ECONOMIC ANALYSIS OF STOCKER CATTLE PRODUCTION ALTERNATIVES USING A COMPUTER SIMULATION MODEL

By

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SIMULATION MODEL

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PREFACE

This study deals with production of stocker cattle in Oklahoma. A model is developed to predict animal gains and economic consequences of various stocker cattle production systems. This allows comparison of alternative choices to be made.

The author wishes to express his appreciation to his major adviser, Dr. Odell L. Walker, for his guidance, assistance and encouragement throughout this study. Special thanks are also due the other committee members, Dr. Gerald Horn, for his contribution to quality and accuracy in both the model and the final manuscript and to Dr. Ted Nelson for his assistance in programming the model.

Thanks are expressed to Billie Blackburn, Chuck Eginton, Janice Calhoun and the many others who offered assistance, advice and support which were essential in completing this study.

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CHAPTER I

INTRODUCTION

Many of Oklahoma's pastures are used for growing calves instead of cow-calf systems. These stocker cattle operations are an important part of Oklahoma's cattle industry. Many producers do not realize the profit potential in new technological advances and some feed their cattle on uneconomic planes of nutrition. Stocker cattle producers and their bankers could benefit from information provided by the results of stocker cattle research, if they knew how to include it in their decisionmaking. A timely, accurate and convenient procedure is needed to compare and evaluate the profit potential of stocker cattle enterprises from year to year and season to season and from one group of cattle to another.

Animal science and agronomy researchers have investigated specific aspects of stocker cattle production and have attempted to account for differences in the gains of stocker cattle. The results of research efforts show the effects of such factors as feed additives, growth stimulants, forage quality, genetics, environment, and different management systems on stocker cattle production. Oklahoma's cattle producers and financial institutions could improve decisions, if the results of all the research efforts about stocker cattle were available in a form that would make accurate estimates of the economic consequences of various stocker cattle alternatives readily available. The major purpose of this study is to develop and provide computerized analytical procedures to estimate physical and economic results of alternative stocker production systems.

Objectives

1. Develop a model for predicting cattle performance from a given set of information on a specific stocker cattle operation.
2. Compare the profitability of various stocker cattle production choices by using the model developed.

Procedure

1. Review the literature from agronomy and animal science experiments on stocker cattle. From these experiments determine the relationship between observed gain and the factors that account for the variation in observed gain. Use the relationship between observed gain and the variables that account for its variation to develop a growth simulation model for Oklahoma stocker cattle. In order that the model may be readily used by stocker cattle producers, it will be developed for use on the Radio Shack TRS-80 mini-computer. The model will provide economic analysis of production decisions.
2. With historical data use the model to test the profitability of Oklahoma stocker cattle production systems.

Other Beef Production Simulation Models

A model is used to simplify the real world in order to make it easier to study. Conceptually a model is a concise, systematically organized statement of a process in the real world, including the specification of the input and the output, the processes and the subprocesses involved, the variables and constants, and the data organization (Lehman, 1977). The real world is governed by a set of laws. A computer is restricted in the same way and can simulate a real process. For this reason a model is often developed for operation on a computer.

Data from actual happenings is used to develop theory. A model is an application of this theory to a specific situation. Assumptions are made to simplify reality in order to make it possible to study. A model therefore is a simplified simulation of a natural process which uses theory and known relationships as the basis for its design.

The model and its theoretical framework need to be empirically tested. Simulation is a test of the theory by operating the model. The simulation is valid if it adequately reflects those aspects of the real world it was designed to model.

Researchers have developed models which aid in analyzing production choices. These decision tools are helpful in meeting the research objectives, but are considered insufficient for analyzing Oklahoma stocker cattle for various reasons. Currently, Oklahoma State University (OSU) has enterprise budgets (Department of Agricultural Economics, OSU, 1980) which model specific stocker cattle production choices. But, there is much information that is not incorporated into the budgets. Also, the budgets lack flexibility in that only a discrete number of choices can be analyzed.

Oklahoma State University's Beef Projection Program designed by Nelson (1979) uses continuous functions to analyze beef production in feedlot situations. However, the Nelson model is not designed for cattle on high roughage diets and additional variables should be included to improve the flexibility of the model. Fox and Black (1977) developed a model which included adjustments for additional variables in cattle growth and used continuous growth functions. But, it was designed specifically for feedlot situations in the corn belt and therefore not applicable to Oklahoma stocker cattle.

The model described in this work uses information from all three of these sources. But, it is specifically designed to provide a framework for analyzing stocker cattle production in Oklahoma. It was designed to offer flexibility needed to simulate an individual's operation and accuracy in analyzing aggregate situations. The model was designed to give results for production conditions in Oklahoma and similar areas. The model outlined in this work uses the OSU Beef Projection program as a base. Fox and Black's work was also used as a guide in many areas. Finance and cost data from Oklahoma State's budgets were also used.

The variables and constants used in the model are developed and supported in Chapter II, while Chapter III gives an outline of the data needed to run the model. Chapter IV gives a brief description of the computer program used and its capabilities. It also shows the results of the model when compared to research experiments. Examples of application of the model in production decisions comprise Chapter V. Chapter VI consists of the summary and implications for further study.

CHAPTER II

MODEL DEVELOPMENT

This chapter is devoted to consideration of variables affecting stocker cattle's ability to convert energy from forage into beef. Past research efforts are analyzed and used as justification for relationships developed in the model used in the study. Data and assumptions used to develop the values used in the model are presented. The equations and constants used to project cattle performance are given and supported by past research efforts.

Energy Requirements

Many variables affect the ability of an animal to convert the energy available in forage into beef. Researchers have done much work in analyzing animals' energy requirements. For many years total digestible nutrients (TDN) was the most commonly used system of measuring energy requirements. TDN measures the sum of four digestible organic nutrients; protein, fiber, nitrogen-free extract and fat. The TDN of a feed measures the digestible energy of a feed in terms of carbohydrate equivalent. In this way, it uses the energy content of carbohydrates as a base.

TDN, as a measure of feed energy, does not account for energy losses such as the gas produced and heat lost through physiological processes. Since these losses are relatively larger for roughages than for concentrates, a pound of TDN in roughage does not have the same value for productive purposes that a pound of TDN in concentrate does. Crampton and Harris (1969) state that TDN values for roughages consistently and appreciably overestimate the usable energy of forages by ruminant animals.

The California Net Energy System (CNES) (Lofgreen and Garrett, 1968), has become the most widely used energy system for ration formulation and gain projection for feedlot cattle in the United States (Fox and Black, 1977). The CNES is also used as the base for the energy requirements in the National Research Council (NRC) "Nutrient Requirements of Beef Cattle" (National Academy of Sciences, 1976). Unlike TDN, net energy is the energy available to the animal after losses due to physiological processes have been deducted.

The net energy system separates net energy into net energy for maintenance (NE_m) and net energy for gain (NE_g). NE_m is a measure of the amount of feed required to maintain an animal in energy balance with no weight loss or gain. It expresses the value of a given feed for maintaining animal weight. NE_g is a measure of the energy stored in new body tissue by the addition of feed above the maintenance requirement of the animal. It expresses the value of a given feed for producing weight gain.

Although CNES was developed primarily using high quality rations, it appears to also be the best method of evaluating energy requirements of cattle on a high roughage diet. After comparing the results of actual gains of Oklahoma stocker cattle with gains predicted by the various energy systems, the net energy system was selected as the best method of evaluating energy requirements. For this reason, the CNES equations were included in the model. The energy requirements for maintenance as developed in the CNES are,

$$NEMR = .043W^{.75}$$

where: NEMR = Net energy required for maintenance (Mcal/day)

W = Empty body weight in pounds ($W^{.75}$ is known as metabolic weight)

The net energy available for gain (NEGA) can then be calculated by the following equation:

$$NEGA = (INTAKE - (NEMR/NE_m))\ (NE_g)$$

where: INTAKE = Daily dry matter intake (lb/day)

NE_m = The net energy for maintenance value of the feedstuff (Mcal/lb feed)

NE_g = The net energy for gain value of the feedstuff (Mcal/lb feed)

The gain for steers (lb/day) is predicted as

$$Gain = \frac{\sqrt{.0001748 + (.003112)(NEGA/W^{.75})} - .01322}{.001556}$$

and for heifers,

$$Gain = \frac{\sqrt{.0001974 + (.005756)(NEGA/W^{.75})} - .01405}{.002878}$$

The CNES framework was developed using average frame size, British breed cattle which were given a DES implant in a relatively stress-free environment. Adjustments are made later in this analysis for cattle that do not fall into this category.

Intake

Assuming one can accurately forecast an animal's ability to convert a given amount of forage to tissue, one must then predict the animal's voluntary intake in order to predict gain. Intake regulation by grazing animals comes under the control of many factors. Baile and Forbes (1974) discussed many of these factors that affect voluntary intake. Voluntary intake is controlled by both physiological and physical factors. Physiological refers to chemical changes in the animals which regulate appetite. Physical refers to regulation of intake by the physical capacity of the rumen.

Energy content of the ration has been shown to be a major factor in intake regulation. Baumgart (1970) presented data on non-lactating ruminants fed a ration which varied in energy content. The data showed that regulation of digestible energy (DE) intake was maintained when the energy content exceeded 2.5 Kcal DE/g. However, regulation of voluntary intake is a function of the capacity of the rumen and the rate of feed residue removal from this organ when feeding low quality feedstuffs to ruminants with high energy demands such as rapidly gaining stockers (Baile and Forbes, 1974). Journet and Redmond (1976) also state that the slow process of digestion principally limits intake of fibrous feed components.

The basis for the primary intake function used in the model is a study by Conrad _et al_. (1964). This study used diets ranging from 52 to 80 percent dry matter digestibility to study voluntary intake. Intake of rations between 52 and 66 percent digestibility was dependent on body size, rate of passage and digestibility. But, intake of rations between 67 and 80 percent digestibility decreased with increasing digestibility and were dependent on metabolic body size and energy needed to sustain the animal's rate of gain or level of milk production.

Conrad et al. (1964) reported that voluntary intake could be predicted at TDN levels up to 66 percent by this equation,

$$I = \frac{.0107W}{(1 - \%D)}$$

where: I = Voluntary intake of dry matter in lbs.

W = Animal body weight in lbs.

%D = Percent of ration that is digestible defined as TDN/100

The equation was compared to equations developed from data obtained from experiments in Oklahoma. Similar results were obtained from data by Wilson (1979). However, a significant relationship between digestibility and intake could not be found when aggregating the results of other experiments ($p > .10$)(Mader, 1979; Smith, 1973; Hopson, 1971; and Rider and Boyer, 1974).

Rumen capacity is directly correlated with body weight. However, for high digestibilities intake is more closely related to energy requirements. Energy requirements under the net energy system use metabolic weight ($W^{.75}$). Conrad et al. (1964) reported that body weight to the .37 power best fit the regression of intake on body weight, while Blaxter et al. (1961) found that body weight to the .734 power for sheep and a similar relationship for steers (Blaxter and Wilson, 1962) best fit the regression.

Dinius et al. (1976) used the standard metabolic weight for their intake equation. It was for rations with DE of 2.8 Kcal/g to 3.6 Kcal/g.

This equation forms the basis of the intake equation for feedstuffs with a TDN greater than 66. The equation as reported by Dinius et al. (1976) was: [D.M. Intake ($g/w^{.75}$) = 227.9 - 38.4 DE(Kcal/g)]. In order to use this equation in the model developed in the present study, DE was converted to TDN by the relationship used in the NRC publication "Nutrient Requirements of Beef Cattle" (TDN = DE/.04409). When this equation was used in conjunction with the equation for low digestibilities problems occurred due to the fact one equation used actual weight and one used metabolic weight. This resulted in a discontinuous intake function where a small change in digestibility resulted in a large change in intake at the point the two functions interchanged. In one instance using wheat pasture, TDN dropped from 67 to 65 and intake increased from 12 to 17 lb. per day.

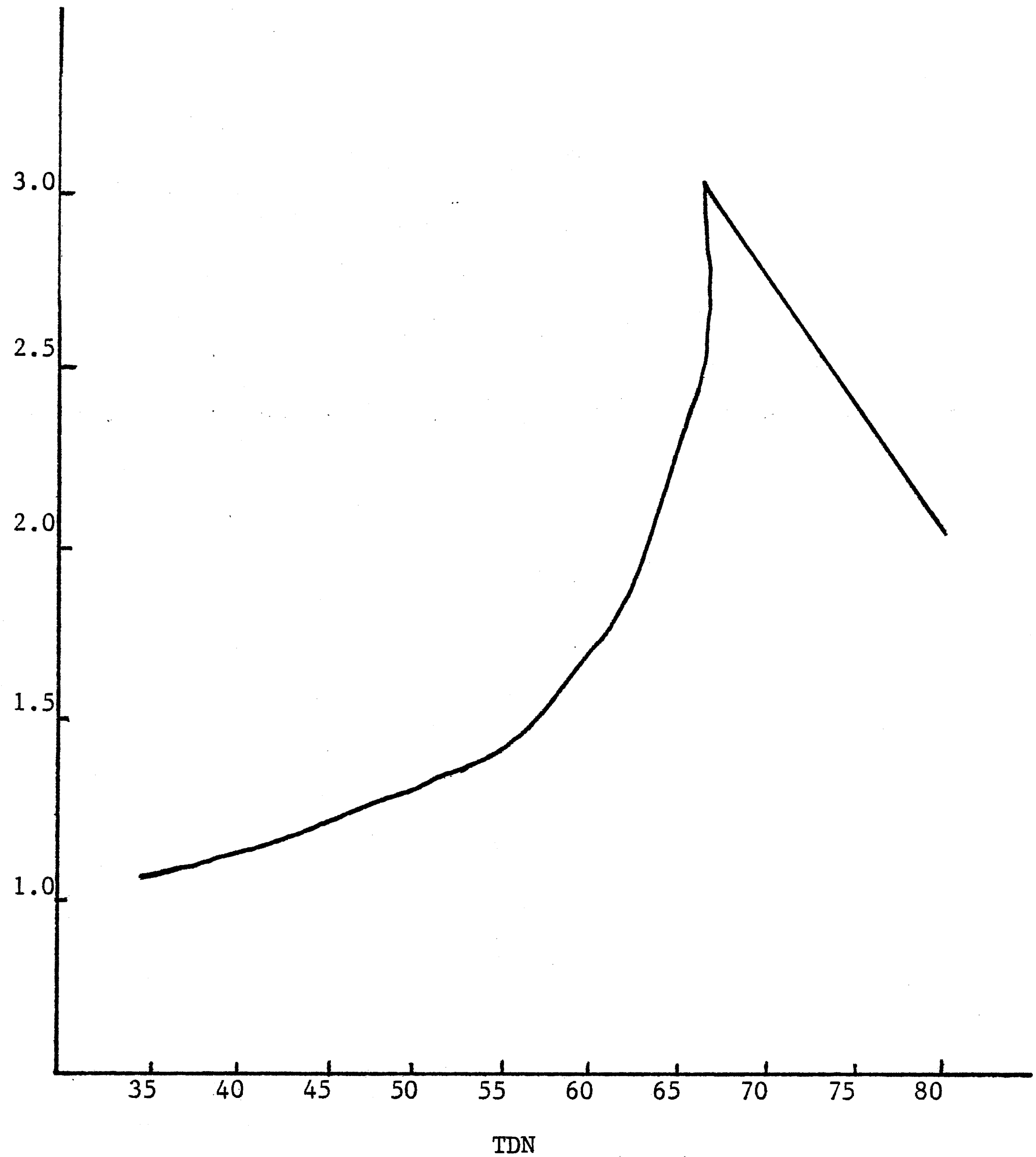
In order to make the intake function continuous for all digestibilities and weights the equation by Dinius et al. (1976) was converted to a function of actual weight. This was done by first solving for the weight of animal where the two equations intersected with a TDN of 66. The parameters of the equation by Dinius et al. (1976) were then converted to give the same answer for a function of weight or $W^{.75}$ at the weight the two original equations intersected when TDN equalled 66. The final intake equation for TDN's greater than 66 is:

$$\text{Intake} = (.061742 - .00045866\ \text{TDN})\ W$$

where: Intake = Dry matter intake per day in pounds

W = Body weight in pounds

This equation causes the model to predict very slowly increasing gains as digestibility increases. Figure 1 shows how intake increases with digestibility at low levels of digestibility and decreases with in-



Source: Conrad _et al_. (1964), Dinius _et al_. (1976)

Figure 1. Relationship Between Forage Digestibility and Voluntary Intake

creases in digestibility at high levels of digestibility. If feed over 67 percent digestibility had been used exclusively, the unmodified Dinius equation could have been used.

There are more factors affecting intake than digestibility. Some of these factors are lignin content, protein content and palatability of the forage. Also past nutritional treatment and genetic background of the animal are important. Some of these factors and others will be discussed later. Also, caution must be exercised when using the results of these intake equations with certain forages such as lovegrass and fescue where a palatability factor may be involved. Reid and Jung (1965) and Bryan et al. (1970) reported increased intake of fescue as forage matured and digestibility decreased during the fall season. A variable was not included in the model for this palatability factor. Thus, the adjustment must be made elsewhere, for example in the forage quality data put in the model for a particular analysis. If actual[1] fescue quality data are used, the model will tend to overpredict intake and therefore average daily gain.

Compensatory Growth

Compensatory growth has been defined by Wilson and Osbourn (1960) as the ability of an animal, previously restricted in growth, to resume growth at a rate greater than normal for animals of the same chronological age. In their review, Wilson and Osbourn (1960) also indicate that the ability of animals to recover from the retardation

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[1]Actual as used here means the quality estimate obtained from laboratory analysis.

sustained during a period of undernutrition has been amply demonstrated.

Experiments indicate that when animals on pasture or other forage rations are fed supplemental feed, and subsequently fed high concentrate rations, they usually gain at slower rates than animals not previously supplemented (Dowe *et al.* 1957; Miller and Morrison, 1953; Peacock *et al.* 1964; Perry *et al.* 1971, 1972). Also, when young cattle were wintered on a low plane of nutrition they made the highest gains on spring and summer grass (Eckles and Swett, 1918; Nelson and Campbell, 1954; Bohman and Torell, 1956; Heinemann and Van Keuren, 1956; Knox and Oakes, 1964; Bisschoff *et al.* 1967; Jones *et al.* 1974). But, some experimenters have reported no compensatory growth even though previous levels of nutrition and rates of growth of two or more groups of cattle were quite different (Baker and Baker, 1952; Baker *et al.* 1956; Stuedemann *et al.* 1967; Levy *et al.* 1971; Lake *et al.* 1974; Coleman *et al.* 1976).

Even though the results of compensatory gain experiments are not consistent there is sufficient evidence to document its existence (Wilson and Osbourn, 1960). The cause of compensatory growth is in question. Wilson and Osbourn (1960) concluded that the increased growth was due to increased intake. The development of the alimentary tract of animals is only very slightly retarded by undernutrition, and is related to chronological age rather than to the physiological age of animal (Trowbridge *et al.* 1918; McMeekan, 1941; Wallace, 1948; Palsson and Verges, 1952; Wilson, 1954). Wilson and Osbourn (1960) suggested that an animal's intake was therefore directly related to chronological age since restricted animals have the capacity to ingest as much as their unrestricted counterparts. Restricted animals would therefore be expected to eat more and gain faster than younger animals of the same weight.

