "original" structure permits the permanent storage of data within the LP matrix which does not change and sets up a generalized superstructure upon which the specific model of the individual producer can be built.

The MPSX algorithm produces program versatility in optimization and ease of eliminating computational problems such as singularly (automatically performed). It also checks for major errors in the revised matrix and unbounded or infeasible solutions. If a major error or an unbounded solution is found a message to that effect is printed and computation is stopped. If an infeasible solution is found, the row causing the infeasibility is printed with the error message and computation is stopped. Additionally since the algorithm has already been developed and tested, the time for programming is reduced and accuracy of computation is assured at the minimum computer cost.

The final source program combines the data from the first and second phase to write a report that can be read and understood by anyone capable of filling in the input form. This allows the beef producer to use the model as a planning tool without having to learn how to use a computer or to build and interpret a linear programming model.

The use of a three phase program allows the necessary region to be kept below 128K thus allowing unrestricted access to the Iowa State University computer throughout the day and the possibility of running the program on other computers with less core storage. However the use of three steps does have disadvantages. For example it is necessary to print on temporary storage files any information that is passed between phases. This requires the availability of temporary disc storage and results in data being reloaded into core at the start of each phase that would already be there if the whole program could be run as a single step.

Setup Procedures

Fortran source programs

The two Fortran source programs (Phase 1 and 3) were written and debugged in Watfive. Watfive was used because of its speed in compiling and sophistication of error messages. After being tested and debugged the Fortran source decks were compiled with the Fortran-G compiler, producing an object program. Then both the source programs and the object programs were placed on tape for permanent storage and ease of access. The object programs can be called directly and executed for each run, avoiding costs of compiling each time. Fortran G is used because its machine code permits fast and efficient execution.

MPSX

The basic "original" model was constructed, tested and placed on permanent tape under name "BEEFOP." The MPSX step (Phase 2) uses that file as a basis, revises it using the data passed from Phase 1 and then error checks and optimizes the revised model. The resulting solution is then passed to Phase 3 on a temporary disc file in standard format.

Linear Programming Matrix Structure

A linear programming matrix superstructure was constructed which would allow the testing of a wide variety of beef production systems. Since it was desired to keep the matrix reasonably small, only beef production activities were introduced directly. Crop production and other livestock raising activities typical of Iowa farms, and not having a direct bearing on the resources available to beef production, were left out of the matrix. However, provision was made to recognize their effect on resource constraints by allowing for their production at a fixed, predetermined level. Thus, labor used for crop production or other livestock, was subtracted from the total labor supply to arrive at the labor constraints for beef production. Similarly, crops available as feeds were fixed at a predetermined level by placing a maximum on the quantity available. Leaving out crop production and other livestock raising activities greatly reduced the size of the model and the amount of data necessary to individualize it. Unfortunately, it also reduced the emphasis on the integrative nature of cattle raising as a part of the whole farm operation. It would have been better, in certain cases, to model the whole farm as a unit, with beef production as a special segment. But, due to the variation in Iowa farms, a general farm model would have been too extensive to program and the required input form would have been too long and involved for the average farmer to handle. Therefore, it was decided that only beef operation would be modeled directly. This allowed the depth of specification necessary to provide results with a high degree of confidence.

After viewing the general practices on Iowa farms in beef raising, it was decided to break beef production into three general phases: cow-calf, backgrounding, and feedlot. This was done because there is a natural break in the beef cycle at weaning and again at the time yearlings come off pasture or are changed from a high roughage ration to a finishing ration. Also, established markets for feeders and yearlings made it possible to obtain purchase price data for the cattle needed in each of these production phases. Linear programming solves for an optimum level and mix of activities or processes to maximize profit. Thus, the activities of interest were alternate methods to raise beef within each of the three production phases.

Cow-calf production activities

Two cow-calf production activities were placed in the model (Table 4), each accompanied by selling activities for the calves and cull cows produced. The size of the present herd was entered as a resource constraint or as a Right Hand Side quantity. A cow buying activity also was defined to allow the program to supplement this present herd. The major constraints on cow-calf production were considered to be feed, labor and facilities. The feed constraint was

Table 4. Structure of activities and constraints for the first two cow-calf production options[a]

Constraints	Activities[b] BCOW1	CC1	CC2	SHC1	SSC1	SCUL1	RHS
C	-()[c]	-()		+()	+()	+()	—
COW1	-1	1					+()
TCOW1		1	-1				0
FCP, FCN		1					0
LJF-ND		+()					+()
C1DM		-()					0
C1N		-()					0
C1E		-()					0
C1P		-()					0
C2DM			-()				0
C2N			-()				0
C2E			-()				0
C2P			-()				0
HC1		-()		1			0
SC1		-()			1		0
CUL1		-()				1	0
UP BND	+()	+()					
LO BND		+()					

[a]Second set of cow-calf production activities have a similar set of constraint coefficients differing only in row and column names.

[b]See Table 5 for meaning of row and column names.

[c]+(), -() coefficient supplied by revise procedure from information taken from the input form.

Table 5. Meaning of Table 4 activity and row names

Rows	
C	Objective function
COW1	Constraint on cow herd size
TCOW1	Transfer row that assures that for each lactating cow produced a dry cow will be fed. Unit 1 head.
FCP, FCN	Transfer rows to supply facilities of either present or new type. Unit 1 headspace.
LJF-ND	Labor supply constraint for each of six two month periods starting with January-February. Unit 1 hour.
C1DM	Dry matter maximum constraint for lactating cow. Unit 1 Kg. dry matter.
C1N	Total digestible nutrients (TDN) minimum constraint for lactating cow. Unit 1 Kg. TDN.
C1E	Metabolizable energy (ME) minimum constraint for lactating cow. Unit 1 Mcal ME.
C1P	Digestible protein (DP) minimum constraint for lactating cow. Unit 1 Kg. DP.
C2DM	Dry matter maximum constraint for dry cows. Unit 1 Kg. dry matter.
C2N	TDN minimum constraint for dry cows. Unit 1 Kg. TDN.
C2E	ME minimum constraint for dry cows. Unit 1 Mcal ME.
C2P	DP minimum constraint for dry cows. Unit 1 Kg DP.
HC1	Transfer row for heifer calves. Unit 1 head.
SC1	Transfer row for steer calves. Unit 1 head.

Table 5. Continued.

Rows	
CUL1	Transfer row for cull cows. Unit 1 head.
UP BND	Upper bounds or maximum value the activity is allowed to attain.
LO BND	Lower bounds or minimum value the activity is allowed to attain.
COLUMNS	
BCOW1	Cow buying activity. Unit 1 head.
CC1	Cow-calf production activity. Unit 1 cow-calf with associated herd bull and replacement heifer.
CC2	Dry cow feeding activity. Unit 1 cow.
SHC1	Heifer calf selling activity. Unit 1 head.
SSC1	Steer calf selling activity. Unit 1 head.
SCUL1	Cull cow selling activity. Unit 1 head.
RHS	Right hand side or B column.

defined by a dry matter maximum and an energy and protein minimum. This was done so that the model would choose the least cost feeds to meet these needs. Since feed costs are normally a major part of the costs involved in beef production, the model's ability to choose among the available feeds for the least cost ration is one of its major advantages.

Due to the considerable difference in feed requirements during lactation and when the cow is dry, the feed constraints were broken into two segments. This was also done in order that the timing of grazing, that is often a major component of beef cow feeds, could be dealt with.

The labor required for handling beef cows varies during the year depending on whether calves are being born, cows are being bred, calves are being weaned, etc. Therefore, to recognize this variance in labor demand, the labor constraint was broken into six two-month periods. This again allowed considerations of timing to enter, at least implicitly, into the model.

The need for buildings, fences and equipment to care for a cow herd was recognized by the addition of a facilities constraint. This constraint was in the form of either one-headspace of present facilities, if the buildings and equipment were already available, or one-headspace of new facilities. The new facilities option was introduced to allow for buying a set of buildings and equipment upon entering cow-calf production for the first time, or as a major expansion. Only one of the two constraints are binding for each management system. It was decided not to allow them to supplement each other, due to the likelihood of differences in labor requirements and feed use efficiencies inherent in different types of facilities.

The sum of the variable costs for veterinary supplies, power and lights, etc., is used as the objective function value. Fixed costs, such as the investment value of the cow, were not considered by the model due to the nature of the model and the short, one year, planning horizon it encompasses. Replacement costs are considered by cull cow selling, death loss and saving replacement heifers.

Separate transfer rows were built for heifer calves, steer calves and cull cows for each production system. This allowed for the level of output to be set separately so that replacement heifers could be kept back. Also they must be able to be picked up separately by the backgrounding and feedlot sections of the model and by the different selling activities.

A selling activity was defined for each group of steers, heifers and cull cows transferred from the production systems. The steer and heifer selling activities allowed for the normal difference in price between them to be recognized. The selling activities also allowed the model to choose between selling the calves at weaning or transferring them to a backgrounding or feedlot production system.

The cull-cow selling activity was defined for the convenience of the revise program, as it assures that the C-row value for the production activity will always be negative. Also, it makes revenue accounting easier for final output considerations.

Bounding constraints, both upper and lower, for the production activities and upper only for the cow buying activity, were also added. This allowed for any management constraints not otherwise recognized to be imposed. For instance, if there was a limit on capital available to invest in new cows, this could be handled by limiting the cow buying activity. Also, if there was a particular herd size or range of herd sizes that was desired, whether profitable or not, this would allow that management decision to be imposed.

Backgrounding production activities

Four backgrounding production activities were placed in the model, each accompanied by a buying activity and a selling activity (Table 6). Backgrounding calves at a lower average daily gain before putting them into the feedlot is a widespread practice in Iowa. It was decided to have four systems in the model so that options with different weight, sex and grade of calves could be tested as alternatives.

A calf buying activity was defined for each system with an objection function value equal to the cost of one calf. This activity was separated from the production activity so that calves transferred from the cow-calf systems could also be considered.

The requirements for each production unit of one head are: (1) a calf, either from the calf buying activity or cow-calf production activities, (2) a headspace of backgrounding facility, (3) labor, and (4) feed in the form of energy and protein.

The facilities constraint was again divided into present or new type to allow a broad set of possible conditions and options to be modeled. One of the two constraints is applied to each production activity but not both.

Table 6. Structure of activities and constraints for first of four backgrounding phase production options[a]

Constraints	Activities[b]			RHS
	BFRB1	BK1	B1S	
C	-()[c]	-()	+()	
B1	-1	1		0
FBP-FBN		1		0
LJF-ND		+()		+()
B1DM		-()		0
B1M		-()		0
B1G		-()		0
B1P		-()		0
SB1		-()	1	0
UP BND		+()		
LO BND		+()		

[a]Second through fourth backgrounding production activities have a similar set of constraint coefficients differing only in row and column names.

[b]See Table 7 for meaning and units of rows and columns.

[c]+(), -() coefficients supplied by the revise procedure from information taken from the input form.

Table 7. Meaning of Table 6 activity and row names

<u>Rows</u>	
C	Objective function.
B1	Transfer row for incoming calves. Unit 1 head.
FBP-FBN	Facilities transfer rows, either present or new type. Unit 1 head space.
LJF-ND	Labor supply constraint for each of six two month periods. Unit 1 hour.
B1DM	Dry matter maximum constraint for first backgrounding activity. Unit 1 Kg. dry matter.
B1M	Net energy for maintenance (NEm) minimum constraint for first backgrounding activity. Unit 1 Mcal NEm.
B1G	Net energy for gain (NEg) minimum constraint for first backgrounding activity. Unit 1 Mcal NEg.
B1P	Digestible protein (DP) minimum constraint for first backgrounding activity. Unit 1 Kg. DP.
SB1	Transfer row for outgoing cattle. Unit 1 head.
UP BND	Upper bounds or maximum value activity is allowed to attain.
LO BND	Lower bounds or minimum value activity is forced to attain.
<u>Columns</u>	
BFRB1	Feeder buying for first backgrounding activity. Unit 1 head.
BK1	First backgrounding production activity. Unit 1 head.
B1S	Selling activity associated with first backgrounding production. Unit 1 head.
RHS	Right hand side or B column.

The labor requirement is specified by a set of six constraints, each representing a two month period. This allows for narrowly defining the labor needed as to time of year. If there are periods during the year when the activity would not be operating, the constraint requirement for that period is set to zero.

The feed requirement is specified by a maximum constraint on dry matter intake, a minimum constraint on net energy for maintenance (NEm) and net energy for gain (NEg) and a minimum constraint on digestible protein (DP). These constraints as a group define a ration for the calves specified in the production system.

Variable costs, except for feed, are entered as the C-row value. Cattle are transferred out of the production system to either a selling activity or a feedlot system, whichever is the more profitable. Upper and lower bounds are available for each production system to handle management constraints other than those specified by the model.

Feedlot production activities

Six feedlot production activities were placed in the model, each accompanied by a buying activity (Table 8). There are many possible alternate types, weights and grades of calves and yearlings that can be fed to market weight in a feedlot. Therefore, it was felt that at least six alternate systems should be available to test against each other and against cow-calf and backgrounding systems. A cattle buying activity was defined for each system in order to allow both purchased cattle and transfers from cow-calf or backgrounding systems to be considered in each production system.

Table 8. Structure of the activities and constraints for first of six feedlot phase production options[a]

Constraints	Activities[b] BFRF1	F1	F1SC1[c]	RHS
C	-()[d]	+()		
F1	-1	+()	-1	0
F1SC1[e]		-1	1	0
FFP-FFN2		1		0
LJF-ND		+()		+()
F1DM		-()		0
F1M		-()		0
F1G		-()		0
F1P		-()		0
F1UR		-()		0
UP BND		+()		
LO BND		+()		

[a]Second through sixth feedlot production activities have a similar set of constraint coefficients differing only in row and column names.

[b]See Table 9 for definitions of row and column names.

[c]Example of added transfer column creating transfer path for steer calf from cow calf system one to feedlot one.

[d]+(), -() coefficients supplied by revise procedure from information taken from the input form.

[e]Example of added constraint restricting number of steer calves that can be transferred from cow calf production system one to feedlot system one.

Table 9. Meaning of Table 8 activity and row names

Rows	
C	Objective function.
F1	Transfer row for incoming cattle. Unit 1 head.
F1SC1	Calf transfer constraint. Unit 1 head.
FFP-FFN2	Facilities transfer rows, either present or one of two new types. Unit 1 head space.
LJF-ND	Labor supply constraint for each of six two month periods. Unit 1 hour.
F1DM	Dry matter maximum constraint for first feedlot activity. Unit 1 Kg. dry matter.
F1M	Net energy for maintenance (NEm) minimum constraint for first feedlot activity. Unit 1 Mcal NEm.
F1G	Net energy for gain (NEg) minimum constraint for first feedlot activity. Unit 1 Mcal NEg.
F1P	Digestible protein (DP) minimum constraint for first feedlot activity. Unit 1 Kg. DP.
F1UR	Urea maximum constraint for first feedlot activity. Unit 1 Kg. urea.
UP BND	Upper bound or maximum value activity is allowed to attain.
LO BND	Lower bound or minimum value activity is forced to attain.
Columns	
BFRF1	Cattle buying for the first feedlot production activity. Unit 1 head.

Table 9. Continued.

Columns	
F1	First feedlot production activity. Unit 1 head-year. (i.e. 1 head multiplied by the number of times the feedlot is turned per year.)
F1SC1	Transfer column used to move calves from output of cow calf or backgrounding to input of feedlot. Unit 1 head.
RHS	Right hand side or B column.

Each feedlot production activity is defined as feeding one head times the number of turns per year. This was done because the planning horizon for the model was one year but many feeders, especially if they are only finishing yearlings, turn out two or more batches a year. Thus, with any other definition, it would have been very hard to handle year-round operations. However, this definition does cause some problems for the model, since the unit of activity for each cow-calf and backgrounding system is one head turned one time per year. The problem arises when the model transfers cattle from a one-turn cow-calf or backgrounding system to a multi-turn feedlot system. For example, it might be profitable to background a hundred head of steers and then finish them in a feeding system that turns twice in a year. Without an added constraint to force the system to feed them all at one time, the model might call for them to be fed in two groups of fifty. Therefore, provision was made to add a constraint row, restricting the number of cattle that could be transferred into a feedlot production activity from any one backgrounding or cow-calf activity to the number of times that feedlot activity enters the solution. These constraint rows are added along with the cattle transfer columns by the revise procedure. Only the transfer columns and transfer constraint rows called for in the input form are added to the working matrix for each individualized solution. This was done to keep the size of the matrix down and to add only those transfer paths that are to be considered in each individualized model.

It was assumed that all cattle out of the feedlot would be marketed, therefore selling was incorporated within the production activity. The revenue from marketing less variable costs is used to generate the C-row coefficient.

The requirements for each production unit are cattle, facilities, labor and feed in the form of energy and protein. The facilities constraint was divided into three possible constraints, only one of which is binding on any one production activity. The three constraints are: a constraint on the present type of feedlot facilities and constraints on each of two new and different types of feedlot facilities. The labor constraints are the same as for backgrounding production activities and serve the same purpose. The feed requirement is specified by a maximum constraint on dry matter intake, a minimum constraint on net energy for maintenance (NEm) and net energy for gain (NEg), and a minimum constraint on digestible protein (DP). There is also a constraint on the maximum amount of protein that can be furnished by urea.

Upper and lower bounds are again available to handle individual management constraints not otherwise specified.

Feed supplying activities

A series of feed buying activities were developed to furnish the nutrients required by the various production activities. Since it was important to provide as much linkage as possible to the crop production that takes place on most Iowa beef farms, two buying activities were developed for each feed. This allowed a different price to be placed on home grown feed compared to the same feed bought commercially. To make the differentiated price structure work and to reflect the real situation, a bounding constraint was added to place a maximum limit on the amount that could be purchased under each price.

Due to the general nature of the model, a wide selection of feeds were represented. See Appendix C for a complete list of feeds included. These were broken into several categories. The first of these was grains, which include corn, ground whole ear corn, sorghum, oats, barley, wheat and grain screenings. Not all of these grains were expected to be available to any one individual at any one time. However, it was felt that all of them could be available in different situations, as they all have been fed to beef cattle in Iowa in the past.

There are so many different types and mixtures of hay fed to beef cattle that it was impossible to provide buying activities for all. Also it was not considered necessary, since most hays have similar nutrient values. The main difference is in the protein content. Therefore, except for alfalfa, which is widely fed, all hay bought was divided into legume, legume-grass and grass hay. Hays were considered legume if they contained more than 70 percent legumes, legume-grass if they contained between 30 to 70 percent grasses and grass if they contained more than 70 percent grass.

The silage buying activities were divided into corn, corn stover, sorghum, sorghum-sudangrass, oat, legume and legume-grass. Even though most silages are home grown and there is no real commercial market from which they can be purchased, two buying activities were still defined for each, partially for reasons of symmetry in the matrix and input form, and also to allow for buying from neighbors or growing on rented ground where costs of production would be higher.

Buying activities for three supplements were included: soybean oilmeal, a 30 percent protein mix and urea. There are numerous commercial supplements on the market that could have been defined in the supplement buying activities, but it was felt that most are composed of a mix of natural protein such as soybean oilmeal and urea. Therefore, given these three, the farmer would be able to adequately define his supplement.

Roughages, in the form of crop residue, are available to many Iowa farmers. To reflect this fact, buying activities were defined for ground corn cobs, corn stover, soybean stover, and small grain straw. The buying cost for these roughages would be the added cost necessary for their utilization, such as stacking, storage and feeding costs.

Pasture and grazing buying activities were especially hard to define, as there is so much variation in pastures, in plant type and particularly in moisture content and yield. Therefore, it was decided to define the pasture buying activities in tons of dry matter and develop a guide table in the input form, to help the farmer translate acres or animal unit months (of pasture) into tons of dry matter. Again, the various plant types possible were grouped into legume, legume-grass and grass categories with the same working definitions as for hay. Cornstalk aftermath and winter wheat grazing buying activities were also defined in this segment in tons dry matter, as these are important sources of grazing in some areas of the state.

The cost per unit to buy each of these feeds was entered as the C-row value. The buying unit, bushels for grain and tons, or tons dry matter, for all other feed, was translated into kilograms dry matter in the appropriate transfer rows and transferred to sets of activity columns where the particular feed was translated into its equivalent nutrient values. The feed buying matrix is illustrated in Table 10.

Nutrient translation activities

Each production activity had to have its own set of translating columns so that a count could be kept of which feeds, and how much of each were used by that particular production activity. Also, since the nutrient requirements of dry cows are different from those of lactating cows each cow-calf system has two sets of nutrient requirements specified. This also allowed timing of pasture and grazing to be considered in the model. Thus, it was possible to drop a particular feed translation column out of a set, removing its possibility of contributing to the nutrient requirements of the production activity which that set represented. For example, in a certain cow-calf system cornstalk aftermath grazing might only be available while the cows were dry. Thus, by dropping the translation column for cornstalk aftermath in the lactating cow set, cornstalk aftermath would be removed from consideration as a possible feed source to meet the nutrient requirements of the lactating cow.

By this same method, the model does not allow any feedlot system's nutrient requirements to be met by pasture and grazing since by definition, feedlot cattle do not graze. Also, urea is restricted only to

Table 10. Illustration of the structure used to meet nutrient requirements through feed buying using corn grain as an example

Constraints	Activities[a]				
	CGB	CGC	C1CG	P1CG	F1CG
C	-()[b]	-()			
CG	-22.61	-22.61	1	1	1
C1DM			1		
C1E			3.29		
C1N			0.91		
C1P			0.075		
F1DM				1	1
F1M				2.28	
F1G					1.48
F1P				0.075	0.075
UP BND	+()	+()			

[a]See Table 11 for meaning of row and column names.

[b]+(), -() coefficient supplied by revise procedure from information furnished by the input form.

Table 11. Meaning of Table 10 activity and constraint row names.

Rows	
C	Objective function.
CG	Corn grain transfer row. Unit 1 Kg. corn grain, dry matter basis.
C1DM	Dry matter maximum constraint for lactating cow in first cow-calf system. Unit 1 Kg. dry matter.
C1E	Metabolizable energy (ME) minimum constraint for lactating cow in first cow-calf system. Unit 1 Mcal ME.
C1N	Total digestible nutrients (TDN) minimum constraint in first cow-calf system. Unit 1 Kg. TDN.
C1P	Digestible protein (DP) minimum constraint for lactating cow in first cow-calf system. Unit 1 Kg. DP.
F1DM	Dry matter maximum constraint for first feedlot system. Unit 1 Kg. dry matter.
F1M	Net energy for maintenance (NEm) minimum constraint for first feedlot system. Unit 1 Mcal NEm.
F1G	Net energy for grain (NEg) minimum constraint for first feedlot system. Unit 1 Mcal NEg.
F1P	Digestible protein (DP) minimum constraint for first feedlot system. Unit 1 Kg. DP.
UP BND	Upper bounds or maximum value activity is allowed to attain.
Columns	
CGB	Corn grain buying activity at price one. Unit 1 bu. #2 corn.
CGC	Corn grain buying activity at price two. Unit 1 bu. #2 corn.

Table 11. Continued.

Columns

C1CG	Activity changing corn grain into its nutrient equivalent for use by lactating cow in first cow-calf system. Unit 1 Kg. corn grain, dry matter basis.
F1CG	Activity changing corn grain into its nutrient equivalent for use in maintaining cattle in first feedlot system. Unit 1 Kg. corn grain, dry matter basis.
F1CGG	Activity changing corn grain into its nutrient equivalent for use in cattle gain in first feedlot system. Unit 1 Kg. corn grain, dry matter basis.

feedlot cattle, as its use is not recommended for calves below six-hundred pounds.

Feeds were translated into Total Digestible Nutrients (TDN), Metabolizable Energy (ME), and Digestible Protein (DP) for cow-calf systems and Net Energy for Maintenance (NEm), Net Energy for Gain (NEg) and Digestible Protein (DP) for backgrounding and feedlot systems. This was done to reduce the individual feeds to a general supply of nutrients defined in the common definitions of energy and protein. The production activities draw energy and protein from this general supply and thereby cause those feeds which can supply the nutrients at the least cost to be bought. See Appendix A for the nutrient values for each feed.

The net energy system used for backgrounding and feedlot systems presented a problem in nutrient translation. The problem being that feed energy used for maintenance cannot be used for gain and the value of a feed as a supplier of maintenance energy is not the same as the value of the same feed as a supplier of gain energy. The problem was solved by defining two sets of feed translation columns for each backgrounding and feedlot production activity, one for meeting the maintenance requirement and one for the gain requirement. Both contribute toward meeting the protein requirement and are constrained by the same dry matter maximum.

Labor hiring activity

The labor requirements of the various production activities are met in two ways (Table 12). First, all the labor of the operator and

Table 12. Illustration of structure used to meet labor requirements

Constraints[b]	Activities[a]			RHS
	LJFH	LMAH...	LNDH	
C	-()[c]	-()	-()	
LJF	-()			+()
LMA		-()		+()
LND			-()	+()
UP BND	+()	+()	+()	

[a]Each activity is a hiring activity furnishing one hour of labor for the particular two month period. RHS operator and permanent hired labor available entered as a Right Hand Side in one hour units.

[b]Meaning of rows:

C Objective function.

LJF-LND Constraint on the number of hours available during each of six two month periods. Unit 1 hour.

UP BND Upper bounds or maximum value activity is allowed to attain.

[c]+(), -() coefficients supplied by revise procedure from information furnished by the input form.

his family, plus any permanently hired labor that is available to the beef operation for each two month period is entered as a Right Hand Side value for each period's constraint row. Then, as a way to supplement this labor, labor hiring activities were defined for each labor period. This allows hourly labor to be hired as needed at different times during the year. The cost per hour to hire labor is entered as the C-row value and whatever limit there is on the amount hirable, is entered as an upper bound.

Facilities supplying activities

The facilities necessary to carry on any of the various production activities are supplied on a headspace basis by a series of facilities buying activities (Table 13). Each of the three major phases, cow-calf, backgrounding and feedlot have an activity to supply present, addition-to-present and new facilities for that phase. The variable cost associated with a headspace of the presently owned facility such as power, utilities, repairs, etc., is entered as the C-row value. To assure that presently owned facilities will be used before addition-to-present type, which furnishes units to the same transfer row, the fixed costs for one year associated with each addition-to-present headspace is added to the variable cost to arrive at the C-row value for addition-to-present facilities. New type facilities include both fixed and variable costs to arrive at the C-row value, as it was felt that the production activity should meet all costs, at least over the planning horizon of one year, before a plan that required building new facilities would be optimal.

Table 13. Illustration of the structure used to meet facilities requirements using cow-calf facilities as an example

Constraints[b]	Activities[a]		
	FCP	FCPA	FCN
C	-()[c]	-()	-()
FCP	-1	-1	
FCN			-1
UP BND	+()	+()	+()

[a]Meaning of activities:

FCP Supplying one unit of cow-calf facilities of the present type.

FCPA Building one additional unit of cow-calf facilities of the present type.

FCN Building one unit of cow-calf facilities of a new type.

[b]Meaning of rows:

C Objective function.

FCP FCN Transfer rows for cow-calf facilities of a particular type. Unit 1 headspace.

UP BND Upper bound or maximum value activity is allowed to attain.

[c]+(), -() coefficient supplied by revise procedure from information furnished by the input form.

The feedlot phase has two facilities buying activities, as there is more information available on performance differences and labor requirements of different feedlot facility setups. By having two new types of facilities defined, it is possible to test feedlot investment decisions against each other within the total beef operation, enhancing the flexibility and usability of the model.

Maximum size limits, on what is presently available and on what management is willing to build, are entered as upper bounds.

METHODOLOGY AND ASSUMPTIONS USED FOR INDIVIDUALIZATION OF THE MODEL

As introduced in the previous chapters, the computerized procedure used to create individualized solutions is a three step program. The first step is a Fortran source program that uses the information provided by the farmer in the input form to generate new resource and production coefficients for each farm. The second step uses these generated coefficients to revise the L.P. matrix prior to optimization of the model by the MPSX routine. Step three is another Fortran source program which compiles and prints the results in a manner that can be easily understood by its user, the farmer.

The special input form designed to collect the information necessary to individualize the prestructured L.P. model is illustrated in Appendix C. This information can be directly punched onto cards and read by the first Fortran program for generation of new resource and production coefficients. By using this form and the accompanying instructions (Appendix B) the farmer can furnish all the data necessary to make the model reflect his particular resource situation and beef production opportunities. The input form has been divided into six sections, each relating to a different beef production activity or resource availability situation. A discussion of each part follows.

First the input form elicits the name and address of the person filling in the form and the date. This information is passed to the report writer program to assure proper identification of results.

Resources Available

Feeds

Section 1 lists thirty feeds commonly available in Iowa. The farmer is asked to fill in the price, at the feedbunk, for all the feeds from the list that he raises on his farm or can purchase for use in his beef operation. If he is limited to a quantity available at a specified price, as he will be for most homegrown feeds, he also enters that limit. A moisture correction table and formula is given in the input instructions to help the farmer establish a correct price and quantity of corn grain, since corn is the main ingredient in many Iowa feeding programs. Since the price and maximum quantity data is required to be entered on an at-the-point-of-feeding basis, formulas and a table of suggested values are given to adjust for storage, spoilage and wastage.

A third table with estimated yield of common Iowa forages is attached to the input instructions to help calculate hay quantities and to assist in translating pasture acreage into the required Tons of Dry Matter. This table is broken into legume, legume-grass and grass segments to match the scheme used in the input form. This table also furnishes a rough guide for translating Animal Unit Months (AUM) into Tons Dry Matter if the farmer is more familiar with that system of pasture measurement.

Feed prices enter the L.P. model as C-row values with the maximum quantity data being entered as upper bounds on that feed buying activity. All feeds left blank are deleted from the model.

The feeds are translated internally to kilograms of Dry Matter and Protein, Mcal of TDN and ME for cow-calf use or Mcal for NEm and NEg for backgrounding and feedlot use.

Each cow-calf, backgrounding and feedlot system has its own set of nutrient translation columns so that certain feeds can be deleted from use by a particular production system and so the amount of kilograms of each feed used by a particular production system can be counted.

Labor

The second section deals with labor. The year is broken into six two-month periods. For each period, the farmer enters the maximum amount of labor he has available for his beef operation. He does this by summing his own labor, family labor and permanent hired labor that can be used in each period. Operator, family and permanent hired labor are considered fixed in supply and thus a fixed cost is charged for their use. The fixed cost is not part of the production input cost. However, it is used by the report writer program to arrive at a return to management after paying these fixed labor costs. If the farmer is able to hire part time hourly labor to supplement his fixed labor supply during any or all periods, he enters its cost per hour and the maximum hirable hours for those periods. If he cannot hire additional help during any or all periods, the resulting blanks will be interpreted by the computer as a command to delete those labor hiring activities from the L.P. model during the revise procedure.

Facilities

Section 3 summarizes the buildings and facilities currently available and describes additional units which the operator can, and is willing to acquire. The facilities section is subdivided into three segments: cow-calf, backgrounding and feedlot, to match the segmentation of the production activities. Each segment has a series of questions designed to elicit information about the present buildings and facilities available. Opportunities are provided for adding new facilities of the type the farmer now has or he can add new buildings and facilities of a different type.

Only the variable cost enters the L.P. model as the C-row value for the present type while the yearly fixed cost is added to the variable cost to form the C-row value for addition-to-present and new type facilities. The headspaces available and maximum willing-to-build figures are entered as upper bounds. The designated name and fixed and investment cost figures do not enter the L.P. model but are passed directly to the report writer program to be used in the output report. If the farmer does not have any facilities for a particular phase of production, or does not wish to build any new facilities, he simply leaves the designating name space blank and the computer will delete that facilities buying activity from the model during the revise procedure.

Production Systems Definition

The last three sections of the input form (sections 4, 5 and 6) elicit the data necessary to individualize the production activities which are the heart of the model. Each section deals with a different cattle production phase, but they all have the same basic structure.

Cow-calf systems

Section 4 deals with the cow-calf phase of production. One or two management systems can be defined using the same cow herd as a base. If the farmer is not interested in cow-calf production, he leaves the two system designation names blank. The first Fortran program then deletes all rows and columns in the L.P. matrix dealing with cow-calf operations during the revise procedure. If the farmer does wish to consider cow-calf production, he designates his alternate management plans with a name and fills in the accompanying data columns.

The herd is described, first by the number of cows presently in the herd, second by cost of and willingness to invest in additional cows, and third by the weight of an average mature cow. The present size of the cow herd enters the matrix as the Right Hand Side value of the cow constraint row. The variable costs associated with buying additional cows become the cow buying activity C-row value. The investment value of additional cows is considered a fixed cost and is not added into the C-row. The cow buying activity is upper bounded at the maximum number of cows the farmer is willing to add. The weight of the mature cows is used when the feed requirements for each management system are developed and to establish the value of cull cows sold.

Feed requirements are not stipulated by the farmer in the input form, but are derived from the input data by two subroutines in the first Fortran program.

The first subroutine contains a series of formulas to calculate the cow-calf production systems' nutrient requirements. The requirements are calculated in Kg of TDN, Mcal of ME, Kg of Dry Matter and Kg of DP. The formulas for the cow, both lactating and dry, and for the herd bull are adopted from a paper by Ewing (17). The requirements for the calf and replacement heifer are calculated by the second subroutine and then translated into TDN and ME to be summed in the first subroutine. The second subroutine (page 59) which also calculates the requirements for the cattle in the backgrounding and feedlot production systems, is used because calf and replacement requirements are dependent on gain, along with weight. The formulas in the second subroutine have gain as a parameter. They are adapted from the National Research Council publication on nutrient requirements of beef cattle and will be defined in the Backgrounding and Feedlot Systems section.

The requirements for the cow-calf systems were divided into two parts. First, the requirements during lactation were defined. The lactation period was defined as the average number of days between birth and weaning age. Second, the requirements during the period the cow is dry and pregnant were defined. This period was defined as 365 days minus the lactation period.