Many researchers have found that animals exhibiting compensatory gain increase intake of food during re-alimentation (Sheehy and Senior, 1942; Quimby, 1948; Winchester and Howe, 1955; Taylor, 1959; Osbourn and Wilson, 1960; Meyer and Clawson, 1964; Meyer et al. 1965; Ashworth, 1969; Fox et al. 1972; O'Donavan et al. 1972; Horton and Holmes, 1978). However, some researchers have reported an increase in energy utilization independent of increased feed intakes during re-alimentation (Meyer and Clawson, 1964; Meyer et al. 1965; Fox et al. 1972; Asplund et al. 1975). In their model Fox and Black (1977) assumed all compensatory growth to be due to increased efficiency of energy utilization. However, their decision was based primarily on one study by Fox et al. (1972). Research experiments have substantiated that compensatory growth is due both to increased intake and increased feed efficiency.

In the model being reported, half of the compensatory growth was assumed to be due to increased intake and half to increased net energy for gain and net energy for maintenance. To simplify the model the percentage effects on net energy for gain and net energy for maintenance were assumed to be the same even though Fox and Black (1977) concluded that there is a greater percentage change in net energy for gain. Fox, et al. (1972) also found an increase in the efficiency of utilization of protein but no adjustment for this was made in the reported model.

Wilson and Osbourn (1960) state that the amount of compensatory gain depends on several factors. Among these are the degree and duration of undernutrition, the stage of development of the body at the commencement of undernutrition, and the pattern of re-alimentation. The number of factors affecting compensatory growth may account for the fact that the results of compensatory growth experiments are inconsistent and highly variable. This high degree of variation made it impossible to quantify the effect of compensatory growth by aggregating actual data. Potter and Withycombe (1926) presented results to indicate that for every pound calves gain during the winter, they make from 0.42 to 0.58 lb. less gain during the grazing period. Beeson et al. (1949) indicated a reduction of 0.2 to 0.5 lb. and McCampbell (1922) showed a reduction ranging from 0.2 to 0.6 lb. in pasture gain for each pound of winter gain. Taylor et al. (1957) demonstrated that carcass gains for re-alimented cattle, restricted during the winter period, were 40 percent greater than the carcass gains of the control group. Similar results were obtained by Winchester and Howe (1955). But, despite the increased summer gain, decreased winter gains resulted in decreased total gains (Ruby et al. 1949). In the model being outlined, cattle undergoing compensatory growth were assumed to regain half of the difference in weight between themselves and their unrestricted counterparts. This agrees with Horton and Holmes (1978) and Bond et al. (1972).

Some additional information about compensatory growth has been documented. Compensatory growth effects are greater during early stages of re-alimentation (Horton and Holmes, 1978). In reviewing the literature, Fox et al. (1972) suggested that maximum compensatory growth occurs only when a high energy ration is used. Horton and Holmes (1978) found a significant difference in average daily gain

(ADG) during the first eight weeks of recovery and ADG was also substantially higher for the next eight weeks.

Based on the experimental results found, practical considerations and judgements, the assumptions of the compensatory growth multiplier used in the model are outlined below:

1. The original effects of compensatory growth depend on the animal's ADG the past 120 days.
2. 1.0 lb. ADG is average.
3. During re-alimentation animals will recover 50 percent of the difference in gain acquired during the restriction period when compared to a higher gaining group.
4. Fifty percent of increased gain is due to increased intake and 50 percent of increased gain is due to increased efficiency of energy utilization (higher NE_m and NE_g values).
5. The NE_m and NE_g multipliers (adjustment factors) are the same.
6. Maximum compensatory growth will occur only on a high quality forage such as wheat pasture.
7. There is a gradual decline of compensatory effects from restricted growth over time.

Fox and Black (1977) used one multiplier for the whole feeding period. In the model developed here, past growth restrictions are phased out and compensatory growth potential is allowed to develop within the model. The multipliers can be obtained from the following equations:

First 60 days: $$\text{IMULT} = \frac{1}{.9064 + .09684\ (\text{PG})}$$

$$\text{GMULT} = \frac{1}{.8866 + .1186\ (\text{PG})}$$

60 - 180 days:

$$IMULT = \frac{1}{.9064+.09684[(PG)(1-\frac{D-60}{180})+(AG)\frac{D-60}{180}]}$$

$$GMULT = \frac{1}{.8866+.1186[(PG)(1-\frac{D-60}{180})+(AG)\frac{D-60}{180}]}$$

Over 180 days:

$$IMULT = \frac{1}{.9064 + .09684\ (MG)}$$

$$GMULT = \frac{1}{.8866 + .1186\ (MG)}$$

where: IMULT = Multiplier for intake; INTAKE = Predicted intake x IMULT

GMULT = Multiplier for NE_g and NE_m

PG = ADG last 120 days before start

AG = ADG since start

D = Days since start

MG = ADG last 180 days

The effects of compensatory growth proved to be the most difficult to quantify of the variables studied. This set of equations meets most of the original specifications. Restricted animals placed on wheat pasture will recover half of the weight difference between them and their non-restricted counterparts. Slightly less response is obtained on lower quality forages. The effects of past restrictions are phased out and growth is affected by restriction within the model. But, the multipliers are constant the first 60 days instead of phasing out the effects of the previous plane of nutrition during this period. Also, the multiplier is originally based on ADG the previous 120 days but eventually on ADG the past 180 days. This makes the compensatory growth effects smaller from restriction within the model. The inconsistencies in the multiplier were introduced to eliminate an unrealistic "cobweb effect", where gain is reduced due to past compensatory growth, then gain is increased due to this reduction and the cycle continues. Even though the compensatory growth adjustment has faults, it does contribute to the predictive ability of the model. Table I shows the multipliers generated from various rates of gain.

TABLE I

ADJUSTMENT FOR STOCKER CATTLE UNDERGOING COMPENSATORY GROWTH

Previous ADG (lb/day)	Intake Mult.	Energy Mult.
0.0	1.10	1.13
0.5	1.05	1.06
1.0	1.00	1.00
1.5	.95	.94
2.0	.91	.89

Protein

Protein is an essential nutrient for animal growth. Inadequate protein results in both decreased gains and decreased intakes. Thus, the net energy approach requires the monitoring of protein as well as energy (Rockeman, 1978). The NRC uses digestible protein for its requirements. Geasler (1978) and Fox et al. (1977) suggested alternative measures of protein requirements. Data for metabolizable protein (Geasler, 1973) or net protein (Fox et al. 1977) methods were considered insufficient to be used in this analysis.

The data used in this analysis to predict protein requirements were given in the tables found in the NRC publication "Nutrient Requirements of Beef Cattle." The weight of the animal and its ADG are the variables that determine protein requirements according to the NRC publication. Utilizing the data from the NRC publication, these two variables were regressed against protein requirements. The equations thus obtained are:

For Steers: $TPR = .14989 + .0005749\ W + .2387\ (ADG)$

For Heifers: $TPR = .1764 + .000576\ W + .2225\ (ADG)$

where: TPR = Pounds of digestible protein required per day

W = Empty body weight in lbs.

ADG = Gain per day (lb/day)

This regression explained over 95 percent of the variation present in the NRC Tables. These equations should be sufficient to estimate protein requirements since the NRC publication "Nutrient Requirements of Beef Cattle", states that protein requirements are not altered by methods of feeding, feeding preparation, and various feed additives. But, requirements do depend on the animal's stage of maturity (Fox et al. 1977), which is not accounted for in the model. Animals at a lower point on the growth curve need more protein. The NRC publication does not adjust for this factor, so it was not included in the analysis.

Equivalent Weight

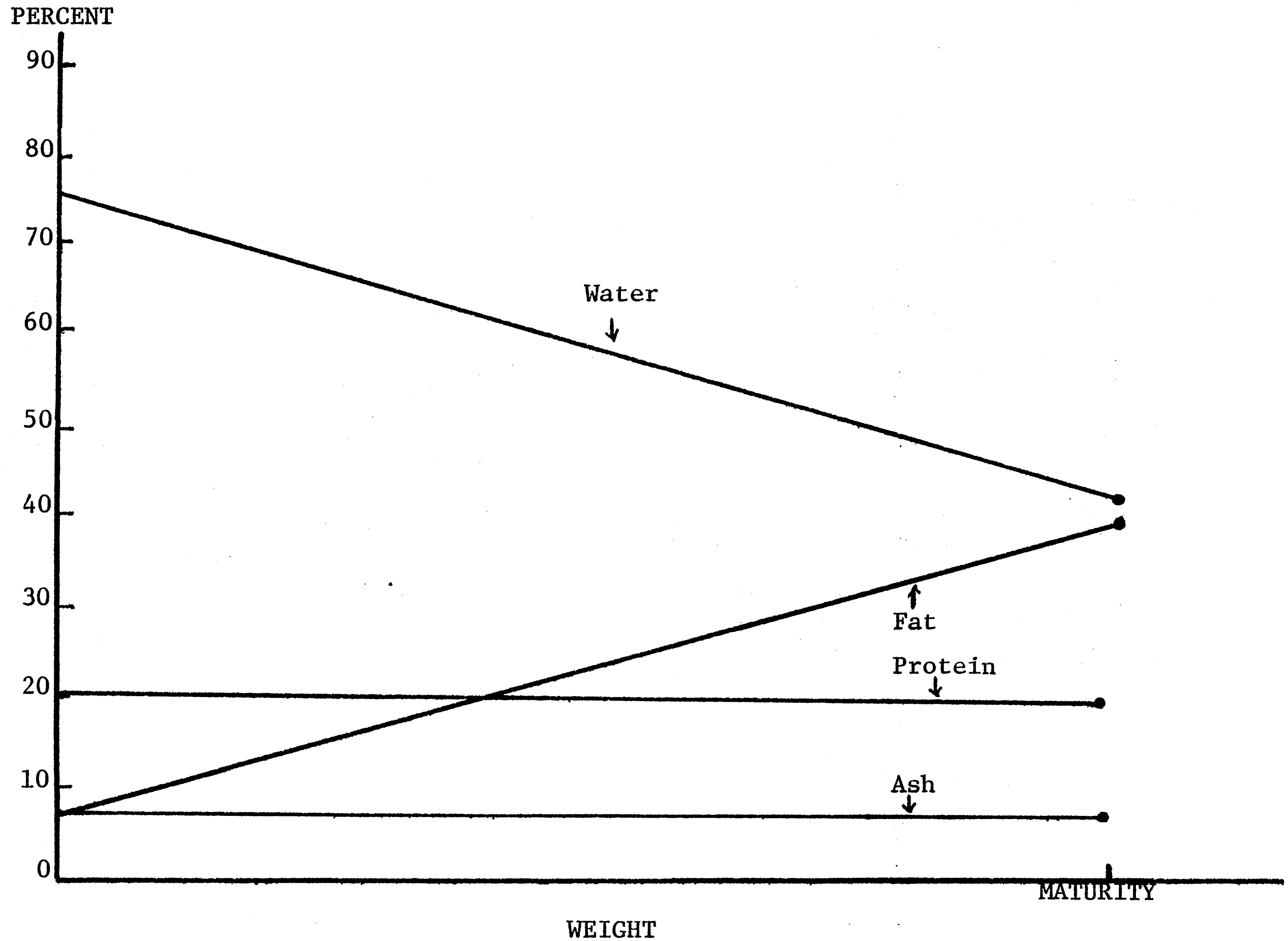
At a given body weight, certain breeds of cattle are known to gain weight faster than others. Fox and Black (1977) assumed that this was due to a difference in mature weight rather than breed per se. Research results suggest that differences in energetic efficiency for British breeds and for British x Exotic are small when animals are compared at the same stage of growth (Klosterman, 1974; Crickenberger et al. 1976; Harpster et al. 1976). For this reason no adjustments were made directly for breed. Adjustments were made for cattle of the same weight but at different stages of maturity.

The maintenance requirement is not affected by the animal's stage of maturity. It is approximately a function of body surface area which is a function of weight to the 3/4 power. However, cattle feeders know that more and more feed is required per pound of gain as cattle reach the end of the feeding period. This is due to cattle putting on more fat, which is high in energy content, relative to muscle which is high in water content. This change in body composition as an animal reaches maturity is shown in Figure 2. Therefore, the animal's efficiency in converting food to gain is actually a function of the animal's stage of maturity and not its actual body weight.

To account for this difference in gain requirements for cattle at different stages of maturity, but the same actual weight, Fox and Black (1977) introduced the concept of equivalent weights. An animal's equivalent weight can be predicted from the following equations:

For Steers: $$EW_t = \frac{1050}{CW} (AW_t)$$

For Heifers: $$EW_t = \frac{840}{CW} (AW_t)$$



Source: Wagner (1977)

Figure 2. Changes in Body Composition With Increasing Maturity of Cattle

where: 1050 lb. and 840 lb. are assumed to be average market weights for steers and heifers respectively.

AW_t = The animal's actual body weight in pounds at time t.

CW = The animal's expected weight at low choice or equivalent market weight for lower quality cattle.

EW_t = The animal's equivalent weight at time t (the weight of an average animal at the same stage of maturity).

The equivalent weight is used in the gain equation instead of actual weight. The gain for steers thus becomes:

$$\text{Gain} = \frac{\sqrt{.0001748 + (.003112)\ (\text{NEGA}/\text{EW}^{.75})} - .01322}{.001556}$$

Fox and Black (1977) say that with the change in energetic efficiency and an adjustment for equivalent weight in the intake function, the results obtained after adjusting for equivalent weight are consistent with the data from several studies. Fox and Black (1977) used a different set of intake equations for their feedlot model since intake of high energy rations is based primarily upon energy requirements. They also made no adjustments in intake for animals with equivalent weights of less than 800 pounds. Since stocker cattle's forage intake is a function of body capacity and stocker cattle are generally sold before they reach 800 pounds, intake was not adjusted for equivalent weight in this study.

Fox and Black (1977) concluded that Holsteins and Holstein crosses are less efficient and included an adjustment to increase intake and reduce efficiency of energy utilization for Holsteins. The model developed in this study underestimates intake and overestimates feed conversion for Holsteins, if Holsteins are less efficient as no adjustment is included.

One particular advantage of the equivalent weight adjustment is that it can be used in conjunction with the frame size category of the new system of feeder grades. Fox example, large frame feeder steers have an expected weight at U.S. Choice of at least 1,200 pounds. This is the information that is needed by the model to compute the adjustment for different mature sizes.

Growth Stimulants

Growth stimulants have been proven to increase average daily gain and feed efficiency in cattle. The major implants that have been used are diethylstilbestrol (DES), Synovex-S (for steers) or Synovex-H (for heifers) and Ralgro (zeranol). The FDA no longer allows the use of DES. The feeding experiment for which CNES was developed used a growth promotant (DES). Since use of DES is no longer legal, the CNES must be adjusted, unless other implants have the same effect.

Fox and Black (1977) assumed that the effects of DES and Synovex-S are equal. In this analysis, DES, Synovex-S and Synovex-H are also assumed to have equal effects on gain.

Cattle given a growth stimulant deposit more protein and less fat and must be fed to a higher weight in order to reach a given grade (Fox and Black, 1977). Fox and Black (1977) accounted for not using growth stimulants by changing the equivalent weight of the animal. This resulted in a change in energy required for gain and in intake.

No adjustment for intake is included here since stocker cattle's intake normally depends on body capacity and not energy requirements. The effect of growth stimulants was accounted for by using a multiplier for net energy available for gain. This essentially yields the same result as Fox and Black's adjustment. The NEGA multiplier for DES and Synovex was given the value 1.00, which means the CNES does not need to be adjusted when using Synovex or DES.

Data used in the analysis are from experiments by Harvey et al. (1959); Bradley et al. (1960); Ewing et al. (1967); Renbarger et al. (1968); McCroskey et al. (1969); Thomas and Hellyer (1973); Heinemann and Rogers (1973); Fontenot and Kelly (1974); Boggs et al. (1976); Smithson et al. (1977); Horn et al. (1978) and Sand (1978). The ratios of the amount of net energy required to give the differences in gains reported were computed using the experimental data. Each trial was given an equal weight. The multipliers used are the simple average of the multipliers implied by the experiments. The results are contained in Table II.

TABLE II

NEGA MULTIPLIERS FOR IMPLANTS
ON STOCKER CATTLE

Implant	Multiplier
DES	1.00
Synovex-S	1.00
Synovex-H	1.00
Ralgro	.91
No Implant	.76

The Ralgo multiplier being less than one is consistent with Fox and Black (1977). Armbruster (1975) and Wagner (1974) say that responses to Ralgro implants are less consistent than those to DES.

Wagner (1974) says that implanted stocker cattle will outgain their unimplanted counterparts by 15-21 percent. Hawkins (1970) in a summary of 19 experiments of cattle on grass reported an increase in gain of 22 percent. Since gain increases at a decreasing rate as the net energy available for gain increases, the .76 figure for non-implanted cattle would seem to be consistent with these other findings. The multiplier assumes cattle will be reimplanted according to manufacturer's instructions. Wagner (1974) and Sand (1978) say that the second implant may be as important as the first.

Rumensin

Monensin (Rumensin) is a biologically active compound produced by a strain of Streptomyces cinnomonensis and increases rumen fermentation and feed efficiency in cattle. Increased molar percentages of propionic acid (Potter et al. 1974; Utley et al. 1976; Perry et al. 1976; Dinius et al. 1976) which has a lower heat increment (Smith, 1971) and is used more efficiently, has been proposed as the reason for the increase in efficiency. In feedlot studies, Rumensin has had little effect on gain but has increased feed efficiency and decreased intake.

Several researchers have reported a significant ($p<.05$) increase in gain from Rumensin fed to stocker cattle (Potter et al. 1974; Oliver, 1975; Boling et al. 1977; Apple and Gill, 1977; Thomas, 1977; Horn et al. 1978; and Burris, 1978). But several experiments did not show a significant difference in average daily gain for cattle fed Rumensin (Anthony *et al*. 1975; Demuth *et al*. 1977; Thomas, 1977; Cmarik and Weichenthal, 1977; Horn *et al*. 1978; Crosthwait *et al*. 1979). Some possible reasons for the differences in research findings were given.

The recommended dosage for stocker cattle is 50 to 200 mg. per day. When intake of Rumensin in an experiment did not fall in this range, a favorable response would not be expected. Any experiment, where Rumensin was not fed at the recommended dosage, was excluded from the analysis.

A more consistent response to Rumensin was obtained in the experiments where the Rumensin was fed daily with a concentrate as the carrier rather than mixing the Rumensin in a free choice mineral supplement or protein block. This may be due to a constant intake of Rumensin when grain was the carrier. Also in some experiments with a mineral carrier, the unpalatable nature of Rumensin resulted in significantly reduced intake of the mineral containing Rumensin (Cmarik and Weichenthal, 1977; Demuth, 1977; Burris, 1978). The consumption of mineral may have been reduced enough to restrict growth. But since effects of the reduction in mineral intake are uncertain, experiments with either grain or mineral as a carrier were included. Thus, the estimate of the effects of monensin is an average for mineral and grain carriers. This is realistic since only one value for the effects of monensin was to be included in the analysis and producers use both grain and mineral as carriers. The multiplier may underestimate effects of Rumensin with a grain carrier and overestimate effects of Rumensin with a mineral carrier.