The requirements for the cow during the lactation period were computed as follows. Milk production was assumed to be 14 lbs. of 4 percent FCM daily. Energy requirements were specified by minimum Kg of Total Digestible Nutrients (TDN) and minimum Megacalories of Metabolizable Energy (ME). The formula for TDN is:

$$TDN = (7.149 + 0.0053\ WT) \times DAYS \times EFF \times 0.4536$$

Where:

WT = Weight of the mature cow in lbs. from input form.

DAYS = Average age of calf at weaning from input form.

EFF = Feed efficiency from input form.

0.4536 = The correction factor necessary to change lbs. into Kg.

The formula for Metabolizable Energy is:

$$ME = (13.1462 + 0.00804\ WT) \times DAYS \times EFF$$

Where:

WT, DAYS and EFF are as defined above.

In order to assure that the cow would be able to eat enough of the least cost ration to meet her energy and protein needs, a maximum constraint was placed on the cows dry matter intake. The formula for the Dry Matter (DM) maximum in Kg is:

$$DM = (0.029\ WT - 0.000005\ WT^2) \times DAYS \times 0.4536$$

Where:

WT, DAYS and 0.4536 are defined above.

The dry matter formula is the mathematical expression of the assumption that a cows maximum feed intake increases at a decreasing rate as the cows weight increases and that an average one-thousand pound cow can eat up to 2.4 percent of her body weight daily.

The digestible protein requirement of the lactating cow is expressed as a minimum 5.4 percent of the maximum dry matter intake. The formula for digestible protein (DP) in Kg is:

$$DP = 0.054\ DM$$

To the requirements for the cow herself, were added the requirements for (1) the calf (other than what the calf received from the cow's milk) and (2) that part of the herd bull and replacement heifer associated with each cow unit. It was assumed that the calf would receive fifty percent of its total energy and protein requirements from its mother's milk and depend on the available feedstuffs for the remainder. The calf's requirements were calculated using the Net Energy formulas defined in the second subroutine (page 59). (See the Backgrounding and Feedlot Systems section for details.) Birth weight, assumed to equal 7.5% of the cow's weight, was used as the starting weight. The weaning weight from the input form was used as the ending weight and the average daily gain was found by dividing the weight increase by the average age in days of the calves at weaning.

The amount of added requirements needed during the lactation period to feed the calf were then calculated by the first subroutine using the following formulas:

$$ME = 0.5(0.58\ NEm + 0.32\ NEg) \times (WEAN \div 100)$$

$$TDN = 0.5(ME \div 3.6155) \times (WEAN \div 100)$$

$$DM = 0.5(DM_R) \times (WEAN \div 100)$$

$$DP = 0.5(DP_R) \times (WEAN \div 100)$$

Where:

NEm, NEg, DM_R, and DP_R are values calculated by the second subroutine.

WEAN = the percentage of cows weaning calves from the input form.

The nutritional requirements of the herd bulls and replacement heifers were calculated for the full year and then apportioned between the lactating period and dry period by multiplying each by [DAYS ÷ 365] and [(365 - DAYS) ÷ 365], respectively. The bull's requirements were calculated by the following formulas:

$$TDN = 0.036\ BWT^{0.75} \times (BUL \div 100) \times 365 \times 0.4536$$

$$ME = 0.062\ BWT^{0.75} \times (BUL \div 100) \times 365$$

$$DM = 0.018\ BWT \times (BUL \div 100) \times 365$$

$$DP = 0.085\ DM$$

Where:

BWT = Average weight of herd bulls from the input form.

BUL = Number of bulls per 100 cows from the input form.

The nutritional requirements of the replacement heifers were also calculated using the Net Energy formulas defined in the second subroutine (page 59). Heifer weaning weight was used as the starting weight and the mature cow weight as the ending weight. Heifers were assumed to calf for the first time at two years of age so average daily gain was calculated to equal [(Mature wt. - Weaning wt) ÷ (730 - DAYS)]; 730 days are equal to two years. It was realized that heifers do not reach mature weight at two years but it was felt that this assumption would not be totally amiss since, in an ongoing herd, the added nutrient requirements this assumption would force into the model would be needed by the young cows in the herd that are still growing. The replacement heifers requirements were then found by:

$ME = (0.60NEm + 0.35\ NEg) \times ((WH + YH) \div 100)$

$TDN = (ME \times 3.6155) \times ((WH + YH) \div 200)$

$DM = DM_R \times ((WH + YH) \div 200)$

$DP = DP_R \times ((WH + YH) \div 200)$

Where:

NEm, NEg, DM_R, DP_R are values calculated by the second subroutine.

WH = Number of weaned replacement heifers per 100 cows from the input form.

YH = Number of yearling replacement heifers per 100 cows from the input form.

The nutritional requirements of the cow when dry are considerably less than when she is lactating and feeding a calf. To recognize this difference and to allow for the change in feed quality that often accompanies it, a separate set of requirement equations were developed for the dry cow. The formulas are as follows:

$TDN = (2.771 = 0.00379\ WT) \times EFF \times (365 - DAYS) \times 0.4536$

$ME = (4.6734 = 0.006814\ WT) \times EFF \times (365 - DAYS)$

$DM = (0.027\ WT - 0.000005\ WT^2) \times (365 - DAYS) \times 0.4536$

$DP = 0.028\ DM$

Where:

WT = The mature cow weight in lbs.

EFF = Feed efficiency from the input form.

DAYS = Average age of calf at weaning from the input form.

The total nutrient requirements during the lactating period are the sum of the requirements for the lactating cow, the calf and the allocated portions of the herd bull and replacement heifer during the period from the birth of the calf until weaning.

The total requirements during the dry period are the sum of the requirement of the dry cow and the associated herd bull and replacement heifers during the period from the weaning of one calf to the birth of the next.

Even though a feed may be available on a farm it is not necessarily the desire of management to feed it to a particular livestock group. This is especially true of grazing which, unlike storable grains, silage and hays can only be fed during the times of the year it is in season. Thus, because the feeding of the cow herd was split into two periods it was necessary to allow the farmer to indicate whether pasture, cornstalk aftermath, and winter wheat grazing would be available to the cows during each of the periods. Those which the farmer indicates as not being available have their nutrient transfer columns for that period and system deleted from the matrix.

The labor requirements and facility type enter the matrix as demands on their respective resource constraints, while the variable costs become the C-row values. The percentage of cows that wean calves is divided by two to give the output rate of steer calves. The percentage of weaned replacement heifers is subtracted from the remainder to give the output rate of heifer calves. Culls are transferred at the culling percentage. The selling price for the heifers, steers and culls multiplied by their weaning and mature cow weights respectively form the C-row values for the associated selling activities.

The operator constraints, if any, enter the matrix as upper and lower bounds on the production activity.

Backgrounding and feedlot systems

The four backgrounding and six feedlot production activities, with their accompanying feeder buying and selling columns, are deleted or modified much like the cow-calf production activity columns. Calves are bought, sold and transferred on a per head basis. Buying price and weight are multiplied together to get the buying activity C-row value. If the input calls for considering calves from the cow-calf systems, or backgrounding systems for feedlot, transfer columns are added to transfer cattle on a per head basis. This is done so that the elements in these columns can always be positive and negative 1's.

Calf type, buying weight, inshrink, feed efficiency and out-weight are all used to arrive at nutritional requirements for each unit of production in the production activities.

The unit of production is one head for backgrounding and one head-year for feedlot (i.e., 1 head X turns per year). Nutritional requirements for backgrounding and feedlot animals are calculated by the second subroutine using the Net Energy for Maintenance and Net Energy for Gain system (40). The formulas are:

Daily NEm = $0.77W^{0.75}$

Daily NEg(steers) = $(0.05272 \text{ Gain} + 0.00684 \text{ Gain}^2)(W^{0.75})$

Daily NEg(heifers) = $(0.05603 \text{ Gain} + 0.01265 \text{ Gain}^2)(W^{0.75})$

Where:

NEm = Net Energy for Maintenance in Mcal (minimum requirement).

NEg = Net Energy for Gain in Mcal (minimum requirement).

W = Weight in Kg.

Gain = Daily gain in Kg.

To get from a daily requirement to the total requirement for the feeding period, the weight in (from the input form) is subtracted from the weight out (from the input form), corrected for inshrink, changed to Kg. and then divided by 20. The number of intervals within the feeding period was arbitrarily set at 20 by the writer of the program. The NEm and NEg is then calculated for each of the 20 intervals using the median weight of the intervals as W and the average daily gain, again corrected to Kg. (from the input form) as Gain. These NEm and NEg requirements are then multiplied by the number of days in the weight interval and summed to get the total NEm and NEg requirements respectively.

The dry matter maximum is calculated at 2.5 percent of the median interval weight times the number of days in each interval and summed over the 20 intervals.

Digestible protein is calculated at 7.2 percent of dry matter maximum. A urea restriction is set at no more than 33 percent of digestible protein, or 1 percent of the feed intake on a dry matter basis, whichever is smaller.

The C-row value, Labor Requirement rows, and Facility Type rows are likewise modified as per the data from the input. Death loss is used to modify the percentage per head transferred to the selling activity for backgrounding.

There is no selling activities for the feedlot production activities as there is no need to allow for the possibility of transferring finished cattle elsewhere. Therefore the selling value is figured internally and used to arrive at a positive C-row value after subtracting off variable production costs and death loss.

Again the production activities can be bounded at either an upper or lower figure as the input form requires. Both the buying and selling activities are unboundable to avoid unnecessary, infeasible solutions.

THE GENERATED REPORT

The last part of the computer model is another Fortran program. It is designated to take the optimal solution from the individualized linear programming matrix and report it in a format easily understood by the farmer. (See Appendix D for an example.) Some of the information from the farmers input data, hereafter referred to as the input form, is also used in writing this report. The output generated by the computer, hereafter referred to as the report, is tailored to fit the circumstances defined by the input form and the optimal solution. However, it always contains a cover sheet and three major sections: (1) production activities, (2) resources used, and (3) total return to management, fixed labor and other costs and investments. The cover sheet lists the name of the farmer concerned, his address and the date the input form was filled out.

Production Activities

The first section of the report deals with the production activities that the farmer designated in his input form. They are reported by phase, first cow-calf systems, then backgrounding, and then feedlot systems. If the farmer did not designate a management system in one particular phase, that phase will be deleted from the report.

Within each phase, the management systems are reported in the same order as they were entered on the input form to make it as easy as possible to refer back to the input data. For each management system that is in the optimal solution, there is an eleven part report tabulated as follows:

1. The number of head in the system and the sex of the cattle fed are listed. For cow-calf activities the number of head of herd bulls and replacement heifers is also listed.

2. The number of head purchased is reported along with the purchase price per hundredweight and the dollar amount. If farm raised calves or yearlings are transferred into the system, the number of head transferred and the name of the production system from which they came is given. These transferred cattle are valued at an opportunity cost equal to the selling price that would have been received had the cattle been sold instead of transferred. This is done so that a total purchase cost for the cattle within a particular system can be calculated and reported.

3. The variable cost for the system is listed. The number of head produced is multiplied by the variable cost per head given in the input form to arrive at the variable cost for the system. Both the per head and the total variable cost is reported.

4. The names of the feeds and the amounts of each in the least cost ration are reported. The cost per units from the input form is given and a cost for each feed is calculated and reported. The individual feed costs are summed to report the total feed cost for the production system.

5. The type of facility used is reported by giving its designated name from the input form. The number of headspaces used,

the variable cost per headspace and the variable cost for facilities chargable to the particular system are all listed.

A total operating cost for the production system is reported by summing the variable cost (3), the feed cost (4), and the facilities cost (5).

6. The number of hours of labor required by the system for each of the six two-month periods is reported by period.

7. The revenue generated by the production system is calculated and reported. For the cow-calf systems, the report separates the total gross revenue, listing the contribution of the heifers produced minus the replacement heifers held back, the contribution of the steers produced and the contribution of the cows culled. For each of the three groups, the number of animals in the groups is reported, with the weight of each animal and the assigned selling price from the input form shown. The number in the group is multiplied by the weight to report the total weight produced. This total weight times the price per hundredweight equals the value of the animals in that group. The value of all three groups is summed to report the total gross revenue.

In order to report the gross revenue for a backgrounding or feed-lot production system, the number of head death loss is subtracted from the number of head produced. The resulting number of head actually sold is reported, along with the price per hundredweight from the input form and the total gross revenue.

8. This part reports two ratios that are useful to the farmer for comparing the costs of different production systems.

The two ratios are feed costs per hundredweight of weaned weight and operating costs per hundredweight of weaned weight. For backgrounding and feedlot systems the ratios are feed costs per hundredweight gained and operating costs per hundredweight gained.

9. The return to management, labor and fixed cost is reported in this segment by repeating the gross revenue figure, subtracting operating costs and reporting the resultant net revenue.

10. The net revenue reported in part nine is divided by the number of head produced to report the return to management, labor and fixed costs on a per head basis.

11. If the production system is constrained by a management restraint, the level of the restraint is reported along with the income penalty associated with the restraint. If no management restraints were imposed on that particular system or if they are not binding, part 11 is left out of the report for the production system.

Production systems that are not in the optimal solution are reported as they occur within each phase. They are reported by the designated name given in the input form, along with the income penalty that would be incurred by forcing one unit of production into the solution.

Resources Used

The second section of the report deals with the feed, labor and facilities used in the total beef operation. Each is reported in a separate segment. Much of the information contained in the input form, dealing with that resource, is repeated in the report for convenience of reference.

1. Feeds. All the feeds which are indicated as being available on the input form are listed in the report, whether they are actually fed or not. For each listed feed, the two prices from the input form are listed. The amount fed at each of the two possible prices is reported, along with the cost of that amount of feed. The maximum available at that price, from the input form, is also reported, as is the reduced cost associated with that maximum. If the reduced cost figure is positive, it indicates how much an added unit of that feed would add to the profitability of the solution. If the reduced cost figure is negative, it indicates how much the price of that feed would have to be reduced before it would be fed. The costs of all the feeds fed are summed to report the total cost of all feeds fed.

2. Labor. A table is generated in the report to list the amounts of labor used, where it comes from and what it costs for each of six two-month periods, starting with January-February. The hours of operator and permanent fixed labor available, from the input form, is listed along with the amount used. The maximum number of hours of labor that actually are hired and the cost are reported in the table. If all the labor available in that period, both fixed and hired, is used up, the report also lists the value of the last hour available in that period. Each periods hired labor cost is summed to report a total hourly hired labor cost. Also, the fixed cost for the operator's labor and the permanent hired labor from the input form, is reported here.

3. Facilities. The facilities segment lists all the facilities the farmer indicated in the input form he had available or was willing to build. Each facilities type is listed by its designated name. The number of headspaces that are available is reported along with the number of headspaces actually used in the optimal plan. The variable cost per headspace from the input form is listed, as is the yearly fixed cost per headspace for new facilities. The variable cost and yearly cost associated with each of the facility types is calculated and reported. If a new facility is required to be constructed, the amount of new investment that building would entail is also reported. The individual variable and fixed costs are summed to report a total variable and total fixed cost value. All new investment is also totaled.

Total Return to Management, Fixed Labor and Other Costs and Investments

The third and final section of the report lists all the production systems that the farmer defined in the input form. For each phase of production, cow-calf, backgrounding and feedlot, the various production systems are listed by the name designated in the input form along with the dollar amount they contribute to revenue over the variable cost figure. The amounts calculated earlier for hired labor, fixed labor and fixed facility costs are listed and subtracted to report a final return to management and investment.

THE DEMONSTRATION FARM

A hypothetical farm unit was constructed to illustrate how the model works. This unit is assumed to be a 440 acre farm in the Northwest Iowa area. It is modeled after farms in northwestern Iowa that raise mostly corn and soybeans with some hay and pasture on land suitable for continuous row crops.

Many farms in this area also raise calves to utilize the permanent pasture required on some of the steep slopes. Beef feeding is also a major enterprise on many of these farms. Beef cattle activities often supplement cash grain production by using crop aftermath and low production labor. The Beef-Opt model is an appropriate tool for planning the beef production systems on this type of farm. The farmer would begin by completing the Beef-Opt data form. The program would help calculate the best use of their resources and most advantageous mix of beef production alternatives.

All costs, labor requirements and resources assumed for this unit are specified in the completed Beef-Opt Data Form, shown in Appendix C, and outlined below.

The demonstration farm is assumed to have fifteen thousand bushels of corn grain available at an opportunity cost of $2.40 per bushel. Also, on hand are fifteen thousand bushels of ear corn at $2.70 per bushel, two hundred tons of alfalfa hay at $50 per ton and one hundred tons of grass hay at $45 per ton. Fifteen hundred tons of corn silage have been put up at a cost of $21 per ton, along with two hundred tons of corn stover, machine harvested at a cost of $13 per ton.

The grass pasture acreage is expected to yield forty-five tons of dry matter next spring and summer, at an expected cost of $15 per ton. There are also two hundred tons of cornstalk aftermath on unplowed ground that can be grazed at a cost of $5 per ton. Furthermore, corn grain is available at the local elevator at $2.55 per bushel, alfalfa hay at $60 per ton, soybean meal at $180 per ton and a thirty percent protein supplement at $128 per ton. It is also possible to rent pasture from a neighbor that will yield up to forty-five tons of grass at an expected cost of $22 per ton.