Lemenager et al. (1978) and Pond et al. (1980) found that cows reduced intake of forage when fed Rumensin. It is generally accepted that in feedlot cattle intake and rate of passage are decreased, while digestibility is increased and average daily gain remains constant. Rumensin's effects on intake of stocker cattle where intake is dependent on body capacity instead of energy requirements could not be expected to be the same. Cmarik and Weichenthal (1977) suggested that Rumensin reduced intake of stocker cattle. However, Horn et al. (1978) and Crosthwait et al. (1979) found no difference in intake for stocker cattle fed Rumensin. The effect of Rumensin on the intake of stocker cattle needs to be researched further, but for this analysis Rumensin was assumed to have no effect on intake. Thus, the increase in gain with Rumensin is due to increased digestibility of the forage and a shift in ruminal VFA's (Pond and Ellis, 1978; Pond et al., 1980).

In this analysis the effects of Rumensin are shown by increasing the TDN of the diet. The increase in TDN subsequently results in increased NE_m and NE_g values of the feed.

In summary, the assumptions used in deriving the Rumensin multiplier are:

1. Good response to Rumensin can be expected only when daily intakes of Rumensin are between 50 and 200 mg. per day.
2. Rumensin has no effect on the voluntary intake of stocker cattle.
3. The carrier used and the method of feeding make no difference in the response to Rumensin.
4. The increase in gain due to Rumensin results from increased digestibility of the forage and a shift in ruminal VFA's.

The value of the Rumensin multiplier was obtained by dividing the TDN necessary for the gain recorded with Rumensin by the TDN necessary for the gain recorded without the Rumensin. The multiplier used in the model is the average of the multiplier implied from all experiments used in the analysis. All trials listed in Table III, that had adequate intake of Rumensin were given equal weight in the analysis. Horn et al. (1978) was the only experiment where gains were significantly reduced by feeding Rumensin. This experiment was not included in the analysis because the cattle were not rotated between pastures, and the difference in gain may have been due to a difference in pastures and not to Rumensin.

The TDN multiplier estimated by this method was 1.05. Therefore, Rumensin was found to increase the digestibility of the forage by five percent. This five percent increase in TDN results in a greater than five percent increase in NE_m and NE_g. There is a greater percentage effect upon low quality forages as is shown in Table IV. The multiplier of 1.05 was assumed to be the correct multiplier for NE_m and NE_g for any concentrates that are fed. Since concentrates are seldom fed, the multipliers for concentrates were considered adequate even though Fox and Black (1977) used 1.10 for both NE_m and NE_g and Table IV would also imply a higher multiplier.

Poos et al. (1978) reported that Rumensin had a protein sparing effect. Even though research indicates this effect does exist, it was not included in the model because of insufficient research in the area. But, the model may overestimate protein requirements when using Rumensin.

TABLE III

SUMMARY OF MONENSIN EXPERIMENTS ON STOCKER CATTLE

Researcher	Head	Days	Monensin Level (mg./day)	A.D.G. (lb.)	Sig*	Carrier
Potter et al. (1974)	28	105	0	.81	a	corn
	28	105	100	1.03	b	daily
	28	105	200	1.12	b	
	28	105	200	.86	a	
Potter et al. (1974)	30	168	0	1.23	a	corn
	30	168	50	1.32	a	daily
	30	168	100	1.54	b	
	30	168	200	1.58	b	
Anthony et al. (1975)	20	112	0	1.43	a	C.S.M.
	20	112	25	1.43	a	daily
	20	112	50	1.47	a	
	20	112	100	1.52	a	
	20	112	200	1.54	a	
Oliver (1975)	20	140	0	1.25	a	corn
	20	140	25	1.54	b	daily
	20	140	50	1.61	b	
	20	140	100	1.72	b	
	20	140	200	1.56	b	
Apple and Gill (1977)	15	112	0	1.14	a	pellet
	15	112	200	1.43	b	daily
Apple and Gill (1977)	25	112	0	1.31	a	pellet
	25	112	200	1.60	b	daily
Boling et al. (1977)	18	140	0	1.21	a	corn
	18	140	25	1.21	a	daily
	18	140	50	1.61	b	
	18	140	100	1.50	b	
Cmarik and Weichenthal (1977)	18	91	0	.15	a	Molasses-mineral
	18	91	65.4	-.02	a	Block free-choice
Demuth et al. (1977)	11	193	0	2.16	a	mineral
	11	193	105	2.05	a	free-choice
Thomas (1977)	30	109	0	1.19	a	protien
	30	109	80	1.61	b	free-choice
Thomas (1977)	30	109	0	1.17	a	protein
	30	109	53	2.02	b	block free-choice

TABLE III (Continued)

Researcher	Head	Days	Monensin Level (mg./day)	A.D.G. (lbs.)	Sig*	Carrier
Thomas (1977)	39	93	0	.59	a	mineral
	41	93	195	.51	a	free-choice
Thomas (1977)	37	93	0	1.41	a	protien block
	40	93	61	1.39	a	free-choice
Burris (1978)	20	112	0	1.25	a	mineral
	20	112	50	1.30	a	free-choice
Burris (1978)	20	84	0	.90	a	mineral
	20	84	50	1.12	b	free-choice
Horn _et al._ (1978a)	43	86	0	1.67	a	pellets
	60	86	200	1.23	b	daily
Horn _et al._ (1978a)	60	120	0	.66	a	molasses-mineral
	60	120	36	.70	a	block free-choice
Horn _et al._ (1978b)	39	112	0	1.40	a	pellet
	39	112	85	1.61	b	
Crosthwait _et al._ (1979)	50	96	0	.94	a	pellet
	50	96	200	1.01	a	daily
Crosthwait _et al._ (1979)	50	133	0	1.67	a	corn
	50	133	200	1.71	a	daily

*experiments with different letters indicate the difference in A.D.G. was significant ($p < .05$).

TABLE IV

EFFECTS OF RUMENSIN ON TDN, NE_M, AND NE_G

TDN (%)	TDN_r* (%)	NE_m (Mcal/Cwt)	NE_{mr}* (Mcal/Cwt)	Ration	NE_g (Mcal/Cwt)	NE_{gr}* (Mcal/Cwt)	Ration
35	36.75	.72	.78	1.07	.005	.056	11.15
45	47.25	1.02	1.08	1.06	.295	.360	1.22
55	57.75	1.30	1.38	1.06	.585	.664	1.14
65	68.25	1.60	1.69	1.06	.875	.969	1.11
75	78.75	1.88	1.99	1.06	1.165	1.274	1.09
85	89.25	2.18	2.30	1.06	1.455	1.578	1.08

*These are the values when Rumensin is fed.

The research on Rumensin is still inadequate in some areas. But, the inclusion of a Rumensin multiplier still contributes to the accuracy and flexibility of the model. It offers a producer an opportunity to get a good estimate of the potential benefits of feeding Rumensin. This will allow a producer to measure the costs of feeding Rumensin against potential benefits.

Additional Comments

The model being reported contains adjustments for selected important variables affecting growth of stocker cattle. Other factors affect the gains of cattle on pasture. But, for various reasons they were not included in the model.

The model implicitly assumes there are no interactive effects between Rumensin, implants, compensatory growth and equivalent weight. Horn et al. (1978) found no interactive effects between Rumensin and implants. Fox and Black (1977) essentially assumed the same thing. There is no evidence that these effects are not additive and therefore the assumption of no interactive effects would seem to be the logical one.

The model also assumes no associative effects between feeds. For example, in the model, corn has the same energy value regardless of the level at which it is being fed. Fox and Black (1977) say that the higher percentage of a feed in the ration, the greater is its energy value per unit. If this factor existed, it would be important in feeding grain to cattle on grass. Research has studied the contributory effect of grain on grass. But, the research is inconsistent and therefore offered nothing to increase the accuracy of the model. Fox and

Black (1977) basically reached the same conclusion by admitting these effects do exist, but offering only possible adjustment factors and not including them directly in the model.

Fox and Black (1977) included an adjustment for environment since the CNES was developed in a thermal neutral environment. Webster _et al_. (1970) and Nelms (1973) compiled tables of temperatures, wind speeds and cattle weights where the maintenance requirement for stocker cattle would be increased. After reviewing these works, it appears that in Oklahoma, smaller, slowly gaining cattle during the coldest weeks of the year would have an increased maintenance requirement due to cold stress. No adjustment for cold stress was included in the model primarily because of the relative unimportance of this factor for Oklahoma and Oklahoma's unpredictable weather. But, under certain conditions, cold, wet, windy weather will increase cattle's maintenance requirement.

The growth equations used in the model assume cattle are in a thermal neutral environment. This should not matter, if cattle have access to shelter in winter, shade in summer, and access to good water. The growth equations also assume that salt and mineral needs are being met. If any of these assumptions are not met, the model can be expected to overestimate the cattle's performance.

CHAPTER III

DEVELOPMENT OF DATA USED IN THE ANALYSIS

The previous chapter dealt with how an animal converts forage into beef. This chapter deals with the data that is needed by the model to predict gains and provide an economic analysis of stocker cattle alternatives. Pastures, supplements, cattle prices and cost data are developed and discussed. The model and its theoretical framework was outlined previously. This chapter deals with the types of data that must be inputed for someone wanting to use the model.

Pasture Data

In order to estimate stocker gains measures of pasture quality and quantity of forage are needed. These measures are needed as discrete values for each of the twelve months. Thus, monthly estimates for major Oklahoma forages were developed to be used in the gain model. A user can use these values or substitute his own data, if he has additional information. Oklahoma data were used to compile the values except for only a few cases when they were not available.

The pasture data compiled are expected values for a given month. Quality values are estimates for what the cattle consume. Cattle tend to eat the best forage and leave the rest. Thus, the values estimated for quality may be higher than the values obtained from forage samples.

The quantity figures refer to how much forage a top manager's cattle would be allowed to consume in a given month. Thus, the quantity figures may be lower than actual total dry matter available for a specific month.

Eight different forages were selected to be included in the model. Others may be added, if the user chooses. The pastures selected as being typical for Oklahoma were overseeded bermudagrass, short native grass (primarily buffalograss), tall native grass (primarily bluestem), lovegrass, sudangrass, fescue and wheat pasture.

Not enough data are available to estimate net energy values directly. More data are available to estimate TDN values of the forage, so TDN was selected as the measure of forage quality. The TDN values are converted to NE_m and NE_g values by the equations reported by Van Soest (1973) where;

$$NE_m \text{ (Mcal/cwt.)} = 1.32 \text{ (TDN)} - 13.2$$

$$NE_g \text{ (Mcal/cwt.)} = 1.32 \text{ (TDN)} - 45.9$$

Many of the experiments used to compile the pasture data reported the <u>in vitro</u> digestible dry matter (IVDMD) of the forage from the method of Tilley and Terry (1963). The IVDMD values were converted to TDN by the equation from Oh, Baumgardt and Scholl (1966) where;

TDN = <u>in Vivo</u> DMD = 16.7 + .74 IVDMD

Monthly estimates of digestible protein for Oklahoma forages could not be obtained directly due to insufficient data. Crude protein values for each of the forages were estimated. The crude protein values were converted to digestible protein by the equation of Holter and Reid, (1959) where;

% Digestible Protein = .929 (% Crude Protein) - 3.48

This equation can yield digestible protein values less than zero. If digestible protein from the equation is negative, it is given a value of zero.

The quantity of forage to be consumed is expressed as pounds of dry matter per month. This quantity is the amount of dry matter cattle are expected to consume in a given month and is used only in valuing forages and estimating stocking rates. Vavra et al. (1973) says that actual gains are inversely related to stocking rates. The quantity of forage does not affect gain in the model since cattle are always assumed to be stocked at an optimum rate. The quantity of forage available figures assume an optimum pattern of utilization of the forage. Thus, in theory, cattle are added or removed from the pasture as needed and all forage for a given month is consumed. All the values for quantity were compiled by McMurphy (1977). The figures were originally in animal unit days per acre. They were converted to pounds per acre by multiplying by 22 pounds per animal unit day.

Eastern Oklahoma quantity values were used for fescue and western Oklahoma quantity values were used for short native grass. Central Oklahoma values were used for the rest. The quantity values should therefore be an approximate value of all production of the particular forage in Oklahoma. So, lower values would be expected in drier western areas of the state and higher yields in the higher rainfall eastern areas, These figures assume a relatively high level of management and fertilization. Therefore, they may be higher than what an average farmer would produce. Normal Oklahoma weather is assumed. Actual forage production will vary as it is affected by the weather. The weather will also influence CP and TDN values of the forage by affecting forage maturity.

The figures for the Oklahoma pastures are in Table V. The figures reflect the general seasonal pattern of forage nutritional values. New growth of forage is the highest quality and quality drops rapidly as the forage matures. Dormant pasture values decrease slowly as weather deteriorates the forage.

Oklahoma sources used to compile the estimates of TDN and crude protein were Smith (1973); Wilson (1979); Mader (1979); Powell et al. (1978) and Wagner (1975). The NRC publication "Nutrient Requirements of Beef Cattle",experiments by Bryan et al. (1970) and Reid and Jung (1965) and a summary of experiments from Southern Regional Research Projects S-45 (1971) were also used as a basis for some of the values in Table V.

The values for bermudagrass and wheat pasture have the largest data base and therefore should be the most accurate. Due to a shortage of data some of the monthly values for other forages are interpolated values. Fescue and lovegrass TDN values are conservative to avoid greatly overestimating intake and gain due to their unpalatable nature.

The forage values outlined here are intended only as estimates of long run expected values. If more information is available about a specific operation different values may be used. The pasture data stored in the model could be improved through increased research on monthly changes of pastures. The focus of the model development was on the animal requirement side and not the pasture side. Even so the

TABLE V

EXPECTED VALUES OF TDN, CRUDE PROTEIN, AND DRY MATTER AVAILABLE FOR SELECTED OKLAHOMA PASTURES

Pasture	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Overseeded Bermudagrass (200N)												
TDN (%)	35.6	37.6	68.0	66.7	63.9	56.9	55.2	52.1	54.9	50.1	42.8	41.9
C.P. (%)	5.6	6.6	25.0	24.2	20.6	16.9	10.0	9.8	10.0	12.1	8.2	7.1
Consumption (lbDM/acre)	0	0	265	1,000	810	925	1,030	970	950	220	0	0
Bermudagrass (200N)												
TDN (%)	35.6	35.0	37.2	43.1	60.0	58.0	56.0	52.0	55.0	51.0	43.5	42.5
C.P. (%)	5.8	5.7	5.9	7.0	13.7	11.9	10.0	9.8	10.0	7.5	6.2	6.0
Consumption (lbDM/acre)	65	65	65	0	330	1,330	1,330	1,330	1,330	330	65	65
Tall Native Grass												
TDN (%)	38.0	38.0	37.0	42.0	60.0	58.0	56.0	54.5	55.0	50.0	40.0	39.0
C.P. (%)	4.0	3.8	3.4	6.5	11.6	9.1	8.1	7.5	7.6	5.2	4.4	4.3
Consumption (lbDM/acre)	65	65	65	65	110	110	110	110	110	65	65	65
Short Native Grass												
TDN (%)	48.0	48.0	47.0	49.0	64.0	62.0	58.0	56.5	57.0	54.0	50.0	49.0
C.P. (%)	6.3	6.1	5.9	7.5	13.0	10.4	9.4	8.9	9.4	7.5	6.7	6.6
Consumption (lbDM/acre)	50	50	50	50	65	65	65	65	65	65	50	50

TABLE V (Continued)

Pasture	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Sudangrass (100 N)												
TDN (%)	47.0	45.0	43.0	42.0	40.0	72.0	65.0	65.0	65.0	55.0	48.0	47.5
C.P. (%)	5.5	5.0	4.5	4.0	3.0	15.0	11.0	11.0	11.0	8.0	6.0	5.7
Consumption (lbDM/acre)	0	0	0	0	0	0	1200	1200	1200	1200	0	0
Lovegrass (160 N)												
TDN (%)	38.0	38.0	37.0	62.0	60.5	53.0	53.0	52.0	52.0	42.0	39.0	39.0
C.P. (%)	4.5	4.5	4.3	12.0	11.4	8.0	7.5	7.5	7.5	6.0	5.0	5.0
Consumption (lbDM/acre)	220	220	0	220	1,760	1,540	1100	880	0	0	0	220
Tall Fescue (100 N)												
TDN (%)	54.0	55.0	53.0	57.0	53.0	40.0	0	0	0	54.0	56.0	54.0
C.P. (%)	15.0	15.0	12.0	16.0	12.0	6.0	0	0	0	15.0	15.0	15.0
Consumption (lbDM/acre)	660	660	660	660	660	0	0	0	0	0	0	660
Wheat Pasture (100 N)												
TDN (%)	68.0	68.0	67.0	65.0	60.0	55.0	0	0	0	68.0	68.0	68.0
C.P. (%)	25.0	25.0	23.0	20.0	18.0	10.0	0	0	0	25.0	25.0	25.0
Consumption (lbDM/acre)	440	440	440	660	660	0	0	0	0	0	0	440

Source: Reid and Jung (1965), Bryan et al. (1970), Southern Regional Research Project S-45 (1971), Smith (1973), Wagner (1975), Powell et al. (1978), Wilson (1979), Mader (1979), National Academy of Sciences (1976).

values obtained are good estimates of expected values for Oklahoma forages. As will be shown later, they are adequate in predicting gains when forage quality is not known.

Pasture Cost

For purposes of the economic analysis in the model, pasture is valued in dollars per unit of TDN. The total annual pasture cost is allocated to an animal by the following formula:

$$PC_t = \frac{ACPA}{\sum_{i=1}^{12} (TDN_i)\ (DM_i)} (TDN_t)\ (Intake_t)$$

where:

i = month

t = day

DM_i = Total dry matter available in month i

$Intake_t$ = Dry matter intake of forage on day t

TDN_t = TDN of forage being consumed on day t

TDN_i = TDN of forage in month i

ACPA = Annual cost per acre of producing the forage

PC_t = Pasture cost allocated to animal for day t

$\sum_t PC_t$ = Total pasture cost for the animal over the grazing period

Annual costs per acre for the forages were calculated from information taken from the OSU enterprise budgets (Department of Agricultural Economics, OSU, 1980) with some adjustments. More fertilizer costs were added when the pasture data in the model assumed a higher level of fertilization than was used in the budgets. Also, the cost of permanent fencing was added to the budgeted costs for each forage. Fencing costs were calculated on the basis of 160 acre tracts for native range and 53.3 acre tracts on the other pastures. Land, labor, and establishment costs were excluded. The pasture costs thus obtained are in Table VI. Costs vary from a low of \$2.58 per acre for short native grass to a high of \$82.90 per acre for overseeded bermudagrass. In general all improved pastures have relatively high costs due to machinery and fertilizer expenses.

Supplement

The model allows for concentrates and hay to be fed while cattle are grazing the forage. The NRC publication "Nutrient Requirements of Beef Cattle" was used to obtain the data for the feedstuffs. Values obtained were NE_m, NE_g, digestible protein and percent moisture. Eight feeds were selected as being typical of Oklahoma. Others may be substituted, if the user chooses. The eight feeds that were selected are corn, milo, wheat, soybean meal, cottonseed meal, alfalfa hay, prairie hay and wheat straw. The nutrient values used for these eight feeds are in Table VII.

If protein is in short supply from pasture, the model balances the ration for protein by adding supplement through an iterative process. When protein is inadequate and supplement is added, the energy concentration of the total diet is changed. Digestibility is determined by summing the products of the percent of each feedstuff in the ration and the respective digestibilities. The change in energy content of the diet results in a change in intake which along with the change in digestibility results in a change in predicted gain. The change in predicted gain results in a new protein requirement. This process is repeated until the change in supplement is less than .05 lb.