The operator and his family has 300 hours of labor available for use in beef production during January-February. 180 hours during March-April, 160 hours during May-June, 200 hours during July-August, 60 hours in September-October, and 180 hours during November-December. The value of this labor is fixed at $5,000 for the year. Part time labor up to 360 hours per two month period, can be hired for $4.50 per hour during crop planting and harvesting periods and for $3.50 per hour during the rest of the year.

The farm is equipped with the facilities necessary to handle 50 head of cows, using a spring pasture calving system. Also, space is available for 150 head of calves, backgrounded in an open lot, and 300 head of cattle on feed in an open lot with fence line bunk and shelter.

To allow a maximum amount of flexibility, the variable and fixed costs are also calculated to add other facilities. A barn and lot type facilities for winter calving of the cow herd is designated to allow the profitability of switching to a winter calving system of cow-calf production to be tested. An expansion of the present back-grounding facilities, up to an additional 100 head, is allowed. Also, the possible addition of the necessary facilities to background calves in the summer, using a part of the present lot and summer grazing for up to 150 head. The present feedlot with a capacity of 300 head is allowed to expand up to an additional 100 head. Further, a confinement facility, with slatted floor and manure pit is designed to allow the testing of feeding yearlings in a high gain, total confinement system.

The data for a spring calving production system is entered as Cow-Calf System #1. The system requires a bull for every 25 cows, a 16 percent culling rate with replacements raised and a 90 percent calf weaning rate, at 210 days average weaning age. The cows are allowed pasture during lactation and cornstalk grazing during the dry period. Variable cost per cow unit is $22.50. Steers weight 450 lbs. at weaning and heifers 420 lbs. Steers can be sold for $33 per cwt. Or if it is more profitable, they can be transferred to the designated backgrounding or feedlot systems. To assure that a minimum cow herd of 20 head is maintained, the system is lower bounded.

Cow-Calf System #2 is designed as an alternative to the spring calving system. It is based on a winter calving system, using artificial insemination for breeding, and feeding in a dry lot during lactation.

Due to the stress of cold weather during lactation, it was assumed that 3 percent more feed would be necessary to maintain a 90 percent calf crop, while bringing the calves to the same weaning weight. Also, the variable cost would increase to $31 per head. However, the advantage would be that the high amount of labor required during calving would be shifted from the labor short months of spring to the winter months when more labor is available.

Four backgrounding systems are entered to allow a wide selection of production possibilities to be considered. Two steer calf systems and two heifer calf systems are defined, one each for winter and spring backgrounding and one each for summer and fall backgrounding. Steers are purchased for $40 per cwt. at 450 lbs. and heifers for $35 per cwt. at 420 lbs. A 3 percent inshrink is taken on all calves at the start of the feeding period. Pasture is available for the calves backgrounded in the summer and fall, and cornstalk grazing is available for calves backgrounded in the winter and spring. Required average daily gain is set at 1.35 lbs. per day for winter steers, 2.1 lbs. per day for summer steers, 1.40 lbs. per day for winter heifers and 1.92 lbs. per day for summer heifers. Death loss is set at 1.5 percent. Steers are expected to weigh 666 lbs., less a 1.5 percent outshrink and heifers, 609 lbs. less a 1.5 percent outshrink at the end of the feeding period.

The selling price is set at $38 per cwt. and $32 per cwt. for steers and heifers, respectively. No constraints are placed on the amount of calves that can be, or have to be, backgrounded under any of the four management systems. This allows the computer to choose the most profitable combination.

Six feedlot production systems are defined, two for steer calves, two for yearling steers and one each for heifer calves and heifer yearlings. Steer calves are purchased for $40 per cwt. at 450 lbs.

and take a 3 percent inshrink. The first group of steer calves are required to put on 2 lbs. per day in gain and have a lot turnover rate of 1.2 times per year. Both sets of steer calves are finished to 1100 lbs. and are sold at $43 per cwt. after taking a 3 percent out-shrink and a 1.5 percent death loss.

One group of yearling steers can be bought for $38 per cwt. at 666 lbs., the other for $39 per cwt. at 750 lbs. Both take a 2 percent inshrink and are finished to 1150 lbs. Required outshrink for yearling steers equals 3 percent and the selling price is set at $43 per cwt. The steers entering at 666 lbs. are required to gain 2.76 lbs. per day and have a lot turnover rate of 2 times per year. The yearlings entering at 750 lbs. gain 2.5 lbs. per day and turnover 2.1 lots per year. Both yearling steer systems as well as the yearling heifer system require a headspace of the slotted floor confinement facility for each head fed.

The heifer calf feeding system starts with 420 lbs. calves that have a purchase price of $35 per cwt. and feeds them to 900 lbs. with a 3 percent inshrink, a 3 percent outshrink, a 1.5 percent death loss and a growth rate of 1.9 lbs. per day. This will keep them on feed for 258 days and allow for a lot turnover rate of 1.4 times per year. Heifer yearlings are purchased for $35 per cwt. at 609 lbs., requiring a 2 percent inshrink, a 3 percent outshrink and an average daily gain of 2.3 lbs. per day. This will finish them to 920 lbs. in 154 days and allows a lot turnover rate of 2.2 times per year. Finished heifers are sold for $41 per cwt. Like the backgrounding system, the feedlot production systems are not constrained, in order that the computer will be free to choose the most profitable systems and levels of production.

After the Beef-Opt Data Form has been filled in, the information on it is keypunched onto IBM data cards in a standard format. The cards are then read by the computer under the control of the Fortran program, which is stored on magnetic tape. The Fortran program rebuilds the linear programming matrix and solves for the optimal beef production plan. A report on this plan is then printed and returned to the farmer. The report generated for the demonstration farm from the data cited above, is given in Appendix D.

Report for Demonstration Farm

The optimal plan for the demonstration farm calls for the maintenance of a 30 cow herd under Cow-Calf Management System #1, with accompanying bulls and replacement heifers. Machine harvested corn stover and grass pasture are to be fed during the lactation period and cornstalk aftermath, with 30 percent protein supplement during the dry period. Feed costs for the cow herd are calculated at \$1881 and all variable costs at \$2616. Twenty-seven calves are weaned, of which five heifers are kept as replacements. The other heifers are sold and the steers kept for backgrounding. The specified selling prices for steers, heifers and cull cows, allows the calculation of an implied gross revenue of \$4673 which after subtracting \$2616 operating costs, leaves a return to management, labor and fixed costs of \$2057, or \$68.56 per cow unit. The winter calving option was not in the optimal solution.

Only the 13 head of steer calves weaned are backgrounded in the optimal plan. No calves are bought for backgrounding either to add to the 13 weaned steers or to feed under one of the three other options. The 13 steers are fed corn grain, soybean meal and cornstalk aftermath for a feed cost of $521 and an operating cost of $832. At the end of the backgrounding period, the steers are finished in the feedlot rather than being sold as yearlings. None of the other three options are in the optimal solution. The fourth option, heifer calves on summer pasture, has an income penalty of $20 per head. The optimal plan calls for keeping the "Open Lot with Shelter" feedlot facilities full with steer calves on a 2.4 lbs. per day gain ration. This requires buying 480 steers per year at a cost of $86,400. The least cost ration consists of corn grain, ground ear corn, alfalfa hay and corn silage, resulting in a feed cost per hundredweight of gain of $25.63. The return to management, labor and fixed costs after subtracting the steer purchase price and operating costs equals $66.86 per head.

The optimal plan also envisions the feeding of 140 yearling steers, (turning two, 70 head lots a year) at an average daily gain of 2.76 lbs. per day. This requires purchasing 127 head plus the 13 head of steers backgrounded during the winter and spring. The least cost ration for the yearling steers consists of corn grain, ground ear corn, alfalfa hay and grass hay. The return to management, labor and fixed costs, after subtracting the purchase price and operating costs, equals $44.42 per head.

Report for Demonstration Farm-Resources Used

All of the corn grain, corn silage, alfalfa hay, grass hay and grass pasture available on the farm was used along with 4,039 bushels of ground ear corn, 23 tons of corn stover and 72 tons of cornstalk aftermath. The plan also requires the purchase of 2.22 tons of soybean meal, 4.16 tons of 30 percent protein supplement and 150 extra tons of alfalfa hay.

All the labor the operator and his family had available for the beef operation was used. Part-time labor was hired in each two-month period. The amount hired ranged from a low of 120 hours in January-February to the maximum of 360 hours during the labor short fall harvesting period in September-October. The last hour hired in September-October had a value to the plan of $21.27 indicating that more labor during that period would be valuable if it could be hired.

Three-fifths of the present cow-calf facilities were utilized, but only one-tenth of the backgrounding facilities. The present feedlot is kept full and the plan requires adding an additional 100 headspaces to it. Further a 70 headspace Slotted Floor Cold Confinement facility is required to maximize profits under the optimal plan.

The optimal plan forecasts a return to management and investment of $17,223 for the total beef production operation. This is, of course, dependent on the cattle prices entered and the costs and availability of resources required.

OTHER APPLICATIONS AND IMPLICATIONS FOR FUTURE RESEARCH

The preceding discussion illustrates how the model could be utilized to plan the beef operation for the coming year after the crops have been harvested. In addition to this use, it is felt that the model may be useful in several other planning roles. The model could be used to make cropping decisions in support of a certain size beef operation. This could be done by entering the costs of production for different feeds but leaving the amounts available open-ended. Then by fixing the level of the different beef systems desired, the least cost amount of each possible feed would be derived by the model. Thus the amount of corn to plant, the amount of silage to harvest, the tons of hay to make and the acres of pasture to support a given beef program at the minimum feed cost could all be calculated at once. The amount of extra labor needed during different times of the year could also be derived using this method.

The model might be used to test alternate production methods against each other or present practices to see how they fit together in resource utilization and profit potential. Also different types of cattle and different gain rates can be tested to see which fit best a given set of facilities and available feed and labor. The calculated costs and returns could be used to convince a bank to loan money on feeder cattle or to show a need for more facilities or feed storage.

Although the model in its present state of development is applicable to many planning situations, there are some possible additions that would broaden its usefulness. One such extension would be the addition of a cash flow segment to the report generated in order to clarify the timing of borrowing and spotlight periods when liquidity might be a problem.

It would be helpful for longer range planning if a multiperiod model of this type were developed. This is particularly true when construction of facilities is contemplated or when addition or expansion of the cow herd is being considered.

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APPENDIX A: NUTRIENT VALUE OF FEEDS[1]

	On dry matter basis						
Feeds	% dry matter	% TDN	ME Mcal/Kg	NEm Mcal/Kg	NEg Mcal/Kg	% DP	NRC feed ref. No.
Grains							
Corn	89	91	3.29	2.28	1.48	7.5	4-02-931
Whole ear corn	87	90	3.25	2.23	1.39	4.6	4-02-849
Sorghum	89	80	2.89	1.85	1.23	7.1	4-04-444
Oats	89	76	2.75	1.73	1.14	9.8	4-03-309
Barley	89	83	3.00	2.13	1.4	9.8	4-00-549
Wheat	89	88	3.18	2.15	1.42	11.2	4-05-294
Grain screenings	90	51	1.84	1.09	0.32	11.4	4-02-151
Hays							
Alfalfa	90	57	2.06	1.22	0.55	12.7	1-00-059
Legume	88.2	62	2.24	1.33	0.73	13.2	1-05-106
Legume/grass	88.25	59	2.15	12.7	0.64	9.0	_[2]
Grass	88.3	57	2.06	1.22	0.55	5.8	1-03-438
Silages							
Corn	40	70	2.53	1.56	0.99	4.7	3-08-153
Corn stover	27	58	2.1	1.24	0.59	2.9	3-02-836
Sorghum	26	58	2.10	1.25	0.61	1.7	3-04-468
Sorghum/sudan	23	59	2.13	1.27	0.64	5.6	3-04-499
Oat	32	59	2.13	1.27	0.64	5.5	3-03-298

[1] Source: National Research Council (40).

[2] Legume/grass nutrient values average of 1-05-106 and 1-03-438.

Continued.

Feeds	On day matter basis						
	% dry matter	% TDN	ME Mcal/Kg	NEm Mcal/Kg	NEg Mcal/Kg	% DP	NRC feed ref. No.
Legume	55	52	1.88	1.1	0.35	10.7	3-08-151
Legume/grass	29	56	2.02	1.19	0.5	6.0	3-02-303
Supplement							
Soybean oilmeal	90	85	3.07	2.06	1.37	41.4	3-04-600
Protein mix	90	62	2.25	1.49	0.98	30.0	_[3]
Urea	100					281.0	_[4]
Roughages							
Ground cobs	90	47	1.7	1.06	0.25	0.0	1-02-782
Corn stover	87	59	2.13	1.21	0.55	2.2	1-01-776
Sm. grain stover	88	41	1.48	1.01	0.14	0.5	1-00-438
Soybean stover	87.6	38	1.37	0.85	0.0	1.7	1-04-567
Pasture/grazing							
Legume	20	70	2.53	1.56	0.99	15.0	2-01-428
Legume/grass	22	67	2.44	1.48	0.9	13.0	_[5]
Glass	24	65	2.35	1.41	0.82	11.0	2-03-440
Cornstalk aftermath	87.2	59	2.13	1.21	0.55	2.2	1-02-776
Winter wheat	22	73	2.64	1.64	1.07	22.2	2-05-176

[3] Protein Mix nutrient values arrived at by taking 30/44 of soybean oilmeal values.

[4] Source: Dyer (15).

[5] Legume/grass nutrient values average of 2-01-428 and 2-03-440.

APPENDIX B: INSTRUCTIONS FOR COMPLETING THE BEEF-OPT DATA FORM

This is a computer based model that is designed to help beef producers identify the most profitable among competing production systems and to give some help in allocating limited resources to their most productive uses. To do this, beef production has been subdivided into three phases: cow-calf, backgrounding and feedlot. Certain producers may not wish to deal with all phases, so the program allows one or more to be deleted. The phases are further subdivided by input requirements. The main inputs considered are feed, labor, facilities and cattle. Managerial ability and adequate capital are assumed although adjustment for varied levels of each are possible.

Within the "resources available" sections (sections 1, 2, 3), the producer is required to define the price and quantity of feeds that are available to his operation, the number of hours of labor that can be used in beef production and the amount and costs for the facilities he has or would be willing to build. Because cattle prices, both feeder and slaughter, are so varied depending on weight, sex, condition, etc., the definition of cattle prices is tied very closely to particular production systems by defining them when the system is defined. This is done in order that the producer will be able to arrive at as exact a figure as possible.

Having defined basic assets or resources, the producer then sets tentative plans as to how these would be used in the different phases to produce beef. It is essential that he have clearly in mind alternatives that are both realistic and practical. The model has been made purposefully general, in order to handle as many different systems as possible. Thus particular care must be used in filling out the input form to closely tailor each system with clearly defined and individualized requirements and expected outputs. The instructions have been written to facilitate this in two ways. First, the instructions attempt to explain what purpose the required piece of data will fill. Second, the instructions in conjunction with the tables and graphs, suggest how the required data can be computed and gives average values that can be used as a guide. Nonetheless, due to the interrelationships involved, each system must be carefully defined as a unit before starting to put down data about it. For instance, the facility used greatly effects both labor requirements and feed efficiency and rate of gain. Also, cattle type and input weight and condition effect efficiency, desirable marketing weight and slaughter price expectations. Thus, the whole system must be clearly in mind before data about any part of it can be entered, if useful output is to be returned.

This being the case, some people may find it more relevant to turn to the different production system definition sections (sections 4, 5, 6) first and then fill out the "resources available" sections as it becomes clearer which needs will have to be met. This may be particularly true when considering the "facilities" section.

Once the form is completely filled out it might be good to look through the whole thing, paying special attention to consistency, particularly in the timing of operations if cattle are to be transferred between phases.

Remember the output is going to be only as good as the data fed in. Inaccurate data or data placed in the wrong spaces will tend to downgrade the usefulness of the output report returned to the producer.

INSTRUCTIONS AND EXAMPLES

Name, address, date.

Fill in your name: up to 20 letters or spaces.

Fill in your address: up to 40 letters or spaces.

Fill in the date: up to 20 letters or spaces.

Section 1: Feeds.

Listed in the Beef-Opt Data Form are 30 feeds commonly available to Iowa farmers. Go through the list and pick out those that are available to your beef operation. Use the formula on page 91 to figure the ready-to-feed price including storage, handling and wastage, if any. Place that price in the "Price" column.

If you are limited as to how much you have available at that price, calculate that limit using the formula on page 90 and then enter it in the "Maximum Quantity" column.

Leave the "Price" and "Maximum Quantity" columns blank for those feeds listed which you cannot or do not wish to feed. The computer will automatically drop them from consideration.