TABLE VI

COSTS PER ACRE FOR OKLAHOMA FORAGES WITH NO CHARGE MADE FOR LAND OR LABOR

Forage	Variable Cost	Fixed Costs	Total Cost
Overseeded Bermuda	73.85	9.05	82.90
Bermuda	55.78	5.02	60.80
Tall Native	1.67	2.08	3.75
Short Native	.77	1.81	2.58
Lovegrass	48.35	3.79	52.14
Fescue	52.53	2.83	55.36
Sudan	33.46	13.67	47.13
Wheat Pasture	41.69	16.50	58.19

Source: Department of Agricultural Economics, OSU (1980).

TABLE VII

NUTRIENT CONTENT AND PRICE INFORMATION
FOR SELECTED FEEDS

	NE_m Mcal/cwt.	NE_g Mcal/cwt.	D.P. %	Pounds /Unit	Moist %	As-is-Price /Unit
Corn	104	67	7.5	56	11.0	2.31
Milo	89	60	7.1	100	11.0	4.04
Soybean Meal	88	59	43.8	100	11.0	13.00
Cottonseed Meal	77	50	36.3	100	8.5	12.10
Wheat	98	65	11.4	60	10.9	3.66
Alfalfa Hay	56	25	12.7	2000	10.0	69.41
Prairie Hay	50	14	4.1	2000	9.0	50.08
Wheat Straw	47	9	.4	2000	9.9	30.00

Source: National Academy of Sciences (1976), USDA (1979).

In this way, the model will not allow protein to be the limiting nutrient for growth. The model will not run if protein needs are not being met. This is because it is assumed that it will never pay to restrict protein past the minimum requirement. Stocking rates are influenced by the addition of supplement but, supplement does not substitute for forage on a one for one basis unless the TDN of the forage and the supplement are the same.

The feed price data used are 1979 average prices for Oklahoma. Cottonseed meal and soybean meal were assumed to be purchased and thus their prices are prices paid by farmers while the other feedstuffs were assumed to be raised and thus, their prices are prices received by farmers. The cost per hundredweight of the ration is computed for the user. The user needs to input price of each feed, pounds of each feed in the ration, and any mixing charge he wishes to add.

Cattle Prices

The cattle prices used in the empirical analysis reported in Chapter V are 1979 average prices for Oklahoma City (Table VIII). However, alternative prices can be substituted very easily. Two prices for different weight intervals of each sex were used for the average of good and choice grades of cattle. The middle of each interval was taken to establish one weight for each price. With two points, a line can be defined. Thus, the two different price and weight combinations for each sex were used to define price as a linear function of weight. The model assumes all price relationships to be linear in relation to weight. As weight increases, price decreases.

TABLE VIII

GOOD AND CHOICE FEEDER CALF AND FEEDER CATTLE PRICES FOR OKLAHOMA CITY

Sex	Wt. Interval	Midpoint	1979 Avg. Price
Steers	400-500 lb.	450 lb.	$91.30
Steers	600-700 lb.	650 lb.	$77.60
Heifers	400-500 lb.	450 lb.	$78.16
Heifers	500-600 lb.	550 lb.	$71.24

Source: U.S. Department of Agriculture (1979)

Prices for each month were also adjusted using 5-year seasonal indexes computed by Blakley (1979) (Table IX). Average prices for the buying and expected selling weights for the year are used to establish price as a linear function of weight. The buying and selling prices and prices for all intervals are then obtained by adjusting the price given by the linear function with the appropriate seasonal indexes. The indexes for different weights and months are determined by linear extrapolation.

Relationship of Feeder Steer Prices to the Prices of Feeder Calves

An analysis was also made to attempt to explain some of the variation observed in cattle prices. Ignorance of the cyclical nature of cattle prices has caused hardships on producers in the past. Producers need information to develop improved expectations for prices and price relationships. Researchers have attempted to define the repetitive portions of price fluctuations. Determining the general cyclic stage for cattle is not difficult except at critical price change points, e.g. points at which prices start increasing or decreasing. Bressert (1977) says there are many cycles in cattle prices, but the most dominant one has averaged ten to eleven years in length over the last several cycles. He also says the length of this cycle is decreasing and is presently about ten years.

The effect of the cycle stage on price relationships among classes of cattle has not been fully researched. Normally, lighter weight cattle are worth more on a price per pound basis, than heavier cattle. The ratio of feeder calf prices to the price of feeder steers (calf-

TABLE IX

SEASONAL PRICE INDEXES FOR GOOD AND CHOICE STOCKER CATTLE IN OKLAHOMA

	Steers		Heifers	
Month	400-500 lb.	600-700 lb.	400-500 lb.	500-600 lb.
Jan.	94.4	96.0	92.2	93.4
Feb.	97.6	99.0	97.4	98.4
March	101.2	100.5	102.0	101.2
April	110.1	109.0	112.4	111.0
May	110.6	108.6	112.3	107.2
June	104.4	103.9	107.0	104.8
July	101.0	102.9	104.0	104.2
Aug.	101.0	101.2	101.8	101.6
Sept.	96.6	96.5	97.2	97.6
Oct.	93.8	94.4	92.1	93.4
Nov.	93.4	93.2	89.6	90.2
Dec.	95.8	95.6	91.9	92.2

Source: Blakley (1979)

steer price ratio) varies over time as shown in Figure 3. This graph exhibits the cyclical nature of the ratio. Preliminary work was initiated to explain the variation that occurs in the calf-steer price ratio. Information of this type can be of importance to decision-makers in the cattle industry. The relationships studied should be of particular interest to producers using the feeder cattle futures to hedge stocker calves.

The principal hypothesis tested econometrically is that the calf-steer ratio exhibits a cyclical pattern. The analysis defined used trigonometric functions (sine and cosine). The cycle length assumed was ten years. A further hypothesis was that in times of low prices and high cattle numbers, heavier stocker-feeder cattle would cost relatively more than light stocker-feeders. Under these conditions, it would be cheaper to purchase lighter cattle and feed them to a higher weight. The third hypothesis tested was that as input prices rise, particularly feed, heavier cattle increase in price compared to lighter ones.

The calf-steer price ratio was the dependent variable, while cattle inventory, feed prices, time and the trigonometric functions were the independent variables. Monthly data wre acquired for the period 1940-1978. Feeder steer and feeder calf prices from the Kansas City market were used in the analysis. The inventory figures used include all cattle and calves for the continental United States. The corn prices used were the average of those paid United States farmers for U.S. No. 2 corn. The hay prices were an average of prices paid for all hay to U.S. farmers.

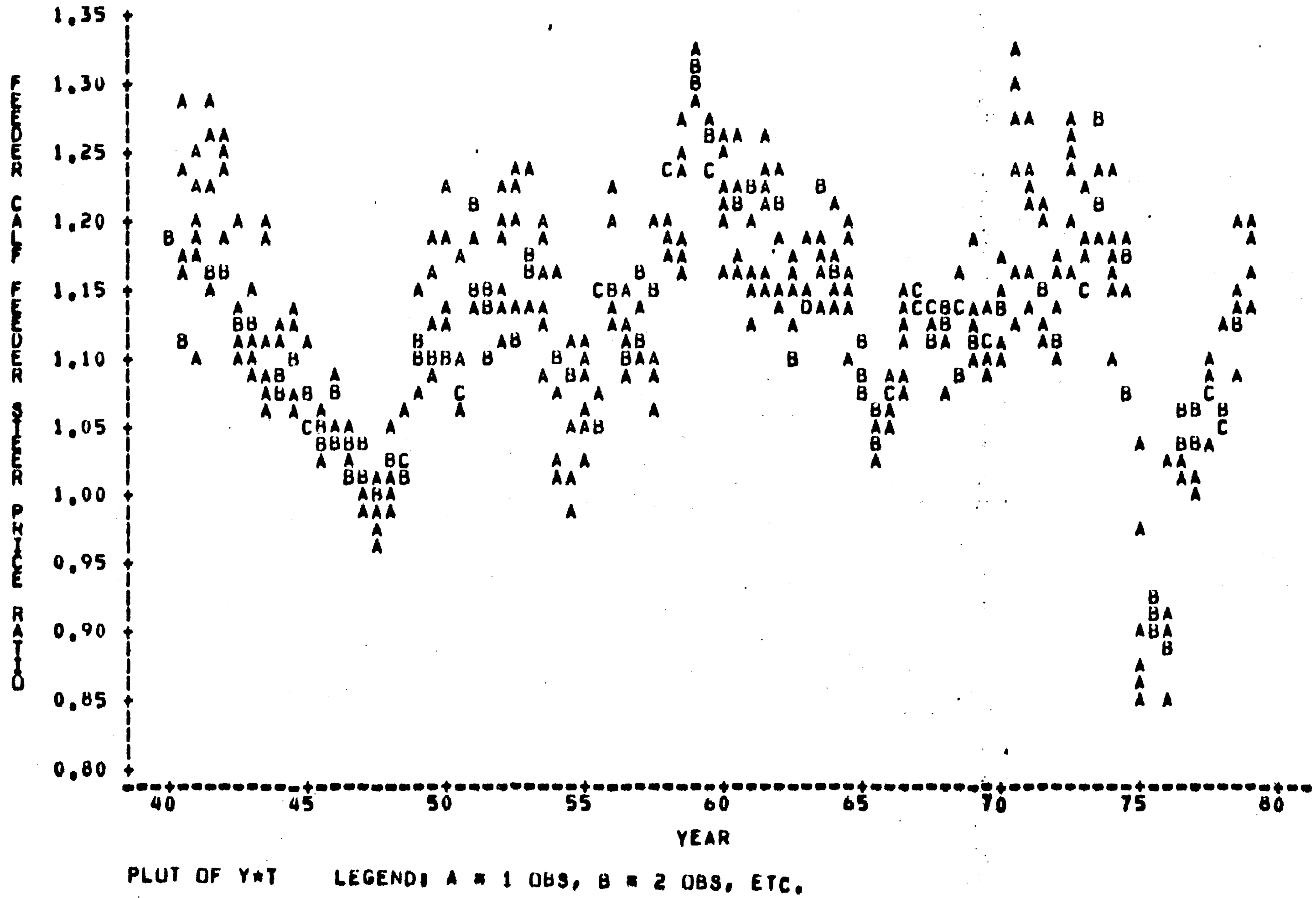


Figure 3. Plot of Calf-Steer Price Ratio Against Time

Until recently the total cattle inventory figures were available only on January 1, of each year. It was assumed that the change in inventory through the year was a linear change. Therefore, the monthly values for inventory are equivalent to the actual inventory value for a given month indexed with the January value equal to 100.

All the values of the variables in this analysis increased over-time. The dependent variable was the ratio of feeder calf prices and feeder steer prices. If the time trend in these two variables was proportional, the model would not need to include a factor for time. The remaining variables had to be detrended. This was done by first regressing against time. The percentage deviations from the trend line were then found by subtracting the predicted value from the observed value and then dividing by the observed value. This was done for hay prices, corn prices, and the cattle inventory figures. The adjusted values of these variables $[(x - \hat{x})/x]$ represent the percentage deviations from the trend line.

Peaks in inventory figures occur before troughs in the calf-steer price ratio. Therefore, the inventory figures were lagged. A fifteen month lag was selected as giving the "best" results. This lagged effect consistently occurred over the range of data analyzed. This can be seen by comparing Figure 3 and Figure 4. The lagged inventory gave a higher R-squared regression than the non-lagged inventory (.33 vs. .08).

The final model selected in this analysis was:

$$Y_{ij} = \underset{(.0001)}{1.12} + \underset{(.3917)}{.00647}\text{COSCYC} + \underset{(.0001)}{.0220}\text{SINCYC} - \underset{(.0134)}{.0102}\text{COSSEA}$$

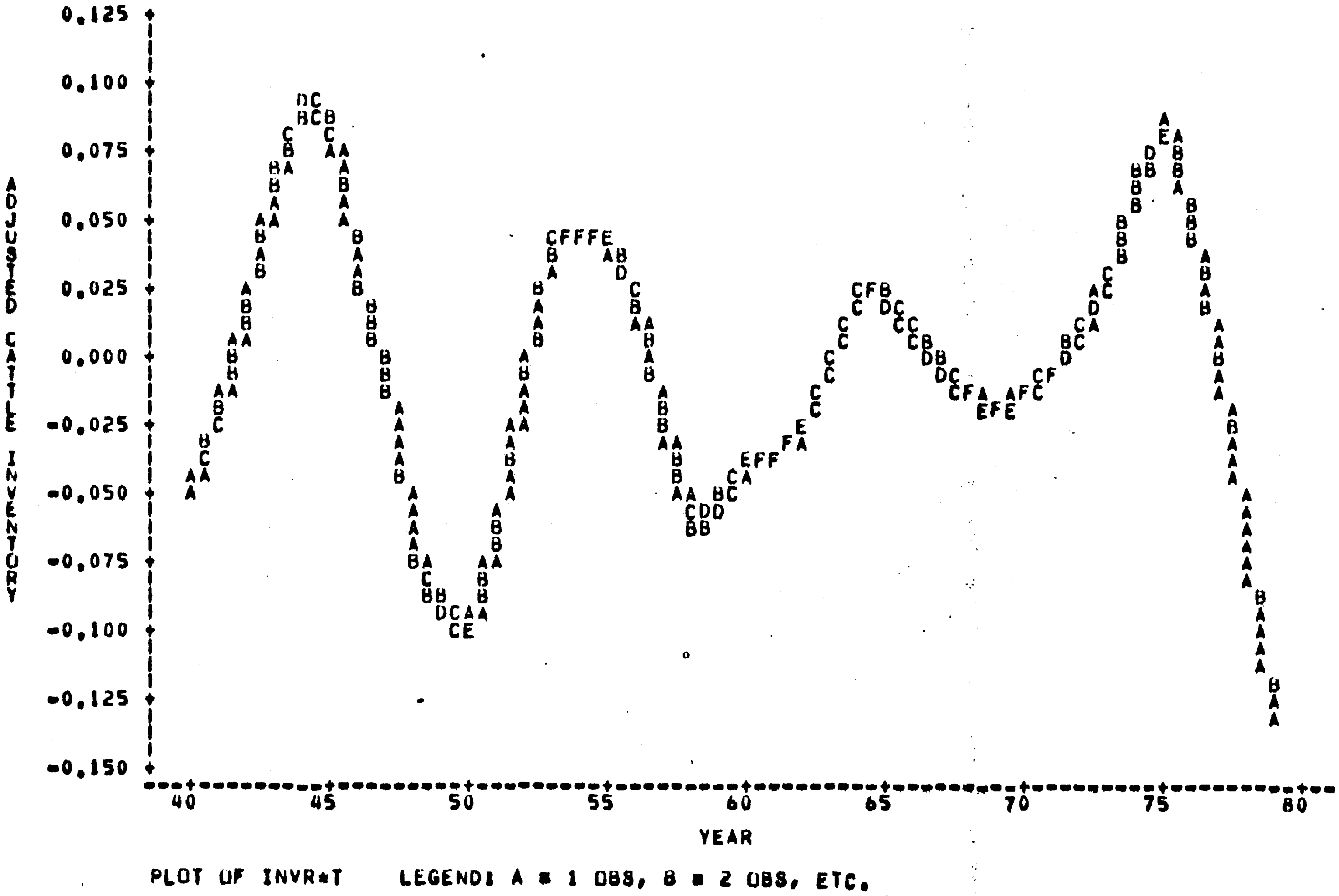


Figure 4. Percentage Deviations From the Trendline for Cattle Inventory Figures

$$-.0195SINSEA - .603INV - .0522H - .0622C$$
(.0001) (.0109) (.0109) (.0009)

The values in parenthesis are the observed significance levels. The variables are defined as follows:

Y = feeder cattle prices divided by feeder steer prices

COSCYC = COS $(\frac{2\pi T}{P})$ where T is the number of the observation and P = 120 which is consistent with a period length of 10 years.

SINSEA = SIN $(\frac{2\pi T}{P})$ where T and P are defined as above.

COSSEA = COS $(\frac{2\pi T}{P})$ where T is defined as above but P = 12, which allows this variable to capture seasonal variation.

SINSEA = SIN $(\frac{2\pi T}{P})$ where T and P are the same as for COSSEA

INV = the percentage deviations from the trendline of total cattle inventory lagged fifteen months.

H = the percentage deviations from the trendline for hay prices.

C = the percentage deviations from the trendline for corn prices.

Time was also considered in the analysis but was found to not be significant ($p > .10$). The R-squared of the final model was .529. COSCYC was included in the final model even though it was not significant ($p > .10$). This is because the sine function was significant ($p < .0001$) and both are needed to properly outline the cycle. Significant seasonal variation in the ratio was also found. As expected when lagged inventory values were high and cattle prices were low, prices of lighter cattle were relatively lower than heavier cattle. Lighter cattle were also priced lower when feed prices rose.

One possible fault of this analysis is that inflation has increased greatly in recent years and some of the changes over time are probably not linear. However, all adjusted variables were again regressed against time and this relationship was not significant for any adjusted variable. The final analysis included data covering thirty-seven years and nine months. If the cycle length is ten years, precision might be increased by taking data over forty years (four full cycles).

The model outlined in this section has potential for use by stocker cattle producers who use the futures market in their marketing plan. Futures markets only offer the opportunity to trade feeder steer contracts. Producers use the feeder steer contracts to hedge feeder calves. By using information from this analysis, producers can predict the price differential between feeder steers and feeder calves for observable inventory and feed supply conditions. This new information should aid producers in making more profitable decisions.

The model used in the study allows input of cattle price data which may be used directly in the model. Thus, a user can use the preceding approach outside the model to adjust price relationships between light and heavy cattle analyzed as stocker alternatives.

CHAPTER IV

THE MODEL

This chapter gives a general introduction to the computer simulation model, its capabilities and assumptions. It also gives an explanation of the printouts available and how to interpret them. Finally, gain projections from the model are compared to results of actual experiments to test the model's validity.

Model Capabilities

The model was developed for use on the Radio Shack TRS-80 mini-computer. The program is run in an interactive fashion and utilizes the BASIC computer language. It was designed for use on the mini-computer, so that farmers with mini-computers can use the model. It will later be adapted for TSO-Central computer access. The model will be used in university classroom and extension programs.

Figure 5 is a general flow chart of the computer program used to model stocker cattle production. The flow chart is intended to outline the interactive format in order to show how to operate the model.