If you don't find a feed that you have in mind listed, locate a listed feed that is similar in nutritional and protein value and use it. Three things to be especially aware of are:

Points to Observe

1. Be certain that you use the correct units as listed for the feed, whether bushels, tons, or tons of dry matter.

2. There are two "Price" and "Maximum Quantity" columns for each feed. Use the second only if you have a secondary source of the same feed at a higher price. It will do no good to enter a second price unless you are limited as to the quantity available under the first price. The computer always feeds the cheapest priced feed first. Therefore do not enter a second price unless you enter a limit to the first price. An example might be: you have corn that you raise and value at the price you would get if you sold it but that is limited to a specific number of bushels. The second "Price" column would then be used if you could buy corn at a higher price from the local elevator.

3. Pasture and forages are in Tons Dry Matter, due to the considerable variation in moisture content possible. Use Table 16 as a guide to change acres of pasture and forage into tons dry matter.

The formulas for "Maximum Quantity" and "Price" with a simple example of how to use each are given below.

Quantity

Suppose that you have harvested 10,000 bu. of "No. 2 corrected" corn which you could sell for $2.00 a bu. (see Table 14 to correct corn to No. 2). Calculate the correct "Maximum Quantity" as follows:

$$\text{Maximum Quantity} = \text{Starting quantity} \times [1 - \frac{(\%\ \text{spoilage} + \%\ \text{wastage})}{100}]$$

If you store your 10,000 bu. for later use in your beef operation you expect to lose 0.5% due to spoilage while storing and a 0.5% wastage during handling (see Table 15 for spoilage and wastage estimates). Therefore:

$$\text{"Maximum Quantity"} = 10{,}000 \times [1 - \frac{(0.5\% + 0.5\%)}{100}]$$

$$= 10{,}000 \times [1 - (0.01)]$$

$$= 10{,}000 \times 0.99$$

$$= 9{,}900 \text{ bu.}$$

Price

Calculate the correct price as follows:

Price = starting price + storing and handling costs.

These costs would include such things as drying, hauling, storage, insurance, interest on inventory, etc.

Spoilage and wastage costs =

$$\text{starting price} \times \left[\frac{(\%\ \text{spoilage} + \%\ \text{wastage})}{100}\right]$$

Continuing with our example, the starting price is $2.00 a bu. Storage and handling will cost $0.10 a bu. ($0.06 drying, $0.01 hauling, $0.03 storage and insurance).

Spoilage and wastage will increase the cost $0.02 and is tabulated as follows:

$$2 \times \left[\frac{(0.05 + 0.05)}{100}\right]$$

$$\$2. \times 0.10 = 0.02$$

Therefore: Price = $2. + 0.10 + 0.02 = $2.12.

Section 2: Labor.

Labor availability and requirements have been broken into six two-month periods in order to more clearly reflect seasonal variations in labor time available and to allow a closer definition of labor needs within the different production system.

Family and permanent hired labor act as restraints on the amount of beef production that can occur and thus should reflect the maximum amounts of labor time available, not the amount you expect to use. The computer will only use what is necessary.

To figure "Total operator's and permanent hired labor" add together the total number of hours the operator, the operator's family and the permanent hired help, if any, could spend on the beef operation during each two-month period. Remember, this is only labor available to the beef operation. Any labor required for the crops or other livestock activities must be subtracted from the total available.

If you can hire hourly labor to supplement the fixed labor supply during peak periods, enter the cost per hour for hired labor and the maximum number of hours hireable in the appropriate spaces. If hourly labor is unavailable during any or all periods, leave the "Cost to Hire" and "Maximum Hirable Hours" spaces blank. The computer is set up so that both spaces must either be blank or have numbers in them. Place the yearly value of family labor and yearly cost of permanent hired labor in the "Family" and "Permanent Fixed Cost" spaces, respectively.

An example of labor availability might be: You are willing to work 400 hours during January-February (50 hours a week for 8 weeks). You also have a 16 year old son, who can work 80 hours (10 hours a week for 8 weeks), and a permanent hired man, who will work 320 hours (40 hours a week for 8 weeks), for a total of 800 hours. If any field work and other livestock will require 300 hours during that period, then "Total Family and Permanent Hired Labor" will equal 500 hours for January-February. You might also be able to hire up to 200 hours of hourly labor at $3.00 an hour for the beef operation, so "Cost to

Hire Hourly Labor/Hour" would be $3.00 and "Maximum Hireable Hours" would be 200. Use the workspace below to figure your labor available.

	Operator +	Family members +	Permanent hired -	Labor for crops and other stock =	Total family & permanent hired
Jan-Feb	______	______	______	______	______
Mar-Apr	______	______	______	______	______
May-June	______	______	______	______	______
July-Aug	______	______	______	______	______
Sept-Oct	______	______	______	______	______
Nov-Dec	______	______	______	______	______

Section 3: Facilities.

This section develops the variable and fixed costs of the facilities for the different beef systems to be considered and the number of head-spaces that you have available or are willing to build. All three divisions, cow-calf, backgrounding, and feedlot are practically the same except that the feedlot section has two new facilities sections to give a greater range of choices to test against each other if that is desired.

To fill in the data first designate your present facilities with a name (up to 20 letters or spaces). Use any descriptive name that will be easy for you to recognize in the output report such as, "Barn, fenced pasture" for cow-calf or "Open lot and stalks" for backgrounding, etc.

If you do not have facilities for a certain phase, leave the name blank and skip to a new type of facilities, if you are thinking of building.

Tabulation procedures follow:

Present type

1. Variable cost per headspace is equal to the costs that will be incurred if the facilities are actually used. The actual amounts should be taken from farm records or experience. This is on a per head basis and would include:

	Cow-calf	Backgrounding	Feedlot
Maintenance & building repairs	______	______	______
Repairs to assoc. equipment	______	______	______
Power & utilities	______	______	______
Misc.	______	______	______
Total	$______	$______	$______

2. Total yearly fixed cost is equal to the total cost of owning the present facilities, whether they are used or not. This would include:

	Cow-calf	Backgrounding	Feedlot
Depreciation on buildings	______	______	______
Depreciation on equipment	______	______	______
Insurance and taxes	______	______	______
Misc.	______	______	______
Total	$______	$______	$______

3. Number of headspaces presently available is equal to the number of cows, calves, etc., that your present facilities can accommodate at one time. This is a restraint maximum and does not necessarily mean all will be used, only that no more than this number are presently available for use.

Additions to present type

If you wish to allow expansion beyond what your present facilities can accommodate, calculate variable and fixed costs to build additional, but similar facilities.

4. Variable cost per headspace is equal to the operating costs incurred to use the facilities on a per head basis. It will be similar to "1" above in most cases, except that start-up costs, if any, would replace maintenance and repair costs.

	Cow-calf	Backgrounding	Feedlot
Start-up costs	____	____	____
Power and utilities	____	____	____
Misc.	____	____	____
Total	$____	$____	$____

5. Yearly fixed cost per space, if built, is equal to the cost of owning one newly built space of the present type. It must be calculated on a per headspace basis because the actual number that will be required is unknown. It will include the first year's:

	Cow-calf	Backgrounding	Feedlot
Depreciation on buildings	______	______	______
Depreciation on equipment	______	______	______
Insurance and taxes	______	______	______
Interest and/or return on investment	______	______	______
Misc.	______	______	______
Total[1]	______	______	______

6. Investment per headspace, if built, is equal to the cost of building one additional headspace. It would include: (see Tables 18 and 19 for examples and suggested costs)

	Cow-calf	Backgrounding	Feedlot
Land	______	______	______
Buildings	______	______	______
Fences or corrals	______	______	______
Well, pipes and waterers	______	______	______
Misc.	______	______	______
Total	$______	$______	$______

You may wish to figure these for 10 or 100 spaces and then move the decimal point if that is easier.

7. Maximum number of headspaces willing to build is equal to the maximum amount you are willing or able to let your present facilities expand.

---

[1]When added together the totals of 4 and 5 above should be greater than the total in 1 for the same beef system. This would be natural under most circumstances and is necessary in this program in order for the computer to use the present facilities before building added units.

New type of facilities

If you wish to consider a different set of facilities from those you presently own, or if you have no facilities for a particular beef operation you are planning, then fill in this section, If you do not wish to consider new facilities for a particular phase, leave the name blank and the computer will drop it from the program.

The feedlot division has two sections so that you may compare two possible facilities types at the same time if you wish. If not, leave one or both names blank.

Again, the name (up to 20 letters or spaces) is your descriptive designation and may be anything that defines this new facility type in your mind. Eight through eleven are exactly like four through seven and are calculated the same way.

8. Variable cost per headspace.

	Cow-calf	Backgrounding	Feedlot A	Feedlot B
Power & utilities	______	______	______	______
Misc.	______	______	______	______
Total	$______	$______	$______	$______

9. Fixed cost per headspace per year.

	Cow-calf	Backgrounding	Feedlot A	Feedlot B
Depreciation on buildings	______	______	______	______
Depreciation on equipment	______	______	______	______
Interest &/or return on investment	______	______	______	______
Misc.	______	______	______	______
Total	$______	$______	$______	$______

10. Investment per headspace built.

	Cow-calf	Backgrounding	Feedlot A	Feedlot B
Land	______	______	______	______
Building	______	______	______	______
Fences & corrals	______	______	______	______
Well, pipes & waterers	______	______	______	______
Misc.	______	______	______	______
Total	$______	$______	$______	$______

11. Maximum number of headspaces willing to build is equal to the maximum size new facility you are planning. This constraint would be based upon restrictions on the amount of investment capital available or other managerial considerations.

Section 4: Cow-calf systems.

Name of system. In 40 letters and spaces or less, title the systems that you wish to consider in the program. If you do not wish to consider cow-calf systems, leave the names blank and skip this entire section. If you only wish to consider one system, leave "System 2" name blank and ignore the spaces for its data.

1. Present number of cow units on hand. Enter the size of your present herd. This enters the program as a given resource like "Labor" or "Present facilities" since the investment in cows is a long-range fixed investment.

2. Cost of buying additional cows. If the optimal herd size (both systems combined) is larger than your present herd, the program will buy cows if possible. Enter the purchase price of each additional cow.

3. Buying and transportation costs per additional cow. Enter the miscellaneous, out of pocket, costs of acquiring and integrating new cows on a per head basis. These might include:

Transportation ______

Veterinary ______

Special feed ______

Miscellaneous ______

Total $______

4. Maximum number of head willing to add to herd. Enter the maximum number that you are able or willing to buy. You may use this as a restraint on herd size or capital outlay. This is a maximum and does not mean that any or all will actually be used, only that no more than this number can be bought.

5. Average weight of mature cows in herd. Enter your average mature cow size in pounds. This weight is used by the program to help determine feed requirements for the cow herd, and weight of cull cows.

Data pertaining to the individual systems.

Fill in the required data for those cow-calf systems which you have named. Instructions and explanations, where appropriate will be listed by number, matching the numbering used on the data sheets.

1. Enter the number of bulls per 100 cows in the breeding herd. If you use artificial insemination, enter 0.

2. Enter the weight of your herd bulls in pounds. This is used to help determine feed requirements for herd bulls.

Replacement heifers.

3. Enter the number of heifers kept at weaning for replacement per 100 cows. This number determines how many heifers will be held back at weaning rather than being sold or transferred. It also helps determine feed requirements. If you do not wish to retain heifers as replacements, enter 0.

4. Enter the number of yearling bred heifers in the cow herd per 100 cows. In an on-going herd this should be equal to the number of weaned heifers saved, less death loss. The number is used to help determine feed requirements.

If you wish to retain a larger percentage of heifers at weaning and then cull those you don't need for replacements as yearlings, this number would be correspondingly smaller. Though there is no specific provision in this program for saving back extra heifers and selling them later, this practice can be handled by increasing the culling percentage in space 26 to include both cows and yearling heifers sold. Since the value of the cows culled is figured on a price per hundredweight times the mature cow weight, the value for the yearlings culled should be roughly correct since they would weigh less than mature cows, but would be expected to bring more dollars per hundredweight.

5. Feed efficiency is an important adjustment factor that allows you to increase or decrease feed requirements to better fit your situation. The nutritional values of the feeds listed and the formulas to arrive at the cow-calf units requirements are taken from the National

Research Council publication on beef. They are of necessity based on average feed and cattle quality in normal feeding situations.

If your feed and/or cattle are generally superior or inferior in quality, you will want to adjust this figure accordingly. Also, if your cattle may be subject to extra stress due to heat or cold or must forage more than usual due to poor pasture conditions, this should also be taken into consideration. Thus, the facilities you specify for this system and forages you allow to be available, are major factors to consider when deciding where to set your efficiency level. The average level is 1 and you should set yours below 1 if you are more efficient than average. For example, if you felt that your feed and cattle were average quality but due to your fine facilities and managerial ability, they were usually 5 percent more efficient in their feed usage than most, you would set your efficiency level at 0.95. That is, your herd would use only 95 percent as much feed as the typical herds of the same size. Be aware that it only takes a small change to make a big difference in feed costs. Only under unusual circumstances would this figure be outside the 0.90 to 1.20 range as each 0.01 change is a 1 percent change in efficiency and thus, feed requirements and costs. See Table 17 for some suggested adjustment factors. Some factors pertain only to feedlot efficiency, such as growth stimulants, but others apply to all phases of cattle production.

6, 7, 8. If these forages will be available to your herd during the lactating period, place a 0 in the appropriate space. If not, place a 1 in the space and the computer will drop the specified forage from consideration as a potential feed source. For instance, if the lactation period runs from April until September, you will probably have pasture available but not cornstalk aftermath, so you would place a 0 in row 6 and 1 in row 7.

Forage availability during dry period.

9, 10, 11. Do the same as above for forages available and unavailable during the period when the cows are dry and the calves have been weaned.

12. Enter a 0 for the systems planned using your present type of facilities and 1 for those planned using a new type. Make sure that you have defined the facilities type designated by filling in the necessary spaces in the facilities section or the computer will not operate correctly.

13. Enter the variable cost per cow-calf unit. This cost would include:

	System 1	System 2
Salt, minerals and vitamins	_____	_____
Veterinary and medicine	_____	_____
Bedding and waste removal (minus manure value)	_____	_____
Breeding charge (AI cost or cow's share of keeping bull minus his feed)	_____	_____
Miscellaneous	=====	=====
Total	_____	_____

Labor requirements.

14-19. For each two-month period enter the number of hours per cow-calf unit required. This includes time necessary to care for the herd bulls and replacement heifers as well as the cow and her calf.

Between 5 to 15 hours per year per cow unit would be an expected amount, depending on your facilities, the timing of your calving period, whether you have a herd bull or use artificial insemination, etc. These hours should be apportioned carefully over the year to reflect as closely as possible the true amount of the time you expect to spend during each time period. For example: Suppose you plan on System 1, calving in March and April, breeding with AI in June and July and weaning in November. You also have first rate facilities and plan to graze your cows in well-fenced summer pastures and winter on corn aftermath. Thus, your total labor needs will be low to medium, let us say 9 hours per cow unit.

You will want to apportion the time with an eye for those periods of greatest requirements. Thus, you might fill in spaces 14-19 as follows:

		System 1
14.	January-February	1
15.	March-April	2.5
16.	May-June	1.25
17.	July-August	1.25
18.	September-October	1
19.	November-December	2

20. Enter the average age of the calves at weaning in days. This number is used in determining the length of the lactation period and thus also the dry period. It also helps determine the feed requirements for calves during nursing.

21. Enter the percentage of cows that wean calves. For instance, if you expect a 90% calf crop this year, you would enter 90. The program assumes that half will be heifers and half steers and allocates them accordingly.

22, 23. Enter the average weaning weights in pounds. This is used to help determine feed requirements up to weaning and to establish the value of the calf crop.

24, 25. Enter the price in dollars per hundredweight that you could get for the calves if you sold them at weaning. The computer will decide whether they should actually be sold at this price or transferred to another part of your beef operation, depending on the relative profitability of the different options.

26. Enter the percentage culling rate for the cow herd. For example, if you plan to cull one-eighth of your herd, enter 12.5 (1/8 = 12.5%).

27. Enter the price you expect to get for your culls in dollars per hundredweight. This is used along with the mature cow weight to establish the value of the cows culled.

Operators constraints on systems sizes.

28, 29. Enter any management restraints. Since the cow-calf business tends to be cyclic in profitability, but very difficult to get started in and get out of, you may wish to maintain a certain herd size in spite of the higher anticipated profits in other beef operations. Or you may not wish to increase your herd beyond a certain size, no matter how profitable. These restraints allow you to do either or both. You must be very careful when using them, particularly the lower limit, as you may inadvertently require a larger herd size than is possible and the program will not run. For example, if you enter a lower limit of 100 but you have only allowed the program to buy enough cows to bring the herd up to 80 head, or you only have enough labor during a certain period for less than 100 head, the limit would be unattainable. In this case the computer would be unable to fulfill the 100 head minimum condition and would stop without giving any usable output. You may, and normally will, want to leave either or both limits blank. The upper limit must, of course, always be higher than the lower limit.

Section 5: Backgrounding Systems.

This section is designed to allow for the definition of up to four different backgrounding beef operations. If you do not wish to consider backgrounding, leave the name blank and skip to the feedlot section. If you have one or more backgrounding systems in mind, designate them by giving each a name (up to 40 letters or spaces). You must use the systems in order (#1 first), as the computer inputs data until it finds a blank name and then stops. Thus, if you try to use system #1 and #4, it will only read #1. For two systems, you must use #1 and #2. It is a good idea to arrive at the time period the system will cover at this point. The time period in days equals $[\frac{\text{Wt out - (Wt. in - inshrink)}}{\text{ADG}}]$. This will also help clarify any problems for cattle transferring between phases.

Data pertaining to the individual systems.

1. Enter a 0 if you wish to consider backgrounding steers, a 1 if heifers. Due to the difference in feed requirements, each sex must be considered separately.

2. Enter the total buying price delivered in dollars per hundredweight. This should include any transportation charges or commissions.

3. Enter the weight at which you are buying the calves. (#2 X #3 should equal the actual price per head of the calves.)

4. Enter the percentage weight loss expected at the start of the backgrounding period. This is used to establish the starting weight for the feeding period.

Consider calves from cow-calf systems.

5, 6. Enter 1 if you wish the program to consider transferring calves from the designated Cow-calf systems. This is to allow consideration of the profitability of backgrounding your feeders rather than selling them. Only the feeders of the correct sex will be considered. In order for this transfer to make sense, the backgrounding system must be planned to start when the feeders have been weaned and must be of the same weight and grade of calves. Weight should be the same as designated weaning weight. Inshrink will be taken at the same percentage as calves purchased. Care must be taken that the buying price for feeders is higher than the selling price given in the cow-calf data, otherwise the program will attempt to reverse the transfer and make infinite amounts of money dealing in calves. Any amount higher, even as little as a dime per hundredweight, will be sufficient to prevent this problem.

7. Enter the average daily gain, in pounds per day, that you wish the calves to make. This is used to set nutritional requirements and thus, the higher the ADG, the more concentrates and the less roughage will be fed. Most backgrounding systems have an ADG of 1 lb. to 1.9 lbs.

8. Feed efficiency is discussed extensively in the cow-calf section, line 5. 1 is average and the range should not normally exceed 0.9 to 1.20. Also, look at Table 17, as some adjustment factors, though specifically for feedlot, can and should be applied here.

Forages available.

9, 10, 11. Enter a 0 if the particular forage is available to the system in question, a 1 if it is not. Availability is dependent on the season or seasons that the system will be operating in, planned facilities and forages on the farm.

12. Enter a 0 if the system is planned around your present facilities, a 1 if around a new type. Make sure you have the selected types defined in the facilities section. Either type may be used in one or more systems. The effect will be additive. That is, a head-space once used in a system is not available to any other, but all may draw equally on the supply.

13. Enter the variable cost in dollars on a per head basis. This would include:

	System #1	System #2	System #3	System #4
Salt, minerals & vitamins	____	____	____	____
Veterinary & medicine	____	____	____	____
Bedding & waste removal (minus manure credit)	____	____	____	____
Interest on cattle	____	____	____	____
Miscellaneous	____	____	____	____
Total	$____	$____	$____	$____

Labor hours per head.

14-19. Enter the hourly labor per head for each labor period in which the system is in operation. If no labor is required during a certain period, leave it blank.

Labor requirements for backgrounding will average ½ to 1 hour per two-month period per head, depending on the type of facilities and feeds fed. Slightly more should be added at the beginning of the feeding period to cover time required to get the calves started. Also, any labor time necessary to sell the calves or clean out the facilities afterward should be added to the last two-month period as appropriate.

20. Enter the expected percentage of calves lost due to death over the backgrounding period. For instance, if in System #2 you expect a 2 percent death loss, enter 2 in the appropriate space.

21. Enter the weight that you wish the calves to attain at the end of the feeding period in pounds. This weight, along with the average daily gain determines how long the cattle will be backgrounded under this system.

22. Enter the percentage shrink from out-weight to selling weight. If the program elects to transfer the backgrounded cattle to a feedlot system you designated (see Feedlot system questions 7-10), the outshrink will not be taken here as there is a space for inshrink in the Feedlot systems but rather the cattle will be transferred at the weight listed in line 21.

23. Enter the selling price that you expect to get (FOB your farm) for the cattle in dollars per hundredweight.

Operators constraints on systems size.

24, 25. Enter the upper and lower limits (in head of cattle in the system) as required to meet specific management objectives. Either or both may and often will be left blank. Care must be taken not to set an unattainable lower limit or a lower limit above the upper limit.

Section 6: Feedlot Systems

This section is designed to allow the definition of up to six different feedlot systems. If you do not wish to consider finishing cattle in a feedlot, leave this section blank. If you have one or more feedlot systems in mind, designate them by giving each an appropriate name (up to 40 letters or spaces). An example of a name might be "Steer calves 450-1050 lbs." or "Heifer yearlings, Oct-Mar." The systems must be used in order starting with 1. That is, if you are considering three different systems, you would designate them in names 1, 2, 3 and leave 4, 5, 6 blank. You would, of course, only develop data and fill in the columns for the designated systems.

<u>Data pertaining to the individual systems</u>.

1. Enter a 0 if you wish to consider steers, a 1 if heifers. Each sex must be considered separately due to the difference in feed requirements for gain.

2. Enter the buying price (FOB your farm) in dollars per hundredweight.

3. Enter the buying weight in pounds.

4. Enter the percentage weight loss expected at the start of the feeding period. This is used to establish the starting weight for days-on-feed purposes.

<u>Consider cattle transferred in</u> (from Cow-calf systems, 5, 6 or backgrounding systems, 7-10)

5, 6. Enter a 1 if you wish the program to consider transferring calves from the designated Cow-calf systems. Only calves of the proper sex will be considered. The program will pick the most profitable option for each calf, whether to sell it or transfer it to available backgrounding or feedlot systems. In order for this transfer to make sense, the system must be planned so that one of the turns, if the feedlot turns over more than once a year, starts when the calves are weaned. It also must use the same weight and grade of calves as are coming out of the Cow-calf system. The computer does not check to see whether the weight is the same and has no way to check timing. These must be done by the one filling in the form if useful information is to be returned.

7-10. Enter a 1 if you wish the program to consider transferring yearlings from the designated backgrounding systems. Weight, grade and sex must be the same as cattle being bought for the system and thought must be given to correct timing if the output is to make sense.

11. Enter the average daily gain in pounds per day you wish the cattle to gain. This is used to set daily energy requirements for gain and will help determine what feedstuffs will be fed. The higher the ADG is set, the greater the amount of concentrates necessary in order to meet energy for gain requirements.

12. Enter the feed efficiency you feel your system will attain. Forages and pastures cannot and will not be fed to feedlot cattle with this program.

Each 1% change in efficiency you wish to include would change the efficiency number 0.01. The more efficient the system is to be, the lower the number. For example, an entry of 0.98 would indicate that you feel this system will be 2 percent more efficient than average. An entry of 1.03 would indicate that this system is 3 percent less efficient than average. Usual range is 0.90 to 1.20. See Table 17 for adjustment factors for feed efficiency.

13. Enter the number of times the feedlot will be turned per year. The computer uses this number to buy and sell the correct number of cattle, etc. It assumes that all cattle groups in the year will be similar. To handle dissimilar groups, different systems must be used.

To determine how many days are required to turn the feedlot once, add days-on-feed to days between cattle batches. Days on feed = $[\frac{\text{wt. out - (wt. in - inshrink)}}{\text{ADG}}]$.

14. Enter a 0 if the system uses the present type of facility, a 1 if the first new type, and a 2 if the second new type. Be certain that the required facility type has been defined in the facilities section.

15. Enter the variable cost for each head in the system. This would include:

	Sys 1	Sys 2	Sys 3	Sys 4	Sys 5	Sys 6
Salt, minerals, vitamins	____	____	____	____	____	____
Veterinary, medicine	____	____	____	____	____	____
Bedding, waste removal (minus manure credit)	____	____	____	____	____	____
Interest on cattle	____	____	____	____	____	____
Miscellaneous	____	____	____	____	____	____
Total	$____	$____	$____	$____	$____	$____

Labor.

16-21. Enter the hours spent during each time period on the care of each head in the system. If a certain system is not in operation during a time period leave the space blank.

Labor requirements per period will be dependent on your facilities, ADG and size of cattle. An average might be from 1 hour per head per two-month period for calves in an open lot which are fed at a low ADG (hence high roughage) to as little as ½ hour per head per two-month period for yearlings in confinement at a high ADG.

22. Enter the percentage of cattle that you expect to lose during the feeding period.

23. Enter the weight that you wish the cattle to attain at the end of the feeding period in pounds.

24. Enter the expected percentage shrink out of the lot. This percentage will be subtracted from the weight out of the lot to get the actual selling weight.

25. Enter the price that you expect to receive for your cattle in dollars per hundredweight.

Operators constraints on system sizes.

26, 27. Enter any upper or lower limits that you wish to impose on the system due to management considerations. Care must be used not to impose a lower limit that cannot be reached. Either or both limits may be, and often will be, left blank.

Table 14. Pounds per bushel of wet corn necessary to equal 1 bu. No. 2 corn[a]

Present moisture in corn (%)[b]	Shelled corn (lbs./bu.)	Ear corn (lbs./bu.)
1-11	53	64
12-13	54	65.5
14-15	55	67.5
16-17	56.5	69.5
18-19	58	72
20-21	59.5	74.5
22-23	61	77.5
24-25	62.5	80.5
26-27	64.5	83.5
28-30	66.5	87
31-33	69.5	91.5
34-37	73	97
38-40	77.5	101.5

[a]Source: Adapted from Extension Publication AG-205 (21).

[b]How to use:

1. Find moisture content of your corn.

2. Get appropriate number from the table.

3. To find price $(\frac{56}{\text{No. from table}})$ X Present price = Right price.

4. To find Max Quantity $(\frac{56}{\text{No. from table}})$ X Present quantity = Corrected quantity.

5. For ear corn use 70 instead of 56 as the numerator.

Table 15. Estimation of storage and wastage losses[a]

	Storage loss %	Range %	Handling and feeding wastage	Range %
Grain	0.5	0.2-1	0.5	0.1-1
Hay			2.0	1-5
(Field cured, no rain)	3.6	2-4		
(Field cured, rain damaged)	4.0	3-5		
Silages			5.0	2-10
1. Gas tight silo	5.0	1-11		
2. Concrete stave silo	6.0	2-12		
3. Bunker or trench silo	15.0	10-26		
4. Stack	20.0	10-25		
Roughages				
Stacked cornstalk aftermath	10.0	5-15	5.0	2-10

[a]Source: Adapted from Extension Publication Pm 535 (24).

Table 16. Estimated yields of common Iowa hay and pasture forages[a]

	Management		Hay (ton/acre)		Pasture (TDN/acre)	
	Fert.[b]	System[c]	Yield	Range	Yield	Range
Legumes						
Alfalfa		H3	5.0	4.0-6.0		
Birdsfoot trefoil		CG			2.1	1.7-2.4
		H1G	1.7	1.5-2.0	0.6	0.4-0.8
Crown vetch		CG			3.0	2.7-3.3
Red clover		H3	4.2	3.5-5.0		
Legume grass						
Alfalfa/grass		H3	3.7	3.0-45.		
		H2G	2.2	2.0-4.5	1.3	1.2-1.5
		H1G	1.8	1.5-2.0	2.0	1.8-2.2
		AG			2.4	1.8-3.0
Birdsfoot trefoil/ grass	60N	H1G	1.6	1.3-1.7	1.0	0.8-1.2
	60N	CG			1.5	1.3-1.8

[a]Source: Adapted from Dobbins (13), Schaller (37), and Extension Publications AG-92 (28), AG-90 (29), Pm-538 (36), Pm-569 (50).

[b]Fertilizers:
60N = 60 lbs. nitrogen
120N = 120 lbs. nitrogen
240N = 240 lbs. nitrogen.

[c]Management systems:
H3 = Harvest 3 cuttings
CT = Continuous grain
H1G = Harvest 1 cutting, graze
H2G = Harvest 2 cuttings, graze
AG = Alternate graze.
3SG = Three season graze.

Table 16. Continued.

	Management		Hay (ton/acre)		Pasture (TDN/acre)	
	Fert.[b]	System[c]	Yield	Range	Yield	Range
White clover/ Kentucky bluegrass	60N	CG			1.4	1.2-1.5
<u>Grass</u>						
Kentucky bluegrass (unimproved)		CG			0.9	0.6-1.4
	60N	CG			1.9	1.2-2.6
Orchardgrass		H3	4.0	3.5-4.5		
	120N	CG			2.4	2.0-2.8
	120N	3SG			2.1	1.7-2.4
Reed canarygrass		H3	4.5	4.0-5.0		
	120N	CG			2.8	2.3-3.4
Timothy		H3	4.2	3.0-5.0		
Reed canarygrass	240N	3SG			3.2	2.0-4.5
	240N	H1G	2.6	2.4-2.8	2.3	1.5-3.0
Smooth brome		H3	4.2	3.7-4.6		
	120	CH			2.4	2.0-2.7
	120N	3SG			2.1	1.9-2.4
	60N	CG			3.3	3.0-3.6
Tall fescue		H3	4.4			
	240N	3SG			3.5	2.0-5.0
Cornstalk aftermath machine harvested			1.6	1.2-2.0		

Table 16. Continued.

	Management		Hay (ton/acre)		Pasture (TDN/acre)	
	Fert.[b]	System[c]	Yield	Range	Yield	Range
Grazed					1.0	0.5-1.5
Soybean stover			0.9	0.7-1.1		

Legume pasture: Ton (dry matter) = approximately 88 AUD (Animal Unit Days) or 2.9 AUM (Animal Unit Months).

Legume grass pasture: Ton (dry matter) = approximately 84 AUD or 2.8 AUM.

Grass pasture: Ton (dry matter) = approximately 81 AUD or 2.7 AUM.

An AUD is considered to be the amount of pasture necessary for a 1,000 lb. cow for 1 day or 16 lbs. of TDN.

An AUM is considered to be the amount of pasture necessary for a 1,000 lb. cow for 1 month or 480 lbs. of TDN.

Table 17. Adjustment factors for feed efficiency for feedlot[a]

1. Breed of cattle

Breed	Adjustment
a. British, Exotic, British X Exotic	1.0
b. Holstein	1.12
c. Holstein X British	1.06

2. Body condition and previous rate of gain

Body condition	Previous rate of gain	Adjustment
a. Very fleshy	2.2 lbs./day	1.05-1.1
b. Average	1.5 lbs./day	1.0
c. Very thin	1.0 lbs./day	0.9-0.96

3. Environmental stress

Lot condition	Adjustment
a. Outside lot, frequent deep mud in winter, no shade in summer.	1.3
b. Outside lot, no shelter but well mounded, bedding during adverse weather	1.1
c. No mud, shelter with good ventilation, no chill stress	1.0

4. Growth stimulants and feed additives

Stimulants	Adjustment
a. None	1.07
b. Antibiotics only	1.05

[a]Source: Adapted from Fox and Black (22).

Table 17. Continued.

c. DES, Synovex S, or Ralgro for steers MGA, Synovex H, or Ralgro for heifers	1.0
d. Rumensin	0.92
5. Adjustment for feed quality — 0.9 to 1.1 depending on how the feed you feed compares with average quality feeds.	
6. Adjustment for management — 0.9 to 1.1.	

To arrive at feed efficiency use the following formula:

Efficiency = 1 X adjustment for breed X adjustment for condition X adjustment for environmental stress X adjustment for growth stimulants X adjustment for feed quality X adjustment for management ability.

Table 18. Building costs for 100 head capacity open lot with shelter or windbreak fence[a]

Item	Open lot-shelter		Open lot-windbreak fence	
	Total	Per head	Total	Per head
Windbreak fence 8' high	166	1.66	662	6.62
Pole building 20 sq. ft./hd.	4,866	48.66	–	–
Concrete paving 58 cu. yd. @ $30 plus labor	2,192	21.92	2,192	21.92
Precast concrete bunks 1 ft./hd. @ $10/ln. ft.	1,000	10.00	1,000	10.00
Road along bunk (60 yd. gravel)	336	3.36	336	3.36
Cable fence, posts and gates	606	6.06	606	6.06
Dirt mound 30 sq. ft./hd. (500 cu. yd.)	450	4.50	450	4.50
Waterers, pipe, trenching	330	3.30	330	3.30
Electric wiring and lights	192	1.92	192	1.92
Grading (460 cu. yd.)	277	2.77	277	2.77
Land 1.2 ac. @ $1200	1,440	14.40	1,440	14.40
	11,855	118.55	7,485	74.85

[a]Source: Adapted from Boehlje and Trede (7).