At the start of the program all variables that are needed to run the simulation are given an initial value. The computer then goes to the central point of the program. From here a user can instruct the

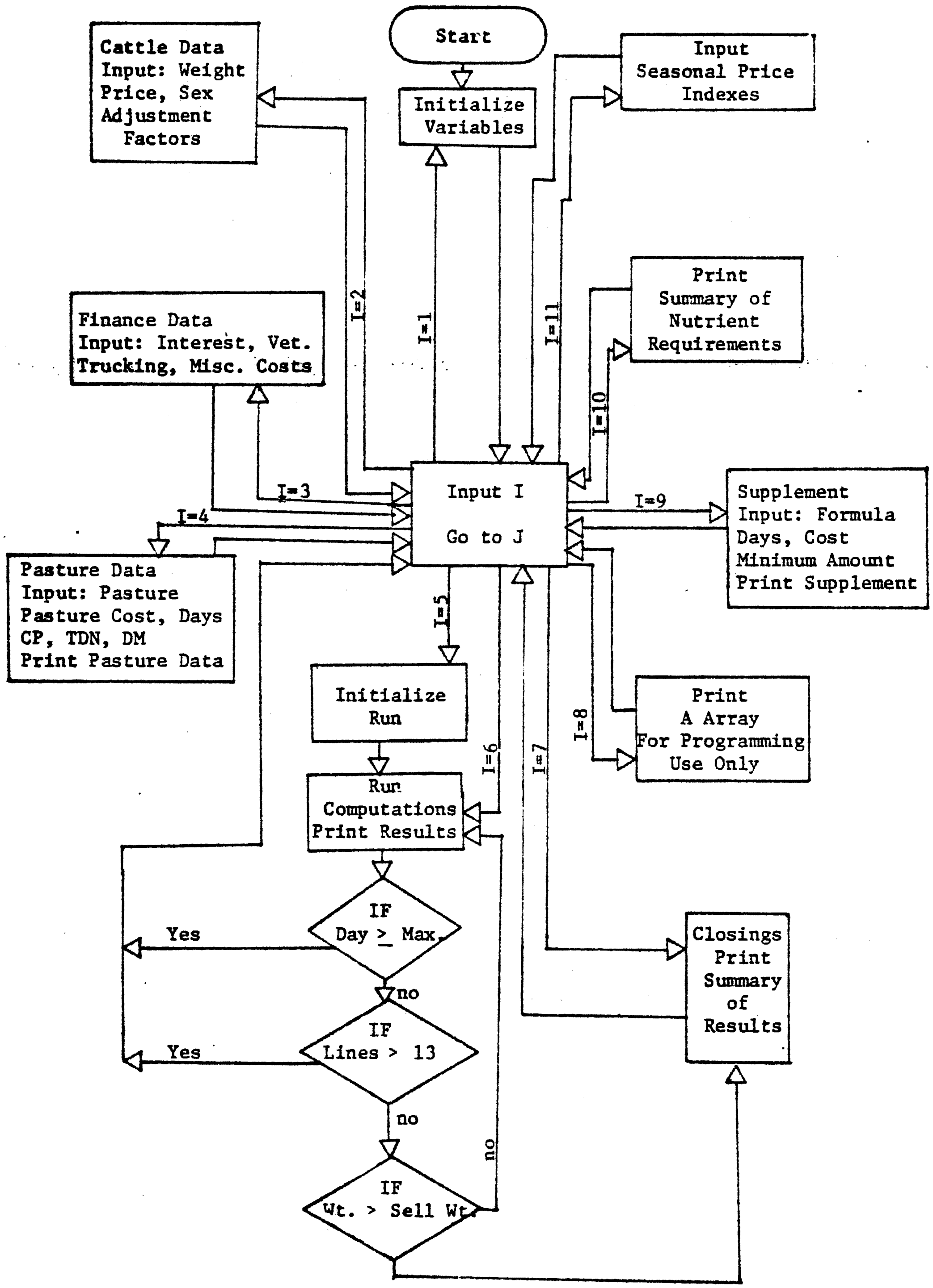


Figure 5. Flow Chart of Stocker Gain Projection Model

computer to go to any of the sections of the model. From the central point a user can go directly to running the simulation.

The initial values may be changed by instructing the computer to go to the appropriate input section. For example, if a user wanted to change the pasture data being used, he would instruct the computer to go to the pasture data section and change the pasture being used. The simulation can then be run with the new pasture. The continue feature of the program allows the pasture or supplement to be changed in the middle of a simulation.

The program being divided into sections permits the user to input only those variables he wants to change. The interactive format allows a user to acquire printouts of only the information he wants.

The model is a predictive one. It predicts expected outcomes for stocker cattle alternatives so farmers using it can make their decisions with improved information. When given information about a specific stocker cattle system, the model estimates growth patterns and economic outcomes. To compare alternatives, new data are provided and the model is re-run. This is a simple matter as long as a printer is available. The model projects outcomes on the basis of one animal but the prediction is applicable to any number of animals, subject to reasonable enterprise size relationships.

The economic analysis accounts for costs such as veterinary supplies, trucking, commissions, labor, pick-up, equipment, mineral and pest control. Interest is computed every printing interval on all costs to date above equity and that amount is added to total interest costs. The program is normally run with zero equity so an opportunity cost will be charged for any actual equity.

Death losses are also accounted for in the model and included as a cost to the individual animal. One-half of the death loss is assumed to occur at the start. For example, if a two percent death loss is inputed, one percent of the initial cost of the animal is added to the initial cost. The additional death loss is allocated by the following formula:

$$DC_i = Cost_i \, (DL/2)/180$$

where: i = Day

$Cost_i$ = Total cost to date on day i

DC_i = Charge made for death loss on day i

DL = Inputed death loss percentage

This formula allocates the death loss over time. It is appealing in that the death loss is higher the longer the animals are kept. But, if the animal is not kept exactly 180 days, the inputed death loss percent does not equal the actual one. For example, with an inputed death loss percent of two percent, if the animal is held 360 days, the actual death loss recorded is three percent.

The model can adjust for any shrinkage expected from buying or selling activities. An animal's weight is reduced by the specified percent at the start or when sold.

An animal often does not perform well when first placed in a new environment. McMurphy (1977) states that cattle do not gain well the first two weeks when placed on wheat pasture. Intake may be reduced the first 15 days to account for the adjustment to a new environment.

The model assumes there are 30 days in each month and 360 days in a year. Cattle must be started on the first day of any of the twelve months. Gains are calculated at 15 day intervals except when nearing the selling weight when the printing interval is changed to five. The average daily gain at the beginning of the interval is assumed to be the gain for each day of the interval.

Output

The basic printout obtained when the model is run is Table X. The first row gives the sex, purchase weight, purchase price, projected selling weight, selling price at the projected selling weight, Rumensin multiplier, implant multiplier, previous average daily gain, and the animal's estimated weight when fed to low choice or equivalent. The second set of values gives commissions per head, trucking rate per hundredweight, veterinary expenses per head, miscellaneous costs per day, interest rate and the dollars of equity per head. These values only tell the user what he has inputed.

The title applied to the particular run precedes the printout of the 15-day analysis. The cattle performance data printed by 15-day periods are current weight in pounds, daily intake of dry matter in pounds, daily gain in pounds per day, optimum stocking rate in head per acre, pounds of supplement fed per day on an as-is basis, marginal revenue minus marginal cost, and profit per day. Marginal revenue minus marginal cost is the change in profit for each day of the interval. Profit per day is simply total profit to date divided by days. The data given in each line are the same for that day and the previous fourteen days except weight and profit per day which are values for the last day of the interval.

TABLE X

EXAMPLE COMPUTER OUTPUT FROM STOCKER CATTLE PRODUCTION MODEL

```
          SX BUYWT  BUYPR    RUM   IMPLANT  FADG CHWT
          S 400.00 104.65    1.00    1.00    1.00 1050
          COMM  TRKRT VETMED OTH/DY  INTRT $EQUITY
          3.50    0.74   4.85   0.07   0.12   0.00
                EXAMPLE PRINTOUT
   DATE    WEIGHT    FD/DY  GAIN/DY    HD/AC  LB.SUP.  MR-MC PROF/DY
   5  0    400.00
   5 15    419.05    10.69    1.27     1.03    0.00    -0.33   -0.33
   5 30    438.52    11.20    1.30     0.98    0.00     0.17   -0.08
   6 15    454.36    11.16    1.06     3.97    0.00    -0.51   -0.22
   6 30    470.53    11.56    1.08     3.83    0.00    -0.36   -0.26
   7 15    483.28    11.43    0.85     3.88    0.00    -0.34   -0.28
   7 30    496.15    11.72    0.86     3.78    0.00    -0.13   -0.25
   8 15    502.93    11.03    0.45     4.02    0.00    -0.09   -0.23
   8 30    509.53    11.21    0.47     3.96    0.00    -0.43   -0.25
   9 15    521.88    12.16    0.80     3.65    0.00    -0.62   -0.29
   9 30    534.14    12.47    0.82     3.56    0.00    -0.51   -0.32
STEER CLOSEOUT AFTER  150 DAYS.                    POUNDS     $
  ADG= 0.89 LB/DAY...    INTAKE=11.46  LB/DAY
  AVG HD/AC= 3.27    MIN HD/AC= 0.98
  CATTLE AT $ 104.65/CWT.........                  400.00    418.59
  MISC. COSTS AT $ 0.07/DAY...(LABOR= 0
  EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5 )                      10.01
  INTEREST @  12 PERCENT...........                           22.46
  COST OF SUPPLEMENT AT $12.10/CWT........ .         0.00      0.00
  PASTURE COST AT $ 1.00/CWT D.M.....             1,719.37     17.11
  D.L= 7.72 +MED= 4.85 +COM= 3.50 +TRK= 1.36                  17.43
  TOTAL SPECIFIED COSTS                                      485.60
  SALE VALUE @ $  82.05/CWT.............           534.14    438.27
  NET RETURNS TO $ 0 EQUITY,MGMT,RISK.
                 & UNPAID LAND & LABOR                       -47.33
  BREAKEVEN SALE PRICE...............                         90.91
        NUTRIENT REQUIREMENTS  TDN=%  DP=%  DM=LB/ACRE
     JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
  TDN  0.0  0.0  0.0  0.0 60.0 58.0 56.0 52.0 55.0  0.0  0.0  0.0
   DP  0.0  0.0  0.0  0.0  6.4  5.9  5.5  5.1  5.3  0.0  0.0  0.0
   DM    0    0    0    0  328  341  347  334  369    0    0    0
                   F E E D    D A T A
         EN.M.  EN.G.  PROT.   WEIGHT  MOIST ASIS-PR  LBS.I    % IN
         /CWT.  /CWT.  /CWT.  /PUR.UN.   %    /CWT.   RATN    RATN
4 CSM    77.00  50.00  36.30    1.00    8.50  12.10 1000.00 100.00
9  TOTAL 77.00  50.00  36.30    1.00    8.50  12.10 1000.00 100.00
                                  EXAMPLE FORAGE
     JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
  TDN 35.6 35.0 37.2 43.1 60.0 58.0 56.0 52.0 55.0 51.0 43.5 42.5
   CP  5.8  5.7  5.3  7.0 13.7 11.9 10.0  9.8 10.0  7.5  6.2  6.0
   DM   65   65   65    0  330 1330 1330 1330 1330  330   65   65
```

The second section of the printout gives a summary of performance. All costs are itemized and the net return and break even sale price is calculated. Interpretations are illustrated in Chapter V.

Additional printouts which the computer provides are printouts of the forage and supplement data being used. Also, a monthly summary of the nutrient requirements of the animal is available. This printout gives the average TDN value of the total ration, minimum percent of digestible protein and pounds of dry matter consumed for each month.

Comparison with Actual Experiments

To get a measure of the accuracy of the model in predicting stocker growth on different pasture systems, results of actual experiments were compared with predictions of the model. The estimates of the model were not significantly different from actual gains ($.4 < p < .5$), when compared using the paired difference test (Steel and Torrie, 1960). An explanation of each experiment and the results obtained are in this section. Information on nutritional and genetic backgrounds of the steers in these experiments was unavailable. All cattle were assumed to be of average nutritional and genetic backgrounds. No additional supplement over what was actually fed was included in any of the simulations.

The first comparison was made with an experiment on bermudagrass by Wilson (1979). The incoming weight of the steers was 708 pounds and the cattle were not implanted. The results of the experiment and the prediction from the model appear in Table XI. Default values are what the model would have predicted, if the additional information about the

TABLE XI

SIMULATION OF ACTUAL PERFORMANCE OF STOCKER CATTLE
GRAZING BERMUDAGRASS, 1979

Month	TDN (%)	Recorded	Predicted	Default	Actual	Predicted	Default
June	57.0	2.18	1.22	1.36	17.58	17.80	18.25
July	53.7	1.19	.83	1.12	19.84	17.34	18.40
Aug.	48.8	-1.32	.35	.66	17.78	16.13	17.50
Sept.	51.9	1.01	.68	1.02	19.10	17.57	19.20
Average		.76	.77	1.04	18.58	17.21	18.38

Source: Wilson (1979)

quality of the forage had not been known. That is, default values are based on the forage data stored in the model which are used unless alternate data are specified. The model did not predict the extreme variations in gains between months. But, it did very well in predicting the gain (.76 vs. .77) and intake (18.58 vs. 17.21) over the whole period. In this case, the additional information about the quality of the forage aided the analysis.

Mader (1979) reported on two experiments of steers on wheat pasture. The cattle were not implanted. The first year, the beginning weight of the steers was 414 pounds and the second year it was 475 pounds. In the second year, bermudagrass hay with a TDN of 48.5 was fed for thirty days, while snow covered the ground. Intake was assumed to be 0.8 of normal during the first fifteen days. Table XII exhibits the approximations of reality that were obtained by operating the model.

Mader (1979) also reported on two experiments of cattle wintered on free choice bermudagrass hay. The incoming weight of cattle, the first year, was 445 pounds and 507 pounds the second year. The cattle were not implanted. In the first year, the steers were fed 2 pounds per day of cottonseed meal the last 22 days. The predictions of gains were again obtained (Table XIII). The model greatly underestimated intake the second year, possibly due to an error in estimating the actual intake. Cattle were self-fed and wastage was probably higher than the twelve percent estimated by Mader (1979). It is unlikely that cattle consumed over three percent of their body weight of 48.5 TDN hay as implied by the data.

The poorest results of any of the comparisons were obtained when simulating a bermudagrass trial by Smith (1973). The in-weight of the

TABLE XII

COMPARISON OF ACTUAL WHEAT PASTURE GAINS TO PREDICTED GAINS

Year	Days	TDN (%)	Actual A.D.G. (lb/day)	Predicted A.D.G. (lb/day)	Default A.D.G. (lb/day)
1	120	77.2	1.87	1.98	1.79
2	150		1.16		1.49

Source: Mader (1976)

TABLE XIII

SIMULATION OF ACTUAL PERFORMANCE OF STOCKER CATTLE FED BERMUDAGRASS HAY

Year	Days	TDN (%)	Crude Protein (%)	Actual A.D.G. (lb/day)	Predicted A.D.G. (lb/day)	Measured Intake (lb/day)	Predicted Intake (lb/day)
1	120	44.39	7.85	0.00	0.01	10.96	8.53
2	140	48.5	11.58	.40	.19	16.25	10.93

Source: Mader (1979)

cattle averaged 578 pounds. Cattle were implanted with DES. Table XIV exhibits the results of this comparison. The poor results may be due to not accounting for some of the variables in the experiment because of limited information. The intake values estimated in this experiment were out of line with other experiments and highly variable. The data from this experiment are questionable. The poor prediction of gain may be due to an error in measuring actual gain or more likely quality of forage consumed.

Horn et al. (1979) wintered calves for 99 days on native range near Woodward, Oklahoma. The incoming weight of the cattle was 538 pounds. The cattle were implanted with DES. The steers were fed 1.75 pounds of supplement per head daily. The cattle were divided into two groups. Group I was fed a supplement with lower protein content. Growth of steers in Group I was restricted due to lack of protein, so the model could not predict a gain for them. Gain prediction for cattle in Group II was within .15 pound per day (Table XV).

The model predicted within .01 and .17 pounds per day of actual gains on small grains reported by McMurphy and Tucker (1972) and McMurphy and Tucker (1974), respectively. In the experiment by McMurphy and Tucker (1972), the 530 pound cattle were implanted with DES in March. For ten days in January and twenty days in February, bermudagrass hay with a TDN of 47 was fed. McMurphy and Tucker (1974) started their steers at 355 pounds. They were implanted with Synovex. Intake of both groups of cattle was assumed to be 0.8 of normal for the first 15 days. Table XVI gives the comparison of the experiments and shows that the model even predicted the general direction of most of the monthly fluctuations.

TABLE XIV

SIMULATION OF ACTUAL CATTLE PERFORMANCE FROM BERMUDAGRASS GRAZING TRIAL, 1973

Month	TDN (%)	Crude Protein (%)	Actual A.D.G. (lb/day)	Predicted A.D.G. (lb/day)	Default A.D.G. (lb/day)
May	54.5	14.0	2.33	.80	1.53
June	51.9	12.0	1.69	.54	1.28
July	49.8	11.1	1.71	.36	1.03
Aug.	51.3	11.9	.21	.56	.58
Average			1.48	.56	1.11

Source: Smith (1973)

TABLE XV

SIMULATION OF ACTUAL CATTLE PERFORMANCE ON NATIVE RANGE IN WESTERN OKLAHOMA

	Values of Supplement NE_m (Mcal/Cwt)	NE_g (Mcal/Cwt)	C.P. (%)	Actual A.D.G. (lb/day)	Predicted A.D.G. (lb/day)
I	81.6	51.4	22.2	.05	None, protein is inadequate
II	78.2	51.4	44.4	.30	.45

Source: Horn *et al.* (1979)

TABLE XVI

SIMULATION OF ACTUAL CATTLE PERFORMANCE ON SMALL GRAINS AT MUSKOGEE, OKLAHOMA

	Trial 1, 1972[a]		Trial 2, 1974[b]	
Month	Actual A.D.G. (lb/day)	Predicted A.D.G. (lb/day)	Actual A.D.G. (lb/day)	Predicted A.D.G. (lb/day)
Nov.	1.9	1.63	1.25	1.90
Dec.	2.3	2.12	2.61	2.40
Jan.	1.5	1.34	1.76	2.47
Feb.	0.2	.56	3.16	2.33
March	2.1	2.58	3.17	2.12
April	2.3	2.42	2.39	1.78
May	___	___	1.38	.96
Average	1.71	1.70	2.24	2.07

[a]Source: McMurphy and Tucker (1972b)

[b]McMurphy and Tucker (1974)

McMurphy and Tucker (1974) reported gains of cattle on overseeded bermudagrass. The steers were implanted with DES. The ADG predicted by the model was within .03 pounds per day of the actual ADG (Table XVII).

In summary, the difference between results of actual experiments and predictions of the model were not significant ($.4 < p < .5$). Lehman (1977) says that a model and its theoretical framework are valid if it can predict reality. Since the model was able to predict reality, it would follow that the simulation is valid. Any theoretical flaws of the model would seem to be outweighed by its ability to predict reality. This section demonstrated that the model can do a good job of predicting gains of stocker cattle in Oklahoma. The next chapter will give additional predictions of the model and demonstrate the kinds of problems that can be solved with the model.

TABLE XVII

SIMULATION OF ACTUAL CATTLE PERFORMANCE ON OVERSEEDED BERMUDAGRASS

Month	Actual A.D.G. (lb/day)	Predicted A.D.G. (lb/day)
March	1.94	2.09
April	2.94	2.54
May	1.53	2.15
June	.87	.96
July	1.21	.72
Aug.	.23	.41
Sept.	.97	.73
Average	1.33	1.30

CHAPTER V

APPLICATIONS OF THE MODEL IN PRODUCTION DECISIONS

The model developed in this study is designed for use by Oklahoma stocker cattle producers in evaluating production alternatives. It can be used directly by producers or by agricultural extension and research workers. This chapter demonstrates some of the problems that can be analyzed with the model. The price data used were 1979 average data and unless otherwise specified, values for pasture, parameters, and finances are those in the model. Empirical results from analyses in this chapter should be interpreted accordingly. The net returns were heavily influenced by the seasonal price indexes that were used. This is true of all the analyses in this chapter. Applications with other input data can also be performed as was demonstrated in the previous chapter.