Table 19. Building costs for 300 head capacity cold confinement unit[a]

Item	Deep pit		Flush gutter	
	Total	Per head	Total	Per head
Land (0.25 ac. @ $1200)	$ 300	$ 1.00	$ 300	$ 1.00
Building (40 X 200)	22,850	76.17	22,850	76.17
Concrete approach-vehicles	240	.80	240	.80
Floor 24 X 200 slotted @ $1.75/sq. yd.	8,400	28.00		
with 400' flushing flumes			8,500	28.33
Bunks (200' @ $12)	2,400	8.00	2,400	8.00
Gates (25 @ $50)	1,250	4.17	1,250	4.17
Waterers (3 @ $210)	630	2.10	630	2.10
Pipe and labor	350	1.17	350	1.17
Electricity	425	1.42	425	1.42
Lagoon (75' X 200' X 16') 4000 cu. yd. dirt			4,800	16.00
pipe and trench			480	1.60
pump and electricity			1,000	3.33
land (0.61 ac. @ $1200)			735	2.45
Pit (200' X 24' X 8') 1600 cu. yd. dirt removed	1,725	5.75		
200 cu. yd. concrete	6,000	20.00		
steel re-rod	1,000	3.33		
forming material	1,700	5.67		

[a]Source: Adapted from Boehlje and Trede (7).

Table 19. Continued.

Item	Deep pit Total	Deep pit Per head	Flush gutter Total	Flush gutter Per head
labor	10,000	33.33		
Totals	$57,270	$190.91	$43,960	$146.54

APPENDIX C: BEEF-OPT DATA FORM

(Completed using data from demonstration farm)

Beef-Opt Data Form

Name: Demonstration Farm

Address: Northwest Iowa

Date: November 1976

Section 1

FEEDS

List price, at feedbunk, for feeds available to your operations. If the quantity you have available is limited specify the limit in the Maximum Quantity column. Use the second Price, Maximum Quantity columns only if you have a second source for that feed at a higher price. If a feed is not available, leave it blank and the computer will drop it from consideration.

GRAINS:

		One		Two	
	Units	Price	Maximum Quantity	Price	Maximum Quantity
Corn	56 lbs./bu.	2.40	15,000	2.55	
Ground ear corn	70 lbs./bu.	2.70	15,000		
Sorghum	60 lbs./bu.				
Oats	32 lbs./bu.				
Barley	48 lbs./bu.				
Wheat	60 lbs./bu.				
Grain screenings	Tons				

	One		Two	
	Price	Maximum Quantity	Price	Maximum Quantity
HAYS: (in tons)				
Alfalfa	50	200	60	
Legume (less than 30% grass)				
Legume/Grass (30%-70% grass)				
Grass	45	100		
SILAGES: (in tons)				
Corn	21	1500		
Corn Stover				
Sorghum				
Sorghum/Sudan				
Oat				
Legume				
Legume/Grass				
SUPPLEMENTS: (in tons)				
Soybean oilmeal (40-45% protein)	180			
Protein Mixture (approx. 30% protein)	128			
Urea				
ROUGHAGES: (in tons)				
Ground Cobs				
Corn Stover (machine harvested)	13	200		
Small Grain Straw				

	One		Two	
	Price	Maximum Quantity	Price	Maximum Quantity
Soybean Stover (machine harvested)				
PASTURE: (in tons of dry matter)				
Legume (less than 30% grass)				
Legume grass (30-70% grass)				
Grass (greater than 70% grass)	15	45	22	45
Cornstalk Aftermath	5	200		
Winter Wheat				

Section 2

LABOR

List the total number of hours available for the beef operation for each two-month period. This includes the operator and family labor plus any labor hired on a monthly or yearly basis. If part-time help can be hired on an hourly basis during any or all periods list the cost per hour and the maximum number of hours that can be hired during each period.

	Total family and permanent hired	Cost to hire add. labor/hour	Maximum hireable hours/period
January-February	300	3.50	360
March-April	180	4.50	360
May-June	160	3.50	360
July-August	200	3.50	360
September-October	60	4.50	360
November-December	180	3.50	360

List the yearly fixed cost for family labor and permanent hired labor that should be charged against the total beef operation.

Family Labor Fixed Cost $ 5,000

Permanent Labor Fixed Cost $ 0

Section 3

FACILITIES

Cow-Calf

List the variable and fixed costs for the cow-calf facilities presently available on your farm along with the maximum number of cow-calf units the facilities can presently handle and a descriptive name. If you are willing to build additional facilities of the same type fill in lines 4-7. If not, leave blank and the computer will drop the alternative of building more from consideration. If you call for "present" facilities in (cow-calf production sys) section 4, line 12, this segment must be filled in.

<u>Present Type</u>. NAME: Pasture Calving

1. Variable cost per head space. $ 2
2. Total yearly fixed cost. $ 250
3. Number of head space presently available. 50

<u>Additions to present type</u>.

4. Variable cost per head space. $______
5. Yearly fixed cost per head space if built. $______
6. Investment per head spaces if built. $______
7. Maximum number of head spaces willing to build. ______

If you do not have cow-calf facilities or would like to test a system using a different type, designate the new facilities with a name and fill in lines 8-11. If left blank, the computer will drop the option from consideration. If you call for "new" facilities in (cow-calf production systems), section 4, line 12, this segment must be filled in.

<u>New type of facilities</u>. NAME: Barn lot, pasture

8. Variable cost per head space. $ 6
9. Yearly fixed cost per head space if built. $ 10
10. Investment per head space if built. $ 20
11. Maximum number of head spaces willing to build. 50

Backgrounding

List the variable and fixed costs for the backgrounding facilities presently available on your farm along with the maximum number of cattle the facilities can presently handle and a descriptive name. If you are willing to build additional facilities of the same type fill in lines 4-7.

If not leave blank, and the computer will drop the alternative of building facilities from consideration. If you call for "present" facilities in (Backgrounding Production System) section 5 line 12 this segment must be filled in.

Present type. NAME: Open lot, trees

1. Variable cost per head space. $ 2

2. Total yearly fixed cost. $ 1500

3. Number of head spaces presently available. 150

Additions to present type.

4. Variable and building cost per head space. $ 1.50

5. Yearly fixed cost per head space if built. $ 14

6. Investment per head space if built. $ 70

7. Maximum number of head spaces willing to build. 100

If you do not have backgrounding facilities or if you would like to test a system using a different type of facility, designate the new facility with a name and fill in lines 8-11. If left blank, the computer will drop the option from consideration. If you call for "new" facilities in (Backgrounding Production Systems), section 5, line 12 this segment must be filled in.

New type of facilities. NAME: Grazing, present lot

8. Variable and building costs per head space. $ 20

9. Yearly fixed cost per head space. $ 10

10. Investment per head space if built. $ 20

11. Maximum number of head spaces willing to build. 150

Feedlot

List the variable and fixed costs for feedlot facilities presently available on your farm along with the maximum number of cattle the facilities can presently handle and a descriptive name. If you are willing to build additional facilities of the same type fill in lines 4-7. If not, leave blank and the computer will drop the alternative of building more from consideration. If you call for "present" facilities in (Feedlot Production Systems), section 6, line 14 this segment must be filled in.

Present type. NAME: Open lot, shelter

1. Variable cost per head space. $ 3

2. Total yearly fixed cost. $ 4500

3. Number of head spaces presently available. 300

Additions to present type.

4. Variable and building cost per head space. $ 2

5. Yearly fixed cost per head space if built. $ 20

6. Investment per head space if built. $ 100

7. Maximum number of head spaces willing to build. 100

If you do not have feedlot facilities or would like to test a system using a different type of facility, designate the new facilities with a name and fill in lines 8-11. If left blank the computer will drop the option from consideration. If you call for "new" facilities in (Feedlot Production System), section 6, line 14 this segment must be filled in.

New type of facilities.

(A.) NAME: Confinement-pit

8. Variable cost per head space. $ 3

9. Yearly fixed cost per head space if built. $ 38

10. Investment per head space if built. $ 190

11. Maximum number of head spaces willing to build. 200

(B.) NAME: ____________

8. Variable cost per head space. $____

9. Yearly fixed cost per head space if built. $____

10. Investment per head space if built. $____

11. Maximum number of head spaces willing to build. 0

Section 4

COW-CALF PRODUCTION SYSTEMS

Section 4 deals with the cow-calf phase of beef production. If you wish to consider a cow herd as a production option fill in this section. If not, leave it blank and skip to section 5. Two alternate systems of management are possible. If you only wish to consider one option leave "Name system 2" blank and ignore the spaces provided for its data.

Name system 1 Spring Calving, pasture and stalks

Name system 2 Calving in lot, AI, past. summer

General Information Concerning Herd

1. Present number of cow units on hand. 30 hd.

2. Cost per head to buy additional cows. $275 /hd.

3. Buying and transportation costs per additional cows. $ 10 /hd.

4. Maximum number of head willing to add to herd. 20 /hd.

5. Average weight of mature cows in herd. 1000 lbs.

Description of the System

	System 1	System 2
1. Number of bulls per 100 cows.	4	0
2. Average weight of herd bulls.	1400	0
Replacement Heifers.		
3. Number of weaned heifers/100 cows.	17	17
4. Number of bred heifers/100 cows.	16	16
Effect of System on Feeding Rate		
5. Feed efficiency. (Average = 1)	1	1.03
Grazing Available during Lactation		
6. Pasture. (yes-0 no-1)	0	1
7. Cornstalk aftermath. (yes-0 no-1)	0	1
8. Winter wheat. (yes-0 no-1)	1	1
Grazing Available during Dry Period		
9. Pasture. (yes-0 no-1)	1	0
10. Cornstalk aftermath. (yes-0 no-1)	0	1
11. Winter wheat. (yes-0 no-1)	1	1
Facilities		
12. Type of facilities. (Present-0 New-1)	0	1
Variable Cost		
13. Variable cost per cow-calf unit.	22.50	31

Labor Requirements (hours per cow-calf unit)

14.	January-February	1	2
15.	March-April	2.5	1.25
16.	May-June	1.25	0.75
17.	July-August	1.25	2
18.	September-October	1	1
19.	November-December	2	2.5

Weaning Age, %, Weights

20.	Average age of calves at weaning (days)	210	215
21.	Percentage of cows that wean calves (%)	90	90
22.	Average weight of steers at weaning (lbs.)	450	450
23.	Average weight of heifers at weaning (lbs.)	420	420

Value of Calves Produced, Culls

24.	Selling price for heifers ($/cwt)	33	33
25.	Selling price for steers ($/cwt)	38	38
26.	Percentage of cows culled (%)	16	16
27.	Selling price for culls ($/cwt)	25	25

Operators Constraints on System Sizes

28.	Upper limit. (Blank if no limit)		
29.	Lower limit. (Blank if no limit)	20	

Section 5

BACKGROUNDING PRODUCTION SYSTEMS

Section 5 allows for the definition of up to four possible management systems for the backgrounding of calves. If you do not wish to consider backgrounding as a production option skip this section. For each management system you wish to consider place a descriptive name in the space provided and fill in the associated data column. You may specify from 1 to 4 backgrounding options but you must do so in system number order.

Name system #1. Steer calf 1.35 ADG

Name system #2. Steer calf 2.1 ADG

Name system #3. Heifer calf 1.4 ADG

Name system #4. Heifer calf 1.92 ADG

	System #1	System #2	System #3	System #4
Description of the Systems				
1. Calf type (steer-0 heifer-1)	0	0	1	1

	System #1	System #2	System #3	System #4
Calf Acquisition				
2. Buying price ($/cwt)	40	40	35	35
3. Buying weight (lbs.)	450	450	420	420
4. Inshrink (%)	3	3	3	3
Consider Calves from Cow-Calf Systems				
5. Cow-calf system 1 (yes-1 no-blank)	1		1	
6. Cow-calf system 2 (yes-1 no-blank)		1		1
Average Daily Gain Calves Are Expected to Make				
7. Average daily gain (lbs./day)	1.35	2.1	1.4	1.92

Effect of System on Feeding Rate				
8. Feed efficiency (1 is average)	1	1	1	1
Grazing Available (yes-0 no-1)				
9. Pasture	1	0	1	0
10. Cornstalk aftermath	0	1	0	1
11. Winter wheat	1	1	1	1
Facilities				
12. Type of facilities (present-0 new-1)	0	1	0	1
Variable Cost				
13. Variable cost ($/hd.)	21	24	18	20
Labor Hours Per Head				
14. January-February	1		1	
15. March-April	0.8		0.8	
16. May-June				
17. July-August		1		1
18. September-October		6		6
19. November-December	0.6	0.8	0.6	0.8
Cattle Output				
20. Death loss (%)	1.5	1.5	1.5	1.5
21. Weight out (lbs.)	666	666	609	609
22. Outshrink	1.5	1.5	1.5	1.5
23. Selling price ($/cwt)	38	38	32	32

Operators Constraints on System Sizes (Blank if no limit)

24. Upper bounds	____	____	____	____
25. Lower bounds	____	____	____	____

Section 6

FEEDLOT PRODUCTION SYSTEMS

Section 6 allows for the definition of up to six possible management systems for the feeding of cattle in a feedlot. If you do not wish to consider a feedlot operation skip this section. For each management system you wish to consider place a descriptive name in the space provided and fill in the associated data column. You may specify from 1 to 6 feeding options but you must do so in system number order.

Name system.
1. Steer calves 2 ADG 325 days
2. Steer calves 2.4 ADG 277 days
3. Yearling steers 2.76 ADG 180 days
4. Yearling steers 2.5 ADG 166 days
5. Heifer calves 1.9 ADG 258 days
6. Heifer yearlings 2.3 ADG 154 days

Description of the Systems

	1	2	3	4	5	6
1. Feeder type (steer-0 heifer-1)	0	0	0	0	1	1
Cattle Acquisition						
2. Buying price ($/cwt)	40	40	38	39	35	35
3. Buying weight (lbs.)	450	450	666	750	420	609

4. Inshrink (%)	3	3	2	2	3	2
Consider Calves Transferred in from Cow-Calf Systems (yes-1 no-blank)						
5. Cow-calf system 1	1				1	
6. Cow-calf system 2						
Consider Yearlings Transferred in from Backgrounding Systems						
7. Backgrounding 1			1			
8. Backgrounding 2			1			
9. Backgrounding 3						
10. Backgrounding 4						
Average Daily Gain Cattle Are Expected to Make						
11. Average daily gain (lbs./day)	2	2.4	2.76	2.5	1.9	2.3
Effect of System on Feeding Rate						
12. Feed efficiency (1 is average)	1	1	1	1	1	1
Number of Times Feedlot Is Turned Per Year						
13. Turns per year	1	1.2	2	2.1	1.4	2.2
Facilities						
14. Type of facilities (present-0 new A-1) (new B-2)	0	0	1	1	0	1
15. Variable cost ($/head)	39	36	40	28	32	26
Labor (hours/head)						
16. January-February	0.7	0.8	0.8	0.9	0.9	0.9
17. March-April	0.7	0.8	1	0.8	0.9	0.9
18. May-June	0.7	0.8	0.8	0.8	0.9	0.9
19. July-August	0.7	0.8	0.8	0.8	0.9	0.9

20.	September-October	0.2	0.8	1	0.8	0.9	0.9
21.	November-December	1	0.8	0.8	0.9	0.9	0.9

Cattle Output

22.	Death loss (%)	1.5	1.5	1	1	1.5	1
23.	Weight out of lot (lbs.)	1100	1100	1150	1150	900	950
24.	Outshrink (%)	3	3	3	3	3	3
25.	Selling price ($/cwt)	43	43	43	43	41	41

Operators Constraints on Systems Sizes (Blank if no limit)

26.	Upper bounds						
27.	Lower bounds						

APPENDIX D: REPORT RETURNED TO FARMER

(Using demonstration farm as an example)

NAME DEMONSTRATION FARM

ADDRESS NORTHWEST IOWA

DATE NOV., 1976

SECTION I. PRODUCTION ACTIVITIES

COW-CALF ACTIVITIES

A. 30.00 HEAD OF COWS. 30.00 HEAD IN SYSTEM #1. 0.0 HEAD IN SYSTEM #2.

SYSTEM #1 SPRING CALVING.PASTURE & STALKS

1. 30.00 HEAD OF COWS

1.20 HEAD BULLS.

5.10 HEAD WEANED REPLACEMENT HEIFERS.

4.80 HEAD YEARLING REPLACEMENT HEIFERS.

3. OPERATING COSTS

30.00 HEAD AT $ 22.50 PER HEAD VARIABLE COST = $ 675.00 (A)

4. FEEDS FED

A) LACTATING PERIOD.

FEED	AMOUNT	COST/UNIT*	COST
CORN STOVER	23.01 TON	$ 13.00/TON	$ 299.18
GRASS PASTURE	50.29 TON	$ 15.00/TON	$ 754.28

B) DRY PERIOD.