Comparison of Oklahoma Forages

Predictions of the model were obtained for each of eight typical Oklahoma forages (Table XVIII through Table XXV). In this part of the analysis, animals were assumed to be implanted with Synovex-S and to be of average genetic and nutritional backgrounds. Cottonseed meal was used as the supplement.

TABLE XVIII

COMPUTER OUTPUT FROM SIMULATION OF STOCKER CATTLE PRODUCTION ON OVERSEEDED BERMUDAGRASS

OVERSEEDED BERMUDAGRASS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	35.6	37.6	68.0	66.7	63.9	56.9	55.2	52.1	54.9	50.1	42.8	41.9
CP	5.6	6.6	25.0	24.2	20.6	16.9	10.0	9.8	10.0	12.1	8.2	7.1
DM	0	0	265	1000	810	925	1030	970	950	220	0	0

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	95.01	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

OVERSEEDED BERMUDAGRASS

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
3 0	400.00						
3 15	435.03	12.21	2.34	0.72	0.00	0.22	0.22
3 30	471.18	13.28	2.41	0.67	0.00	1.90	1.06
4 15	507.67	14.66	2.43	2.27	0.00	2.23	1.45
4 30	545.17	15.80	2.50	2.11	0.00	1.44	1.45
5 15	577.09	16.14	2.13	1.67	0.00	0.42	1.24
5 30	607.92	16.81	2.06	1.61	0.00	-0.11	1.02
6 15	622.10	14.61	0.94	2.11	0.00	-0.81	0.76
6 30	635.80	14.82	0.91	2.08	0.00	-0.56	0.59
7 15	646.32	14.48	0.70	2.37	0.00	-0.34	0.49
7 30	656.75	14.67	0.70	2.34	0.00	-0.42	0.40

STEER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 1.71 LB/DAY... INTAKE=14.75 LB/DAY		
AVG HD/AC= 1.80 MIN HD/AC= 0.67		
CATTLE AT $ 95.01/CWT.........	400.00	380.04
MISC. COSTS AT $ 0.07/DAY... (LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		20.92
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.43/CWT D.M.....	2,212.02	31.65
D.L= 7.10 +MED= 4.85 +COM= 3.50 +TRK= 1.36		16.81
TOTAL SPECIFIED COSTS		459.42
SALE VALUE @ $ 79.05/CWT.............	656.75	519.14
NET RETURNS TO $ 0 EQUITY, MGMT, RISK, & UNPAID LAND & LABOR		59.72
BREAKEVEN SALE PRICE...............		69.95

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	0.0	0.0	68.0	66.7	63.9	56.9	55.2	0.0	0.0	0.0	0.0	0.0
DP	0.0	0.0	7.4	6.6	5.9	5.0	4.3	0.0	0.0	0.0	0.0	0.0
DM	0	0	382	457	494	441	437	0	0	0	0	0

TABLE XIX

COMPUTER OUTPUT FROM SIMULATION OF STOCKER CATTLE PRODUCTION ON BERMUDAGRASS

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	104.65	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

BERMUDAGRASS SYNOVEX

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
5 0	400.00						
5 15	419.03	10.69	1.27	1.03	0.00	-0.33	-0.33
5 30	438.52	11.20	1.30	0.98	0.00	0.17	-0.08
6 15	454.36	11.16	1.06	3.97	0.00	-0.51	-0.22
6 30	470.53	11.56	1.08	3.83	0.00	-0.36	-0.26
7 15	483.28	11.43	0.85	3.88	0.00	-0.34	-0.28
7 30	496.15	11.72	0.86	3.78	0.00	-0.13	-0.25
8 15	502.93	11.03	0.45	4.02	0.00	-0.09	-0.23
8 30	509.93	11.21	0.47	3.96	0.00	-0.43	-0.25
9 15	521.88	12.16	0.80	3.65	0.00	-0.62	-0.29
9 30	534.14	12.47	0.82	3.56	0.00	-0.51	-0.32

STEER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 0.89 LB/DAY... INTAKE=11.46 LB/DAY		
AVG HD/AC= 3.27 MIN HD/AC= 0.98		
CATTLE AT $ 104.65/CWT.........	400.00	418.59
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		22.46
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.00/CWT D.M.....	1,719.37	17.11
D.L= 7.72 +MED= 4.85 +COM= 3.50 +TRK= 1.36		17.43
TOTAL SPECIFIED COSTS		485.60
SALE VALUE @ $ 82.05/CWT.............	534.14	438.27
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		-47.33
BREAKEVEN SALE PRICE...............		90.91

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	0.0	0.0	0.0	0.0	60.0	58.0	56.0	52.0	55.0	0.0	0.0	0.0
DP	0.0	0.0	0.0	0.0	6.4	5.9	5.5	5.1	5.3	0.0	0.0	0.0
DM	0	0	0	0	328	341	347	334	369	0	0	0

TABLE XX

COMPUTER OUTPUT FROM SIMULATION OF STOCKER CATTLE PRODUCTION ON TALL NATIVE GRASS

```
                                 TALL NATIVE GRASS
      JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
  TDN 38.0 37.5 37.0 42.0 60.0 58.0 56.0 54.5 55.0 50.0 40.0 39.0
   CP  4.0  3.8  3.4  6.5 11.6  9.1  8.1  7.5  7.6  5.2  4.4  4.3
   DM   65   65   65   65  110  110  110  110  110   65   65   65
          SX BUYWT  BUYPR   RUM  IMPLANT  PADG CHWT
          5 400.00 104.65   1.00   1.00   1.00 1050
          COMM  TRKRT VETMED OTH/DY  INTRT $EQUITY
          3.50   0.34   4.85   0.07   0.12   0.00
                TALL NATIVE GRASS
   DATE    WEIGHT   FD/DY  GAIN/DY    HD/AC  LB.SUP.  MR-MC PROF/DY
   5  0    400.00
   5 15    419.03   10.69    1.27     0.34    0.00    -0.27   -0.27
   5 30    438.52   11.20    1.30     0.33    0.00     0.24   -0.01
   6 15    457.04   11.52    1.23     0.34    0.71    -0.41   -0.15
   6 30    475.74   11.98    1.25     0.32    0.66    -0.28   -0.18
   7 15    492.36   12.11    1.11     0.33    1.08    -0.27   -0.20
   7 30    509.26   12.53    1.13     0.32    1.06    -0.02   -0.17
   8 15    524.09   12.59    0.99     0.32    1.27     0.07   -0.13
   8 30    539.14   12.95    1.00     0.31    1.27    -0.32   -0.16
   9 15    554.81   13.39    1.04     0.30    1.23    -0.66   -0.21
   9 30    570.60   13.75    1.05     0.29    1.22    -0.53   -0.24
 STEER CLOSEOUT AFTER  150 DAYS.                POUNDS     $
   ADG= 1.14 LB/DAY...   INTAKE=12.27  LB/DAY
   AVG HD/AC= 0.32   MIN HD/AC= 0.29
   CATTLE AT $ 104.65/CWT.........               400.00   418.59
   MISC.  COSTS AT $ 0.07/DAY...(LABOR= 0
   EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5 )                  10.01
   INTEREST @  12 PERCENT...........                       22.51
   COST OF SUPPLEMENT AT $12.10/CWT........      127.64    15.44
   PASTURE COST AT $ 0.43/CWT D.M.....         1,726.98     7.39
   D.L= 7.73 +MED= 4.85 +COM= 3.50 +TRK= 1.36              17.44
   TOTAL SPECIFIED COSTS                                  491.37
   SALE VALUE @ $  79.68/CWT.............        570.60   454.65
   NET RETURNS TO $ 0 EQUITY,MGMT,RISK.
                    & UNPAID LAND & LABOR                 -36.73
   BREAKEVEN SALE PRICE................                    86.11
         NUTRIENT REQUIREMENTS  TDN=%  DP=%  DM=LB/ACRE
      JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
   TDN  0.0  0.0  0.0  0.0 60.0 59.3 58.1 57.0 57.3  0.0  0.0  0.0
    DP  0.0  0.0  0.0  0.0  6.4  6.1  5.7  5.5  5.3  0.0  0.0  0.0
    DM    0    0    0    0  328  353  370  383  407    0    0    0
```

TABLE XXI

COMPUTER OUTPUT FROM SIMULATION OF STOCKER CATTLE PRODUCTION ON SHORT NATIVE GRASS

```
                                   SHORT NATIVE GRASS
     JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
 TDN 48.0 47.5 47.0 43.0 64.0 62.0 58.0 56.5 57.0 54.0 50.0 49.0
  CP  6.3  6.1  5.9  7.5 13.0 10.4  9.4  8.9  9.4  7.5  6.7  6.6
  DM   50   50   50   50   65   65   65   65   65   65   50   50
          SX BUYWT  BUYPR   RUM  IMPLANT  PADG CHWT
          S 400.00 104.65   1.00   1.00   1.00 1050
          COMM  TRKRT VETMED OTH/DY  INTRT $EQUITY
          3.50   0.34   4.85   0.07   0.12   0.00
                 SHORT NATIVE GRASS
  DATE    WEIGHT   FD/DY  GAIN/DY   HD/AC  LB.SUP.  MR-MC PROF/DY
  5  0    400.00
  5 15    428.43   11.88    1.90    0.18    0.00    0.17    0.17
  5 30    457.68   12.72    1.95    0.17    0.00    0.64    0.40
  6 15    482.95   12.92    1.68    0.17    0.10   -0.13    0.22
  6 30    508.51   13.58    1.70    0.16    0.00   -0.03    0.16
  7 15    526.56   13.07    1.20    0.17    0.28   -0.10    0.11
  7 30    544.09   13.40    1.17    0.16    0.20    0.10    0.11
  8 15    559.08   13.38    1.00    0.17    0.39    0.04    0.10
  8 30    574.03   13.70    1.00    0.16    0.35   -0.32    0.05
  9 15    588.65   13.96    0.97    0.16    0.00   -0.63   -0.03
  9 30    603.31   14.29    0.98    0.15    0.00   -0.47   -0.07
STEER CLOSEOUT AFTER  150 DAYS.                   POUNDS     $
  ADG= 1.36 LB/DAY...   INTAKE=13.29  LB/DAY
  AVG HD/AC= 0.16   MIN HD/AC= 0.15
  CATTLE AT $ 104.65/CWT.........                  400.00   418.59
  MISC.  COSTS AT $ 0.07/DAY...(LABOR= 0
  EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5 )                     10.01
  INTEREST @  12 PERCENT...........                          22.27
  COST OF SUPPLEMENT AT $12.10/CWT.......           19.90     2.41
  PASTURE COST AT $ 0.41/CWT D.M.....            1,975.58     8.10
  D.L= 7.70 +MED= 4.85 +COM= 3.50 +TRK= 1.36                 17.41
  TOTAL SPECIFIED COSTS                                     478.78
  SALE VALUE @ $  77.55/CWT.............           603.31   467.84
  NET RETURNS TO $ 0 EQUITY,MGMT,RISK.
                 & UNPAID LAND & LABOR                      -10.93
  BREAKEVEN SALE PRICE...............                        79.36
        NUTRIENT REQUIREMENTS  TDN=%  DP=%  DM=LB/ACRE
     JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
  TDN 0.0  0.0  0.0  0.0 64.0 62.1 58.4 57.2 57.0  0.0  0.0  0.0
  DP  0.0  0.0  0.0  0.0  6.9  6.2  5.6  5.3  5.2  0.0  0.0  0.0
  DM    0    0    0    0  369  397  397  406  424    0    0    0
```

TABLE XXII

COMPUTER OUTPUT FROM SIMULATION OF STOCKER CATTLE PRODUCTION ON SUDANGRASS

SUDANGRASS

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	47.0	45.0	43.0	42.0	40.0	72.0	65.0	65.0	65.0	55.0	48.0	47.5
CP	5.5	5.0	4.5	4.0	3.0	15.0	11.0	11.0	11.0	7.0	6.0	5.7
DM	0	0	0	0	0	0	1200	1200	1200	1200	0	0

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	96.48	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

SUDANGRASS

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
7 0	400.00						
7 15	432.06	12.34	2.14	3.32	0.31	0.15	0.15
7 30	464.48	13.24	2.16	3.04	0.09	0.73	0.44
8 15	497.46	14.18	2.20	2.82	0.00	0.88	0.56
8 30	531.32	15.19	2.26	2.63	0.00	0.47	0.56
9 15	566.02	16.22	2.31	2.47	0.00	-0.02	0.44
9 30	599.87	17.03	2.26	2.35	0.00	-0.03	0.36
10 15	615.31	14.67	1.03	3.01	1.53	-0.49	0.24
10 30	630.34	14.92	1.00	2.95	1.51	-0.46	0.15

STEER CLOSEOUT AFTER 120 DAYS. POUNDS $

ADG= 1.92 LB/DAY... INTAKE=14.73 LB/DAY

AVG HD/AC= 2.82 MIN HD/AC= 2.35

	POUNDS	$
CATTLE AT $ 96.48/CWT.........	400.00	385.91
MISC. COSTS AT $ 0.07/DAY... (LABOR= 0		
EQU= 1.2 PICK-UP= 2.4 MIN= 3.2 PEST= 1.2)		8.00
INTEREST @ 12 PERCENT...........		16.66
COST OF SUPPLEMENT AT $12.10/CWT........	51.48	6.23
PASTURE COST AT $ 0.98/CWT D.M.....	1,721.21	16.94
D.L= 6.42 +MED= 4.85 +COM= 3.50 +TRK= 1.36		16.13
TOTAL SPECIFIED COSTS		449.88
SALE VALUE @ $ 74.29/CWT.............	630.34	468.27
NET RETURNS TO $ 0 EQUITY, MGMT, RISK, & UNPAID LAND & LABOR		18.39
BREAKEVEN SALE PRICE..............		71.37

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	0.0	0.0	0.0	0.0	0.0	0.0	65.2	65.0	65.0	57.6	0.0	0.0
DP	0.0	0.0	0.0	0.0	0.0	0.0	7.0	6.5	6.0	5.1	0.0	0.0
DM	0	0	0	0	0	0	384	441	499	444	0	0

TABLE XXIII

COMPUTER OUTPUT FROM SIMULATION OF STOCKER CATTLE PRODUCTION ON LOVEGRASS

```
                                 LOVEGRASS
     JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
 TDN 38.0 38.0 37.0 62.0 60.5 53.0 53.0 50.0 52.0 42.0 39.0 38.5
  CP  4.5  4.4  4.3 12.0 11.4  8.0  7.5  7.5  7.5  6.0  5.0  4.7
  DM  220  220    0  220 1760 1540 1100  880    0    0    0  220
            SX BUYWT  BUYPR   RUM  IMPLANT  PADG CHWT
            S 400.00 102.18   1.00   1.00   1.00 1050
            COMM  TRKRT VETMED OTH/DY  INTRT $EQUITY
            3.50   0.34   4.85   0.07   0.12   0.00
                  LOVEGRASS
  DATE      WEIGHT    FD/DY  GAIN/DY    HD/AC  LB.SUP.  MR-MC PROF/DY
  4  0      400.00
  4 15      423.49    11.25    1.57     0.65    0.00   -0.14   -0.14
  4 30      447.60    11.91    1.61     0.62    0.00    1.37    0.62
  5 15      468.84    12.11    1.42     4.84    0.00    0.65    0.63
  5 30      490.56    12.69    1.45     4.62    0.00    0.13    0.50
  6 15      501.81    11.63    0.75     4.72    0.86   -0.91    0.22
  6 30      512.98    11.86    0.74     4.62    0.85   -0.73    0.06
  7 15      524.93    12.22    0.80     3.27    1.14   -0.47   -0.01
  7 30      537.11    12.51    0.81     3.19    1.14   -0.26   -0.04
  8 15      544.45    11.94    0.49     2.64    0.91   -0.29   -0.07
  8 30      551.97    12.12    0.50     2.59    0.91   -0.62   -0.12
STEER CLOSEOUT AFTER  150 DAYS.                  POUNDS      $
  ADG= 1.01 LB/DAY...   INTAKE=12.02  LB/DAY
  AVG HD/AC= 3.18   MIN HD/AC= 0.62
  CATTLE AT $ 102.18/CWT.........                 400.00   408.74
  MISC.  COSTS AT $ 0.07/DAY...(LABOR= 0
  EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5 )                    10.01
  INTEREST @  12 PERCENT...........                         22.11
  COST OF SUPPLEMENT AT $12.10/CWT........         87.00    10.53
  PASTURE COST AT $ 0.88/CWT D.M.....           1,726.09    15.27
  D.L= 7.57 +MED= 4.85 +COM= 3.50 +TRK= 1.36                17.28
  TOTAL SPECIFIED COSTS                                    483.93
  SALE VALUE @ $  84.29/CWT.............          551.97   465.23
  NET RETURNS TO $ 0 EQUITY,MGMT,RISK.
                 & UNPAID LAND & LABOR                     -18.69
  BREAKEVEN SALE PRICE...............                       87.67
           NUTRIENT REQUIREMENTS  TDN=%  DP=%  DM=LB/ACRE
     JAN  FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
 TDN  0.0  0.0  0.0 62.0 60.5 54.9 55.4 52.2  0.0  0.0  0.0  0.0
  DP  0.0  0.0  0.0  6 6  6.1  5.4  5.3  5.0  0.0  0.0  0.0  0.0
  DM    0    0    0  347  372  352  371  361    0    0    0    0
```

TABLE XXIV

COMPUTER OUTPUT FROM SIMULATION OF STOCKER CATTLE PRODUCTION ON FESCUE

```
                                 FESCUE
     JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC
 TDN 54.0  55.0  53.0  57.0  53.0  40.0   0.0   0.0   0.0  54.0  56.0  54.0
  CP 15.0  15.0  12.0  12.0  12.0   6.0   0.0   0.0   0.0  15.0  15.0  15.0
  DM  660   660   660   660   660     0     0     0     0     0     0   660
          SX BUYWT   BUYPR    RUM   IMPLANT   PADG CHWT
          S 400.00   90.18    1.00    1.00    1.00 1050
          COMM   TRKRT VETMED OTH/DY   INTRT $EQUITY
          3.50    0.34   4.85   0.07    0.12    0.00
                FESCUE
 DATE     WEIGHT    FD/DY  GAIN/DY    HD/AC  LB.SUP.  MR-MC PROF/DY
 12  0    400.00
 12 15    408.28     9.29     0.55     2.37     0.00  -0.86   -0.86
 12 30    416.71     9.49     0.56     2.32     0.00   0.07   -0.40
  1 15    425.28     9.68     0.57     2.27     0.00  -0.18   -0.33
  1 30    434.00     9.88     0.58     2.23     0.00   0.11   -0.22
  2 15    444.42    10.31     0.70     2.13     0.00   0.48   -0.08
  2 30    455.37    10.61     0.73     2.07     0.00   0.53    0.02
  3 15    463.64    10.45     0.55     2.10     0.00   0.46    0.09
  3 30    472.35    10.69     0.58     2.06     0.00   0.85    0.18
  4 15    488.44    11.97     1.07     1.84     0.00   1.51    0.33
  4 30    504.96    12.40     1.10     1.77     0.00   0.91    0.39
STEER CLOSEOUT AFTER  150 DAYS.                 POUNDS      $
 ADG= 0.70 LB/DAY...  INTAKE=10.48  LB/DAY
 AVG HD/AC= 2.12    MIN HD/AC= 1.77
 CATTLE AT $  90.18/CWT.........                400.00    360.71
 MISC. COSTS AT $ 0.07/DAY... (LABOR= 0
 EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5 )                    10.01
 INTEREST @  12 PERCENT...........                         19.63
 COST OF SUPPLEMENT AT $12.10/CWT........         0.00      0.00
 PASTURE COST AT $ 1.41/CWT D.M.....          1,571.56     22.12
 D.L= 6.71 +MED= 4.85 +COM= 3.50 +TRK= 1.36                16.42
 TOTAL SPECIFIED COSTS                                    428.88
 SALE VALUE @ $  96.43/CWT.............         504.96    486.93
 NET RETURNS TO $ 0 EQUITY,MGMT,RISK.
                 & UNPAID LAND & LABOR                     58.04
 BREAKEVEN SALE PRICE..............                        84.93
         NUTRIENT REQUIREMENTS  TDN=%  DP=%  DM=LB/ACRE
     JAN   FEB   MAR   APR   MAY   JUN   JUL   AUG   SEP   OCT   NOV   DEC
 TDN 54.0  55.0  53.0  57.0   0.0   0.0   0.0   0.0   0.0   0.0   0.0  54.0
  DP  5.6   5.6   5.4   5.7   0.0   0.0   0.0   0.0   0.0   0.0   0.0   5.7
  DM  293   314   317   365     0     0     0     0     0     0     0   282
```

TABLE XXV

COMPUTER OUTPUT FROM SIMULATION OF STOCKER CATTLE PRODUCTION ON WHEAT PASTURE

WHEAT PASTURE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	68.0	68.0	67.0	65.0	60.0	55.0	0.0	0.0	0.0	68.0	68.0	68.0
CP	25.0	25.0	23.0	20.0	18.0	10.0	0.0	0.0	0.0	25.0	25.0	25.0
DM	440	440	440	660	660	0	0	0	0	0	0	440

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	90.18	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

WHEAT PASTURE

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
12 0	400.00						
12 15	435.03	12.21	2.34	1.20	0.00	0.12	0.12
12 30	471.18	13.28	2.41	1.10	0.00	0.97	0.54
1 15	508.41	14.38	2.48	1.02	0.00	0.63	0.57
1 30	546.70	15.52	2.55	0.95	0.00	1.01	0.68
2 15	585.99	16.68	2.62	0.88	0.00	1.25	0.80
2 30	624.04	17.57	2.54	0.83	0.00	0.84	0.80
3 15	660.20	18.65	2.41	0.79	0.00	0.48	0.76
3 30	695.05	19.39	2.32	0.76	0.00	0.94	0.78
4 15	725.28	19.79	2.02	1.11	0.00	1.40	0.85
4 30	754.46	20.35	1.95	1.08	0.00	0.53	0.82

STEER CLOSEOUT AFTER 150 DAYS. POUNDS $

ADG= 2.36 LB/DAY... INTAKE=16.78 LB/DAY

AVG HD/AC= 0.97 MIN HD/AC= 0.76

	POUNDS	$
CATTLE AT $ 90.18/CWT.........	400.00	360.71
MISC. COSTS AT $ 0.07/DAY... (LABOR= 0 EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		20.29
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.93/CWT D.M.....	2,517.13	48.69
D.L= 6.80 +MED= 4.85 +COM= 3.50 +TRK= 1.36		16.51
TOTAL SPECIFIED COSTS		456.20
SALE VALUE @ $ 76.71/CWT.............	754.46	578.78
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		122.57
BREAKEVEN SALE PRICE...............		60.47

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	68.0	68.0	67.0	65.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.0
DP	6.8	6.3	5.6	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4
DM	448	514	571	602	0	0	0	0	0	0	0	382

The gains obtained are a reflection of the quality data assumed for each forage. If any of the gains, stocking rates, or supplementation requirements are inaccurate, it would be due to erroneous forage data. Several of the forages required protein supplementation. Since the cottonseed meal used as a supplement has a high energy content, gain would not be as high if the supplement was not fed.

Table XVIII gives the results of the simulation of steers grazing overseeded bermudagrass. The gains were higher during the early grazing due to higher quality forage. No protein supplement was required. Net return to management, risk, land and labor was $59.72. The net return would have been higher if the cattle had been marketed earlier. This can be seen by examining marginal revenue minus marginal cost. When this figure is negative the producer is losing money by keeping the cattle. The marginal revenue minus marginal cost column allows a producer to determine how long to keep his cattle. If the pasture is a fixed cost, the model should be run with no charge for pasture in order to determine when to sell the cattle.

The highest weight gains were recorded on wheat pasture, sudangrass and overseeded bermudagrass. With the exception of fescue, which benefited from a favorable seasonal price relationship, the forages with the highest average daily gains had the largest net return per animal. The higher net returns were obtained in spite of relatively high pasture cost. This illustrates the importance of high quality forage in a stocker operation.

According to the model native grasses require protein supplementation during the summer months (Table XX and Table XXI). This seems to a contradiction of reality since producers do not ordinarily feed a protein supplement to cattle on native grass. The data for native grass protein was compiled by Waller et al. (1972) and Powell et al. (1978). Neither of these sources calculated crude protein values for the summer months that were high enough to support the gains that the quality values used for native grass would predict. This prediction of the model is supported by the fact that good quality prairie hay also requires supplementation for protein. The crude protein values in the experiments used to compile the data were measures obtained from total forage available and not necessarily what cattle were actually consuming. Through selective grazing cattle may be able to increase the protein content of their diet. Therefore, the crude protein values for native grasses reported in previous studies may be too low.

Economic Significance of Adjustment Factors

Producers need information on additives and different types of cattle to determine profit potentials. The effects of adjustment factors were illustrated for heifers grazing wheat pasture (Table XXVI through Table XXXI) and steers grazing bermudagrass (Table XXXII through Table XXXVII). With the model a producer can study economic benefits from factors such as implants, Rumensin, compensatory growth and frame size. These adjustments permit simulation of a specific set of cattle.

The runs indicate that Synovex increases net returns by 15 dollars for steers on bermudagrass (Table XXXII versus Table XXXIV) and 8 dollars for heifers on wheat pasture (Table XXVI versus Table XXVIII). Ralgro increases returns by 9 dollars for steers on bermudagrass (Table XXXIII versus Table XXIV) and 6 dollars for heifers on wheat pasture

TABLE XXVI

PROJECTION OF HEIFER PERFORMANCE WHEN IMPLANTED WITH SYNOVEX AND GRAZING WHEAT PASTURE

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
H	400.00	74.54	1.00	1.00	1.00	840

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

WHEAT PASTURE SYNOVEX

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
12 0	400.00						
12 15	430.94	12.21	2.06	1.20	0.00	-0.29	-0.29
12 30	462.72	13.15	2.12	1.12	0.00	0.62	0.17
1 15	495.31	14.12	2.17	1.04	0.00	0.43	0.25
1 30	528.68	15.12	2.22	0.97	0.00	0.94	0.43
2 15	562.81	16.13	2.28	0.91	0.00	0.87	0.51
2 30	596.21	16.94	2.23	0.87	0.00	0.62	0.53
3 15	628.34	17.95	2.14	0.82	0.00	0.36	0.51
3 30	659.66	18.66	2.09	0.79	0.00	0.74	0.54
4 15	687.30	19.05	1.84	1.16	0.00	1.13	0.60
4 30	714.28	19.61	1.80	1.12	0.00	0.09	0.55

HEIFER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 2.10 LB/DAY... INTAKE=16.29 LB/DAY		
AVG HD/AC= 1.00 MIN HD/AC= 0.79		
CATTLE AT $ 74.54/CWT.........	400.00	298.17
MISC. COSTS AT $ 0.07/DAY... (LABOR= 0 EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		17.09
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.93/CWT D.M.....	2,444.02	47.28
D.L= 5.68 +MED= 4.85 +COM= 3.50 +TRK= 1.36		15.39
TOTAL SPECIFIED COSTS		387.93
SALE VALUE @ $ 65.87/CWT.............	714.28	470.53
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		82.59
BREAKEVEN SALE PRICE...............		54.31

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	68.0	68.0	67.0	65.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.0
DP	6.4	6.0	5.5	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.0
DM	439	496	549	580	0	0	0	0	0	0	0	380

TABLE XXVII

PROJECTION OF HEIFER PERFORMANCE WHEN IMPLANTED WITH RALGRO AND GRAZING WHEAT PASTURE

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
H	400.00	74.54	1.00	0.91	1.00	340

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

WHEAT PASTURE RALGRO

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
12 0	400.00						
12 15	428.54	12.21	1.90	1.20	0.00	-0.36	-0.36
12 30	457.81	13.08	1.95	1.12	0.00	0.56	0.10
1 15	487.77	13.97	2.00	1.05	0.00	0.37	0.19
1 30	518.41	14.89	2.04	0.99	0.00	0.90	0.37
2 15	549.72	15.82	2.09	0.93	0.00	0.84	0.46
2 30	580.50	16.58	2.05	0.88	0.00	0.62	0.49
3 15	610.26	17.55	1.98	0.84	0.00	0.37	0.47
3 30	639.42	18.23	1.94	0.80	0.00	0.76	0.51
4 15	665.30	18.61	1.73	1.18	0.00	1.16	0.58
4 30	690.68	19.17	1.69	1.15	0.00	0.14	0.54

HEIFER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 1.94 LB/DAY... INTAKE=16.01 LB/DAY		
AVG HD/AC= 1.01 MIN HD/AC= 0.80		
CATTLE AT $ 74.54/CWT.........	400.00	298.17
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0 EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		17.08
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.93/CWT D.M.....	2,401.64	46.46
D.L= 5.68 +MED= 4.85 +COM= 3.50 +TRK= 1.36		15.39
TOTAL SPECIFIED COSTS		387.10
SALE VALUE @ $ 67.67/CWT.............	690.68	467.40
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		80.30
BREAKEVEN SALE PRICE...............		56.05

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	68.0	68.0	67.0	65.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.0
DP	6.2	5.8	5.4	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.7
DM	433	486	537	567	0	0	0	0	0	0	0	379

TABLE XXVIII

PROJECTION OF HEIFER PERFORMANCE WHEN NOT IMPLANTED AND GRAZING WHEAT PASTURE

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
H	400.00	74.54	1.00	0.76	1.00	840

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

WHEAT PASTURE NO IMPLANT

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
12 0	400.00						
12 15	424.41	12.21	1.63	1.20	0.00	-0.49	-0.49
12 30	449.37	12.95	1.66	1.13	0.00	0.45	-0.02
1 15	474.85	13.71	1.70	1.07	0.00	0.28	0.08
1 30	500.84	14.49	1.73	1.01	0.00	0.82	0.26
2 15	527.33	15.29	1.77	0.96	0.00	0.78	0.37
2 30	553.61	15.96	1.75	0.92	0.00	0.58	0.40
3 15	579.23	16.86	1.71	0.87	0.00	0.37	0.40
3 30	604.57	17.49	1.69	0.84	0.00	0.78	0.45
4 15	627.25	17.85	1.51	1.23	0.00	1.18	0.53
4 30	649.70	18.38	1.50	1.20	0.00	0.20	0.50

HEIFER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 1.66 LB/DAY... INTAKE=15.52 LB/DAY		
AVG HD/AC= 1.04 MIN HD/AC= 0.84		
CATTLE AT $ 74.54/CWT.........	400.00	298.17
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		17.05
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.93/CWT D.M.....	2,327.83	45.04
D.L= 5.68 +MED= 4.85 +COM= 3.50 +TRK= 1.36		15.39
TOTAL SPECIFIED COSTS		385.65
SALE VALUE @ $ 70.80/CWT.............	649.70	459.96
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		74.32
BREAKEVEN SALE PRICE..............		59.36

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	68.0	68.0	67.0	65.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.0
DP	5.9	5.5	5.1	4.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2
DM	423	469	515	543	0	0	0	0	0	0	0	377

TABLE XXIX

PROJECTION OF HEIFER PERFORMANCE WHEN FED RUMENSIN WHILE GRAZING WHEAT PASTURE

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
H	400.00	74.54	1.05	0.76	1.00	840

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

WHEAT PASTURE RUMENSIN

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
12 0	400.00						
12 15	427.47	12.21	1.83	1.20	0.00	-0.39	-0.39
12 30	455.58	13.05	1.87	1.12	0.00	0.53	0.07
1 15	484.32	13.90	1.92	1.05	0.00	0.35	0.16
1 30	513.67	14.78	1.96	0.99	0.00	0.88	0.34
2 15	543.62	15.68	2.00	0.94	0.00	0.83	0.44
2 30	573.14	16.41	1.97	0.89	0.00	0.61	0.47
3 15	601.82	17.36	1.91	0.84	0.00	0.37	0.45
3 30	630.00	18.03	1.88	0.81	0.00	0.77	0.49
4 15	655.23	18.41	1.68	1.20	0.00	1.17	0.57
4 30	680.06	18.97	1.65	1.16	0.00	0.16	0.53

HEIFER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 1.87 LB/DAY... INTAKE=15.88 LB/DAY		
AVG HD/AC= 1.02 MIN HD/AC= 0.81		
CATTLE AT $ 74.54/CWT.........	400.00	298.17
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		17.07
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.93/CWT D.M.....	2,381.89	46.08
D.L= 5.68 +MED= 4.85 +COM= 3.50 +TRK= 1.36		15.39
TOTAL SPECIFIED COSTS		386.71
SALE VALUE @ $ 68.48/CWT.............	680.06	465.72
NET RETURNS TO $ 0 EQUITY, MGMT, RISK, & UNPAID LAND & LABOR		79.01
BREAKEVEN SALE PRICE...............		56.86

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	68.0	68.0	67.0	65.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.0
DP	6.1	5.8	5.3	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.6
DM	430	481	531	561	0	0	0	0	0	0	0	379

TABLE XXX

PROJECTION OF LARGE FRAMED HEIFER PERFORMANCE ON WHEAT PASTURE

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
H	400.00	74.54	1.00	0.76	1.00	1000

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

WHEAT PASTURE 1000 LB MARKET WEIGHT

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
12 0	400.00						
12 15	427.35	12.21	1.82	1.20	0.00	-0.40	-0.40
12 30	455.37	13.04	1.87	1.12	0.00	0.53	0.07
1 15	484.04	13.90	1.91	1.06	0.00	0.35	0.16
1 30	513.34	14.77	1.95	0.99	0.00	0.88	0.34
2 15	543.25	15.67	1.99	0.94	0.00	0.83	0.44
2 30	572.73	16.40	1.97	0.89	0.00	0.61	0.47
3 15	601.31	17.35	1.91	0.85	0.00	0.37	0.45
3 30	629.39	18.02	1.87	0.81	0.00	0.77	0.49
4 15	654.36	18.39	1.66	1.20	0.00	1.17	0.57
4 30	678.92	18.95	1.64	1.16	0.00	0.16	0.53

HEIFER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 1.86 LB/DAY... INTAKE=15.87 LB/DAY		
AVG HD/AC= 1.02 MIN HD/AC= 0.81		
CATTLE AT $ 74.54/CWT.........	400.00	298.17
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		17.07
COST OF SUPPLEMENT AT $12.10/CWT.........	0.00	0.00
PASTURE COST AT $ 1.93/CWT D.M.....	2,380.50	46.05
D.L= 5.68 +MED= 4.85 +COM= 3.50 +TRK= 1.36		15.39
TOTAL SPECIFIED COSTS		386.68
SALE VALUE @ $ 68.57/CWT.............	678.92	465.53
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		78.85
BREAKEVEN SALE PRICE...............		56.96

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	68.0	68.0	67.0	65.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.0
DP	6.1	5.8	5.3	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5
DM	430	481	531	560	0	0	0	0	0	0	0	379

TABLE XXXI

PROJECTION OF HEIFER PERFORMANCE WHEN PREVIOUSLY RESTRICTED IN GROWTH AND GRAZING WHEAT PASTURE

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
H	400.00	74.54	1.00	0.76	0.50	840

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

WHEAT PASTURE .5 PREVIOUS ADG

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
12 0	400.00						
12 15	428.46	12.81	1.90	1.14	0.00	-0.38	-0.38
12 30	457.58	13.72	1.94	1.07	0.00	0.54	0.08
1 15	487.36	14.66	1.99	1.00	0.00	0.36	0.18
1 30	517.77	15.61	2.03	0.94	0.00	0.88	0.35
2 15	548.78	16.59	2.07	0.88	0.00	0.82	0.45
2 30	578.77	17.27	2.00	0.85	0.00	0.59	0.47
3 15	607.29	18.15	1.90	0.81	0.00	0.34	0.45
3 30	634.78	18.72	1.83	0.78	0.00	0.73	0.49
4 15	658.81	18.96	1.60	1.16	0.00	1.13	0.56
4 30	681.99	19.38	1.55	1.13	0.00	0.12	0.51

HEIFER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 1.88 LB/DAY... INTAKE=16.59 LB/DAY		
AVG HD/AC= 0.98 MIN HD/AC= 0.78		
CATTLE AT $ 74.54/CWT.........	400.00	298.17
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		17.13
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.93/CWT D.M.....	2,488.09	48.14
D.L= 5.69 +MED= 4.85 +COM= 3.50 +TRK= 1.36		15.40
TOTAL SPECIFIED COSTS		388.84
SALE VALUE @ $ 68.33/CWT.............	681.99	466.04
NET RETURNS TO $ 0 EQUITY, MGMT, RISK.		
& UNPAID LAND & LABOR		77.20
BREAKEVEN SALE PRICE...............		57.02

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	68.0	68.0	67.0	65.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	68.0
DP	5.9	5.5	5.1	4.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4
DM	454	508	553	575	0	0	0	0	0	0	0	398

TABLE XXXII

PROJECTION OF STEER PERFORMANCE WHEN GRAZING BERMUDAGRASS WHILE IMPLANTED WITH SYNOVEX

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	104.65	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

BERMUDAGRASS SYNOVEX

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
5 0	400.00						
5 15	419.03	10.69	1.27	1.03	0.00	-0.33	-0.33
5 30	438.52	11.20	1.30	0.98	0.00	0.17	-0.08
6 15	454.36	11.16	1.06	3.97	0.00	-0.51	-0.22
6 30	470.53	11.56	1.08	3.83	0.00	-0.36	-0.26
7 15	483.28	11.43	0.85	3.88	0.00	-0.34	-0.28
7 30	496.15	11.72	0.86	3.78	0.00	-0.13	-0.25
8 15	502.93	11.03	0.45	4.02	0.00	-0.09	-0.23
8 30	509.93	11.21	0.47	3.96	0.00	-0.43	-0.25
9 15	521.88	12.16	0.80	3.65	0.00	-0.62	-0.29
9 30	534.14	12.47	0.82	3.56	0.00	-0.51	-0.32

STEER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 0.89 LB/DAY... INTAKE=11.46 LB/DAY		
AVG HD/AC= 3.27 MIN HD/AC= 0.98		
CATTLE AT $ 104.65/CWT.........	400.00	418.59
MISC. COSTS AT $ 0.07/DAY... (LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		22.46
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.00/CWT D.M.....	1,719.37	17.11
D.L= 7.72 +MED= 4.85 +COM= 3.50 +TRK= 1.36		17.43
TOTAL SPECIFIED COSTS		485.60
SALE VALUE @ $ 82.05/CWT.............	534.14	438.27
NET RETURNS TO $ 0 EQUITY, MGMT, RISK.		
& UNPAID LAND & LABOR		-47.33
BREAKEVEN SALE PRICE..............		90.91