FEED	AMOUNT	COST/UNIT*	COST
PROTEIN MIX	4.16 TON	$ 128.00/TON	$ 532.05
CORNSTALK ATFERMATH	59.08 TON	$ 5.00/TON	$ 295.39

TOTAL FEED COST $ 1880.89 (B)

* PRICE #1 ALWAYS USED AS COST/UNIT

5. FACILITIES

PASTURE CALVING

30.00 HEAD SPACES AT $ 2.00 PER HD. SPACE VARIABLE COST = $ 60.00 (C)

TOTAL OPERATING COST (A+B+C) = $ 2615.89

6. LABOR

JAN - FEB	30.00 HOURS
MAR - APR	75.00 HOURS
MAY - JUNE	37.50 HOURS
JULY- AUG	37.50 HOURS
SEPT- OCT	30.00 HOURS
NOV - DEC	60.00 HOURS

7. REVENUE

13.50 HEIFERS WEANED MINUS 5.10 HEIFERS SAVED AS REPLACEMENTS EQUALS
8.40 HEIFERS AT 4.20 CWT EACH = 35.28 CWT
AT $ 33.00 PER CWT IMPLIED PRICE = $ 1164.24

13.50 STEERS WEANED AT 4.50 CWT EACH = 60.75 CWT
AT $ 38.00 PER CWT IMPLIED PRICE = $ 2308.50

4.80 COWS CULLED AT 10.00 CWT EACH = 48.00 CWT
AT $ 25.00 PER CWT IMPLIED PRICE = $ 1200.00

TOTAL REVENUE $ 4672.74

ALLOCATION OF CALVES PRODUCED

AT 90.00% WEANED 13.50 HEAD STEERS AND 13.50 HEAD HEIFERS PRODUCED

5.10 HEAD HEIFERS SAVED AS REPLACEMENT

8.40 HEIFERS SOLD AT $ 33.00 PER CWT = $ 1164.24

0.0 STEERS SOLD AT $ 38.00 PER CWT = $ 0.0

13.50 STEERS TRANSFERRED TO STEER CALF 1.35 ADG

8. RATIOS

FEED COST PER CWT WEANED WE&GHT $ 16.01

OPERATING COST PER CWT WEANED WE&GHT $ 22.27

9. RETURN TO MANAGEMENT, LABOR, FIXED COST

$ 4672.74 TOTAL REVENUE MINUS $ 2615.89 OPERATING COSTS = $ 2056.85

10. ON PER HEAD BASIS RETURN = $ 68.56

SYSTEM 2:FALL CALVING IN LOT,A.I., PAST. SUMMER WAS NOT IN THE OPTIMAL SOLUTION.

INCOME WOULD BE REDUCED $ 0.0 IF ONE COW-CALF UNIT WAS REQUIRED TO BE PRODUCED

BACKGROUNDING ACTIVITIES

SYSTEM 1:STEER CALF 1.35 ADG

1. 13.50 HEAD STEERS

2. BUYING COST

0.0 HEAD PURCHASED AT $ 40.00 PER CWT. = $ 0.0

13.50 HEAD TRANSFERRED FROM SPRING CALVING,PASTURE & STALKS

AT AN OPPORTUNITY COST EQUAL TO $ 2308.50

TOTAL COST OF CALVES $ 2308.50

3. OPERATING COSTS

13.50 HEAD AT $ 21.00 PER HEAD VARIABLE COST = $ 283.50 (A)

4. FEEDS FED

FEED	AMOUNT		COST/UNIT*		COST
CORN GRAIN	22.78 BU.	$	2.40/BU.	$	54.66
SOYBEAN OILMEAL	2.22 TON	$	180.00/TON	$	400.21
CORNSTALK ATFERMATH	13.24 TON	$	5.00/TON	$	66.21

TOTAL FEED COST $ 521.08 (B)

* PRICE #1 ALWAYS USED AS COST/UNIT

5. FACILITIES

OPEN LOT,TREES

13.50 HEAD SPACES AT $ 2.00 PER HD. SPACE VARIABLE COST = $ 27.00 (C)

TOTAL OPERATING COST (A+B+C) = $ 831.58

6. LABOR

JAN - FEB	13.50 HOURS
MAR - APR	10.80 HOURS
MAY - JUNE	0.0 HOURS
JULY- AUG	0.0 HOURS
SEPT- OCT	0.0 HOURS
NOV - DEC	8.10 HOURS

7. REVENUE

13.50 HEAD PRODUCED MINUS 0.20 HEAD DEATH LOSS EQUALS 13.30 HEAD

0.0 HEAD SOLD AT $ 38.00 PER CWT. EQUALS $ 0.0

13.30HEAD TRANSFERRED TO YEARLING STEERS 2.76 ADG 180 DAYS

AT $ 38.00PER CWT. OPPORTUNITY COST $ 3365.33

TOTAL REVENUE $ 3365.33

8. RATIOS

FEED COSTS PER CWT OF GAIN $ 17.87

OPERATING COST PER CWT OF GAIN $ 28.52

9. RETURN TO MANAGEMENT, LABOR, FIXED COST

$ 3365.33 TOTAL REVENUE MINUS $ 831.58 OPERATING COSTS = $ 2533.75

MINUS $ 2308.50 COST OF ACQUIRING CALVES = $ 225.25

10. ON PER HEAD BASIS RETURN = $ 16.69

SYSTEM 2:STEER CALF 2.1 ADG WAS NOT IN THE OPTIMAL SOLUTION.

INCOME WOULD BE REDUCED $ 0.0 IF ONE HEAD WAS REQUIRED TO BE BACKGROUNDED UNDER THIS SYSTEM

SYSTEM 3:HEIFER CALF 1.4 ADG WAS NOT IN THE OPTIMAL SOLUTION.

INCOME WOULD BE REDUCED $ 0.0 IF ONE HEAD WAS REQUIRED TO BE BACKGROUNDED UNDER THIS SYSTEM

SYSTEM 4:HEIFER CALF 1.92 ADG WAS NOT IN THE OPTIMAL SOLUTION.

INCOME WOULD BE REDUCED $ -20.50 IF ONE HEAD WAS REQUIRED TO BE BACKGROUNDED UNDER THIS SYSTEM

FEEDLOT ACTIVITIES

SYSTEM 1:STEER CALVES 2.0 ADG 325 DAYS WAS NOT IN THE OPTIMAL SOLUTION.

INCOME WOULD BE REDUCED $ 0.0 IF ONE HEAD WAS REQUIRED TC BE FED UNDER THIS SYSTEM

SYSTEM 2:STEER CALVES 2.4 ADG 277 DAYS

1. 400.00 HEAD STEERS PER TURN 1.20 TURNS PER YEAR

2. BUYING COST

480.00 HEAD PURCHASED AT $ 40.00 PER CWT. = $ 86399.94

TOTAL COST OF CALVES $ 86399.94

3. OPERATING COSTS

480.00 HEAD AT $ 36.00 PER HEAD VARIABLE COST = $ 17279.99 (A)

4. FEEDS FED

FEED	AMOUNT	COST/UNIT*	COST
CORN GRAIN	9731.45 BU.	$ 2.40/BU.	$ 23355.46
GROUND EAR CORN	2305.38 BU.	$ 2.70/BU.	$ 6224.52
ALFALFA HAY	287.41 TON	$ 50.00/TON	$ 14370.53
GRASS HAY	100.00 TON	$ 45.00/TON	$ 4499.96
CORN SILAGE	1500.15 TON	$ 21.00/TON	$ 31503.05

TOTAL FEED COST $ 79953.50 (B)

* PRICE #1 ALWAYS USED AS COST/UNIT

5. FACILITIES

OPEN LOT, SHELTER

400.00 HEAD SPACES AT $ 3.00 PER HD. SPACE VARIABLE COST = $ 1200.00 (C)

TOTAL OPERATING COST (A+B+C) = $ 98433.44

6. LABOR

JAN - FEB	320.00	HOURS
MAR - APR	320.00	HOURS
MAY - JUNE	320.00	HOURS
JULY- AUG	320.00	HOURS
SEPT- OCT	320.00	HOURS
NOV - DEC	320.00	HOURS

7. REVENUE

480.00 HEAD PRODUCED MINUS 7.20 HEAD DEATH LOSS EQUALS 472.80 HEAD SOLD

AT $ 43.00 PER CWT. TOTAL REVENUE = $ 216925.06

8. RATIOS

FEED COSTS PER CWT OF GAIN $ 25.63

OPERATING COST PER CWT OF GAIN $ 31.55

9. RETURN TO MANAGEMENT, LABOR, FIXED COST

$ 216925.06 TOTAL REVENUE MINUS $ 98433.44 OPERATING COSTS = $ 118491.63

MINUS $ 86399.94 COST OF ACQUIRING CALVES = $ 32091.69

10. ON PER HEAD BASIS RETURN = $ 66.86

SYSTEM 3:YEARLING STEERS 2.76 ADG 180 DAYS

1. 70.00 HEAD STEERS PER TURN 2.00 TURNS PER YEAR

2. BUYING COST

126.70 HEAD PURCHASED AT $ 38.00 PER CWT. = $ 32065.84

13.30 HEAD TRANSFERRED FROM STEER CALF 1.35 ADG

AT AN OPPORTUNITY COST EQUAL TO $ 3365.33

TOTAL COST OF CALVES $ 35431.17

3. OPERATING COSTS

140.00 HEAD AT $ 30.00 PER HEAD VARIABLE COST = $ 4200.00 (A)

4. FEEDS FED

FEED	AMOUNT	COST/UNIT*	COST
CORN GRAIN	5246.38 BU.	$ 2.40/BU.	$ 12591.30
GROUND EAR CORN	1734.38 BU.	$ 2.70/BU.	$ 4682.82
ALFALFA HAY	62.95 TON	$ 50.00/TON	$ 3147.52

TOTAL FEED COST $ 20421.65 (B)

* PRICE #1 ALWAYS USED AS COST/UNIT

5. FACILITIES

CONFINEMENT-PIT FAC.

70.00 HEAD SPACES AT $ 3.00 PER HD. SPACE VARIABLE COST = $ 210.00 (C)

TOTAL OPERATING COST (A+B+C) = $ 24831.64

6. LABOR

JAN - FEB	56.00 HOURS
MAR - APR	70.00 HOURS
MAY - JUNE	56.00 HOURS
JULY- AUG	56.00 HOURS
SEPT- OCT	70.00 HOURS
NOV - DEC	56.00 HOURS

7. REVENUE

140.00 HEAD PRODUCED MINUS 1.40 HEAD DEATH LOSS EQUALS 138.60 HEAD SOLD

AT $ 43.00 PER CWT. TOTAL REVENUE = $ 66481.50

8. RATIOS

FEED COSTS PER CWT OF GAIN $ 30.14

OPERATING COST PER CWT OF GAIN $ 36.65

9. RETURN TO MANAGEMENT, LABOR, FIXED COST

$ 66481.50 TOTAL REVENUE MINUS $ 24831.64 OPERATING COSTS = $ 41649.86

MINUS $ 35431.17 COST OF ACQUIRING CALVES = $ 6218.68

10. ON PER HEAD BASIS RETURN = $ 44.42

SYSTEM 4:YEARLING STEERS 2.5 ADG 166 DAYS WAS NOT IN THE OPTIMAL SOLUTION.

INCOME WOULD BE REDUCED $ 0.0 IF ONE HEAD WAS REQUIRED TO BE FED UNDER THIS SYSTEM

SYSTEM 5:HEIFER CALVES 1.9 ADG 258 DAYS WAS NOT IN THE OPTIMAL SOLUTION.

INCOME WOULD BE REDUCED $ 0.0 IF ONE HEAD WAS REQUIRED TO BE FED UNDER THIS SYSTEM

SYSTEM 6:HEIFER YEARLINGS 2.3 ADG 154 DAYS WAS NOT IN THE OPTIMAL SOLUTION.

INCOME WOULD BE REDUCED $ 0.0 IF ONE HEAD WAS REQUIRED TO BE FED UNDER THIS SYSTEM

SECTION II. RESOURCES USED

1. FEEDS

FEED	PRICE #1	AMOUNT	COST	MAX. AVAIL	REDUCED COST	PRICE #2	AMOUNT	COST	MAX. AVAIL	REDUCED COST
CORN GRAIN	2.40	15000.00	35999.98	15000.00	0.00	2.55	0.0	0.0		-0.15
GROUND EAR CORN	2.70	4039.27	10906.03	15000.00	0.0					
ALFALFA HAY	50.00	200.00	10000.00	200.00	10.00	60.00	150.30	9017.73		0.0
GRASS HAY	45.00	100.00	4500.00	100.00	0.91					
CORN SILAGE	21.00	1500.00	31499.99	1500.00	4.60					
SOYBEAN OILMEAL	180.00	2.22	400.13		0.0					
PROTEIN MIX	128.00	4.16	531.95		0.0					
CORN STOVER	13.00	23.01	299.18	200.00	0.0					
GRASS PASTURE	15.00	45.00	675.00	45.00	7.00	22.00	5.30	116.57	30.00	0.0
CORNSTALK ATFERMATH	5.00	72.34	361.70	200.00	0.0					

TOTAL COST OF FEEDS FED $ 104307.94

REDUCED COST:

IF POSITIVE EQUALS - THE ADDED VALUE OF ONE MORE UNIT AT THAT PRICE

IF NEGATIVE EQUALS - THE CHANGE IN PRICE REQUIRED BEFORE FEED WOULD BE FED

2. LABOR

	OPERATOR AND PERMANENT HIRED HRS AVAIL	HRS USED	MAX HRS HIRABLE	HOURS HIRED	TOTAL HRS USED	COST/HR TO HIRE	COST TO HIRE	COST TO PROGRAM OF HAVING 1 LESS AVAIL
JAN - FEB	300.00 HR	300.00 HR	360.00 HR	119.50 HR	419.50 HR	$ 3.50/HR	$ 418.25	$ 0.0
MAR - APR	180.00 HR	180.00 HR	360.00 HR	295.80 HR	475.80 HR	$ 4.50/HR	$ 1331.10	$ 0.0
MAY - JUN	160.00 HR	160.00 HR	360.00 HR	253.50 HR	413.50 HR	$ 3.50/HR	$ 887.25	$ 0.0
JULY - AUG	200.00 HR	200.00 HR	360.00 HR	213.50 HR	413.50 HR	$ 3.50/HR	$ 747.25	$ 0.0
SEPT - OCT	60.00 HR	60.00 HR	360.00 HR	360.00 HR	420.00 HR	$ 4.50/HR	$ 1620.00	$ 21.27
NOV - DEC	180.00 HR	180.00 HR	360.00 HR	264.10 HR	444.10 HR	$ 3.50/HR	$ 924.35	$ 0.0

HOURLY HIRED LABOR COST $ 5928.19

OPERATOR FIXED LABOR COST $ 5000.00

PERMANENT HIRED LABOR COST $ 0.0

3. FACILITIES

NAME	SPACE AVAIL OR WILLING TO BUILD	HEAD SPACE USED	VARIABLE COST PER HEADSPACE	VARIABLE COST	YEARLY FIXED COST/HD.SPACE	YEARLY FIXED COST	NEW INVESTMENT
COW-CALF FACILITIES							
PASTURE CALVING	50.00	30.00	2.00	60.00	0.0	250.00	0.0
BARN LOT,PASTURE	50.00	0.0	6.00	0.0	10.00	0.0	0.0
BACKGROUNDING FACILITIES							
OPEN LOT,TREES	150.00	13.50	2.00	27.00	0.0	1500.00	0.0
ADDITIONS TO PRESENT	100.00	0.0	1.50	0.0	14.00	0.0	0.0
GRAZING,PRESENT LOT	150.00	0.0	2.00	0.0	10.00	0.0	0.0
FEEDLOT FACILITIES							
OPEN LOT,SHELTER	300.00	300.00	3.00	900.00	0.0	4500.00	0.0
ADDITIONS TO PRESENT	100.00	100.00	2.00	200.00	20.00	2000.00	10000.00
CONFINEMENT-PIT FAC.	200.00	70.00	3.00	210.00	38.00	2660.00	13300.00

TOTAL VARIABLE $ 1397.00 TOTAL FIXED $ 10909.99

TOTAL NEW INVESTMENT $ 23299.99

TOTAL FACILITIES COST $ 12306.99 (VARIABLE PLUS FIXED)

SECTION III. TOTAL RETURN TO MANAGEMENT, FIXED LABOR AND OTHER COSTS AND INVESTMENT

COW-CALF ACTIVITIES

SPRING CALVING,PASTURE & STALKS	$	2056.85
FALL CALVING IN LOT,A.I., PAST. SUMMER	$	0.0

BACKGROUNDING ACTIVITIES

STEER CALF 1.35 ADG	$	225.25
STEER CALF 2.1 ADG	$	0.0
HEIFER CALF 1.4 ADG	$	0.0
HEIFER CALF 1.92 ADG	$	0.0

FEEDLOT ACTIVITIES

STEER CALVES 2.0 ADG 325 DAYS	$	0.0
STEER CALVES 2.4 ADG 277 DAYS	$	32091.69
YEARLING STEERS 2.76 ADG 180 DAYS	$	6218.68
YEARLING STEERS 2.5 ADG 166 DAYS	$	0.0
HEIFER CALVES 1.9 ADG 258 DAYS	$	0.0
HEIFER YEARLINGS 2.3 ADG 154 DAYS	$	0.0
TOTAL	$	40592.47

MINUS HIRED LABOR COST	$	5928.19
MINUS FIXED LABOR COST	$	5000.00
MINUS FIXED FACILITIES COST	$	10909.99
MINUS ADJUSTMENT FOR FEED PRICE DIFFERENCE	$	1530.88

EQUALS RETURN TO MANAGEMENT AND INVESTMENT	$	17223.41