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	0.0	0.0	0.0	0.0	60.0	58.0	56.0	52.0	55.0	0.0	0.0	0.0
DP	0.0	0.0	0.0	0.0	6.4	5.9	5.5	5.1	5.3	0.0	0.0	0.0
DM	0	0	0	0	328	341	347	334	369	0	0	0

TABLE XXXIII

PROJECTION OF STEER PERFORMANCE WHILE GRAZING BERMUDAGRASS WHEN IMPLANTED WITH RALGRO

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	104.65	1.00	0.91	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

BERMUDAGRASS RALGRO

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
5 0	400.00						
5 15	417.42	10.69	1.16	1.03	0.00	-0.41	-0.41
5 30	435.23	11.15	1.19	0.99	0.00	0.10	-0.16
6 15	449.66	11.08	0.96	4.00	0.00	-0.56	-0.29
6 30	464.36	11.44	0.98	3.87	0.00	-0.41	-0.32
7 15	475.91	11.28	0.77	3.93	0.00	-0.38	-0.33
7 30	487.64	11.56	0.78	3.84	0.00	-0.16	-0.30
8 15	493.84	10.87	0.41	4.08	0.00	-0.11	-0.27
8 30	500.28	11.04	0.43	4.02	0.00	-0.43	-0.29
9 15	511.31	11.98	0.74	3.70	0.00	-0.63	-0.33
9 30	522.67	12.27	0.76	3.61	0.00	-0.52	-0.35

STEER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 0.82 LB/DAY... INTAKE=11.34 LB/DAY		
AVG HD/AC= 3.31 MIN HD/AC= 0.99		
CATTLE AT $ 104.65/CWT.........	400.00	418.59
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		22.46
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.00/CWT D.M.....	1,700.29	16.92
D.L= 7.72 +MED= 4.85 +COM= 3.50 +TRK= 1.36		17.43
TOTAL SPECIFIED COSTS		485.41
SALE VALUE @ $ 82.80/CWT.............	522.67	432.76
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		-52.65
BREAKEVEN SALE PRICE...............		92.87

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	0.0	0.0	0.0	0.0	60.0	58.0	56.0	52.0	55.0	0.0	0.0	0.0
DP	0.0	0.0	0.0	0.0	6.2	5.8	5.4	5.1	5.2	0.0	0.0	0.0
DM	0	0	0	0	328	338	343	329	364	0	0	0

TABLE XXXIV

PROJECTION OF STEER PERFORMANCE WHILE GRAZING BERMUDAGRASS WHEN NOT IMPLANTED

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	104.65	1.00	0.76	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

BERMUDAGRASS NO IMPLANT

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
5 0	400.00						
5 15	414.70	10.69	0.98	1.03	0.00	-0.54	-0.54
5 30	429.67	11.08	1.00	0.99	0.00	-0.02	-0.28
6 15	441.74	10.93	0.80	4.05	0.00	-0.64	-0.40
6 30	454.00	11.24	0.82	3.94	0.00	-0.49	-0.42
7 15	463.58	11.03	0.64	4.02	0.00	-0.43	-0.43
7 30	473.39	11.28	0.65	3.93	0.00	-0.21	-0.39
8 15	478.61	10.59	0.35	4.19	0.00	-0.14	-0.35
8 30	484.09	10.75	0.37	4.12	0.00	-0.45	-0.37
9 15	493.52	11.67	0.63	3.80	0.00	-0.65	-0.40
9 30	503.29	11.94	0.65	3.71	0.00	-0.55	-0.41

STEER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 0.69 LB/DAY... INTAKE=11.12 LB/DAY		
AVG HD/AC= 3.38 MIN HD/AC= 0.99		
CATTLE AT $ 104.65/CWT.........	400.00	418.59
MISC. COSTS AT $ 0.07/DAY... (LABOR= 0 EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		22.45
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 1.00/CWT D.M.....	1,668.04	16.61
D.L= 7.72 +MED= 4.85 +COM= 3.50 +TRK= 1.36		17.43
TOTAL SPECIFIED COSTS		485.09
SALE VALUE @ $ 84.06/CWT.............	503.29	423.06
NET RETURNS TO $ 0 EQUITY, MGMT, RISK, & UNPAID LAND & LABOR		-62.03
BREAKEVEN SALE PRICE...............		96.38

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	0.0	0.0	0.0	0.0	60.0	58.0	56.0	52.0	55.0	0.0	0.0	0.0
DP	0.0	0.0	0.0	0.0	5.8	5.5	5.2	5.0	5.1	0.0	0.0	0.0
DM	0	0	0	0	327	333	335	320	354	0	0	0

TABLE XXXV

PROJECTION OF STEER PERFORMANCE WHILE GRAZING BERMUDAGRASS WHEN IMPLANTED WITH SYNOVEX AND FED RUMENSIN

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	104.65	1.05	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

BERMUDAGRASS SYNOVEX & RUMENSIN

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
5 0	400.00						
5 15	422.46	10.69	1.50	1.03	0.00	-0.17	-0.17
5 30	445.51	11.29	1.54	0.97	0.00	0.32	0.07
6 15	464.69	11.34	1.28	3.91	0.00	-0.39	-0.08
6 30	484.29	11.83	1.31	3.75	0.00	-0.26	-0.12
7 15	500.21	11.76	1.06	3.78	0.05	-0.26	-0.15
7 30	516.28	12.13	1.07	3.66	0.00	0.03	-0.12
8 15	525.25	11.42	0.60	3.88	0.00	-0.07	-0.11
8 30	534.35	11.61	0.61	3.82	0.00	-0.42	-0.15
9 15	548.78	12.62	0.96	3.51	0.00	-0.61	-0.20
9 30	563.42	12.95	0.98	3.42	0.00	-0.48	-0.23

STEER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 1.09 LB/DAY... INTAKE=11.76 LB/DAY		
AVG HD/AC= 3.17 MIN HD/AC= 0.97		
CATTLE AT $ 104.65/CWT.........	400.00	418.59
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 FEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		22.47
COST OF SUPPLEMENT AT $12.10/CWT........	0.74	0.09
PASTURE COST AT $ 0.99/CWT D.M.....	1,763.85	17.54
D.L= 7.73 +MED= 4.85 +COM= 3.50 +TRK= 1.36		17.44
TOTAL SPECIFIED COSTS		486.14
SALE VALUE @ $ 80.15/CWT.............	563.42	451.56
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		-34.58
BREAKEVEN SALE PRICE...............		86.28

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	0.0	0.0	0.0	0.0	60.0	58.0	56.0	52.0	55.0	0.0	0.0	0.0
DP	0.0	0.0	0.0	0.0	6.8	6.3	5.8	5.3	5.5	0.0	0.0	0.0
DM	0	0	0	0	330	347	358	345	384	0	0	0

TABLE XXXVI

PROJECTION OF STEER PERFORMANCE WHILE GRAZING BERMUDAGRASS WHEN IMPLANTED WITH SYNOVEX AND STEER IS OF LARGE FRAME SIZE

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	104.65	1.00	1.00	1.00	1200

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

BERMUDAGRASS SYNOVEX 1200 LB MARKET WEIGHT

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
5 0	400.00						
5 15	420.89	10.69	1.39	1.03	0.00	-0.24	-0.24
5 30	442.33	11.25	1.43	0.98	0.00	0.25	0.00
6 15	459.83	11.26	1.17	3.94	0.00	-0.45	-0.15
6 30	477.71	11.70	1.19	3.79	0.00	-0.31	-0.19
7 15	491.87	11.60	0.94	3.82	0.00	-0.30	-0.21
7 30	506.08	11.92	0.95	3.72	0.00	-0.07	-0.19
8 15	513.52	11.22	0.50	3.95	0.00	-0.09	-0.17
8 30	521.16	11.40	0.51	3.89	0.00	-0.43	-0.21
9 15	534.15	12.37	0.87	3.58	0.00	-0.62	-0.25
9 30	547.42	12.69	0.88	3.49	0.00	-0.50	-0.28

STEER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 0.98 LB/DAY... INTAKE=11.61 LB/DAY		
AVG HD/AC= 3.22 MIN HD/AC= 0.98		
CATTLE AT $ 104.65/CWT.........	400.00	418.59
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		22.47
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 0.99/CWT D.M.....	1,741.45	17.33
D.L= 7.72 +MED= 4.85 +COM= 3.50 +TRK= 1.36		17.43
TOTAL SPECIFIED COSTS		485.82
SALE VALUE @ $ 81.19/CWT.............	547.42	444.43
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		-41.39
BREAKEVEN SALE PRICE...............		88.75

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	0.0	0.0	0.0	0.0	60.0	58.0	56.0	52.0	55.0	0.0	0.0	0.0
DP	0.0	0.0	0.0	0.0	6.6	6.1	5.7	5.2	5.4	0.0	0.0	0.0
DM	0	0	0	0	329	344	353	339	376	0	0	0

TABLE XXXVII

PROJECTION OF STEER PERFORMANCE WHILE GRAZING BERMUDAGRASS WHEN IMPLANTED WITH SYNOVEX AND PREVIOUSLY RESCTRICTED IN GROWTH

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
5	400.00	104.65	1.00	1.00	0.50	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

BERMUDAGRASS SYNOVEX .5 PREVIOUS ADG

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
5 0	400.00						
5 15	423.42	11.22	1.56	0.98	0.00	-0.13	-0.13
5 30	447.44	11.87	1.60	0.93	0.00	0.35	0.11
6 15	467.50	11.95	1.34	3.71	0.00	-0.36	-0.05
6 30	488.00	12.49	1.37	3.55	0.00	-0.24	-0.10
7 15	504.73	12.44	1.12	3.56	0.00	-0.22	-0.12
7 30	520.91	12.73	1.08	3.48	0.00	0.02	-0.10
8 15	529.74	11.93	0.59	3.72	0.00	-0.09	-0.10
8 30	538.32	12.05	0.57	3.68	0.00	-0.45	-0.14
9 15	551.60	13.00	0.89	3.41	0.00	-0.65	-0.20
9 30	564.65	13.24	0.87	3.35	0.00	-0.54	-0.23

STEER CLOSEOUT AFTER 150 DAYS.	POUNDS	$
ADG= 1.10 LB/DAY... INTAKE=12.29 LB/DAY		
AVG HD/AC= 3.04 MIN HD/AC= 0.93		
CATTLE AT $ 104.65/CWT.........	400.00	418.59
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.5 PICK-UP= 3 MIN= 4 PEST= 1.5)		10.01
INTEREST @ 12 PERCENT...........		22.49
COST OF SUPPLEMENT AT $12.10/CWT........	0.00	0.00
PASTURE COST AT $ 0.99/CWT D.M.....	1,843.90	18.35
D.L= 7.73 +MED= 4.85 +COM= 3.50 +TRK= 1.36		17.44
TOTAL SPECIFIED COSTS		486.87
SALE VALUE @ $ 80.07/CWT.............	564.65	452.09
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		-34.78
BREAKEVEN SALE PRICE...............		86.23

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	0.0	0.0	0.0	0.0	60.0	58.0	56.0	52.0	55.0	0.0	0.0	0.0
DP	0.0	0.0	0.0	0.0	6.6	6.1	5.6	5.1	5.2	0.0	0.0	0.0
DM	0	0	0	0	346	367	378	360	394	0	0	0

(Table XXVII versus Table XXVIII). No charge was made for the implant. It would seem to be poor management for producers to not implant their cattle.

The return from an implant is normally greater when the animal is gaining more rapidly. If the animal is gaining nothing there is no benefit. In this example steers showed more return from an implant than heifers, due to a more favorable price relationship between light and heavy cattle. With the price data used, heifer prices dropped more rapidly than steer prices as weight increased. These runs indicate Synovex increases gain by 26 to 30 percent. This is higher than the 22 percent increase in gain due to implanting estimated by Hawkins (1970). But, it does correspond to the experiments reviewed in this analysis.

The increase in net return due to feeding Rumensin is approximately 13 dollars per head for steers on bermudagrass (Table XXXII versus Table XXXV) and 5 dollars for heifers on wheat pasture (Table XXVIII versus Table XXIX). Returns were again increased more for steers. Since no charge was made for Rumensin a producer would compute his cost of adding Rumensin and compare it to the additional return from feeding Rumensin to determine if it would pay to feed Rumensin. Gains were increased by approximately 0.2 pounds per day in both cases.

Net returns are increased five dollars for heifers on wheat pasture and nine dollars per head for steers on bermudagrass by feeding an animal with a projected market weight approximately 150 pounds greater than average (Table XXVIII versus Table XXX and Table XXXII versus Table XXXVI). In this case a producer could therefore afford to pay $1.25 to $2.25 more for the 400 pound animal with a mature size 150 pounds larger than the other. This demonstrates how the model could be used in a purchase decision.

A steer that had been gaining at a rate of 0.5 pounds per day the previous 120 days yielded net returns approximately 13 dollars per head more than one that was previously gaining one pound per day (Table XXXII versus Table XXXVII). Therefore in this case, a producer could pay up to $3.25 more per cwt. for the 400 pound steer that had previously been restricted in growth. A heifer grazing wheat pasture and previously restricted in growth would yield net returns 3 dollars higher than one not previously restricted (Table XXVIII versus Table XXXI). A steer grazing wheat pasture would show more economic benefit due to a more favorable price relationship.

Other Applications of the Model

Several runs were made to demonstrate the flexibility of the model. The program permits an animal to be fed entirely on concentrates and hay. Table XXXVIII shows the results of cattle being fed alfalfa hay only. Average daily gain increased during the period the alfalfa hay was fed even though energy content of the hay was held constant. Part of this increase is due to compensatory growth. Also, as an animal grows its intake increases faster than its maintenance requirement, leaving more energy available for gain. Since no pasture is being used the model predicts an infinite number of head can be grazed on each acre. The program prints 99 to indicate the number is large.

Table XXXIX again shows the model's flexibility. The steer is fed alfalfa hay for sixty days and then placed on wheat pasture. This demonstrates that animals can be transferred from one forage to another

TABLE XXXVIII

PROJECTION OF CATTLE PERFORMANCE WHEN SELF-FED ALFALFA HAY

F E E D D A T A

	EN. M. /CWT.	EN. G. /CWT.	PROT. /CWT.	WEIGHT /PUR. UN.	MOIST %	ASIS-PR /CWT.	LBS. I RATN	% IN RATN
6 ALFHAY	56.00	25.00	12.70	20.00	10.00	3.47	1000.00	100.00
9 TOTAL	56.00	25.00	12.70	20.00	10.00	3.47	1000.00	100.00

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	88.57	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

ALFALFA HAY

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
11 0	400.00						
11 15	406.87	9.11	0.46	99.00	10.12	-1.15	-1.15
11 30	413.87	9.27	0.47	99.00	10.30	-0.16	-0.65
12 15	420.97	9.43	0.47	99.00	10.47	0.02	-0.43
12 30	428.20	9.59	0.48	99.00	10.65	-0.23	-0.38
1 15	435.54	9.75	0.49	99.00	10.84	-0.49	-0.40
1 30	443.40	9.98	0.52	99.00	11.09	-0.18	-0.36
2 15	451.77	10.22	0.56	99.00	11.36	0.14	-0.29
2 30	460.65	10.48	0.59	99.00	11.64	0.18	-0.23
3 15	470.03	10.74	0.63	99.00	11.94	0.22	-0.18
3 30	479.90	11.02	0.66	99.00	12.24	0.61	-0.10
4 15	490.24	11.31	0.69	99.00	12.56	1.01	-0.00
4 30	501.04	11.60	0.72	99.00	12.89	0.41	0.03

STEER CLOSEOUT AFTER 180 DAYS.	POUNDS	$
ADG= 0.56 LB/DAY... INTAKE=10.21 LB/DAY		
AVG HD/AC=99.00 MIN HD/AC=99.00		
CATTLE AT $ 88.57/CWT.........	400.00	354.27
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.8 PICK-UP= 3.6 MIN= 4.8 PEST= 1.8)		12.01
INTEREST @ 12 PERCENT...........		24.77
COST OF SUPPLEMENT AT $ 3.47/CWT........	2,041.61	70.85
PASTURE COST AT $ 0.00/CWT D.M.....	0.00	0.00
D.L= 7.50 +MED= 4.85 +COM= 3.50 +TRK= 1.36		17.21
TOTAL SPECIFIED COSTS		479.11
SALE VALUE @ $ 96.77/CWT.............	501.04	484.86
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		5.75
BREAKEVEN SALE PRICE...............		95.62

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	53.1	53.1	53.1	53.1	0.0	0.0	0.0	0.0	0.0	0.0	53.1	53.1
DP	5.5	5.4	5.4	5.4	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.5
DM	296	311	326	344	0	0	0	0	0	0	276	285

TABLE XXXIX

PROJECTION OF CATTLE PERFORMANCE WHEN FED ALFALFA HAY FOR 60 DAYS THEN GRAZED ON WHEAT PASTURE 120 DAYS

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	89.52	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

ALFALFA 60 DAYS WHEAT PASTURE 120 DAYS

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
10 0	400.00						
10 15	406.87	9.11	0.46	99.00	10.12	-1.15	-1.15
10 30	413.87	9.27	0.47	99.00	10.30	-0.49	-0.82
11 15	420.97	9.43	0.47	99.00	10.47	-0.35	-0.66
11 30	428.20	9.59	0.48	99.00	10.65	-0.17	-0.54
12 15	464.14	13.07	2.40	1.12	0.00	1.23	-0.18
12 30	501.38	14.19	2.48	1.03	0.00	0.89	-0.01
1 15	539.10	15.26	2.51	0.96	0.00	0.62	0.08
1 30	576.75	16.26	2.51	0.90	0.00	0.92	0.19
2 15	613.98	17.21	2.48	0.85	0.00	1.01	0.28
2 30	650.56	18.09	2.44	0.81	0.00	0.64	0.32
3 15	685.79	19.20	2.35	0.76	0.00	0.36	0.32
3 30	720.17	19.97	2.29	0.73	0.00	0.84	0.36

STEER CLOSEOUT AFTER 180 DAYS.	POUNDS	$
ADG= 1.78 LB/DAY... INTAKE=14.22 LB/DAY		
AVG HD/AC=33.60 MIN HD/AC= 0.73		
CATTLE AT $ 89.52/CWT.........	400.00	358.06
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 1.8 PICK-UP= 3.6 MIN= 4.8 PEST= 1.8)		12.01
INTEREST @ 12 PERCENT...........		24.74
COST OF SUPPLEMENT AT $ 3.47/CWT........	623.13	21.63
PASTURE COST AT $ 1.95/CWT D.M.....	1,998.64	39.03
D.L= 7.54 +MED= 4.85 +COM= 3.50 +TRK= 1.36		17.25
TOTAL SPECIFIED COSTS		472.71
SALE VALUE @ $ 74.70/CWT.............	720.17	538.00
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		65.28
BREAKEVEN SALE PRICE...............		65.64

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	68.0	68.0	67.0	0.0	0.0	0.0	0.0	0.0	0.0	53.1	53.1	68.0
DP	6.6	6.1	5.5	0.0	0.0	0.0	0.0	0.0	0.0	5.6	5.5	7.2
DM	473	529	588	0	0	0	0	0	0	276	285	409

or as in this case they can be fed all hay and then turned out to pasture. Thus, the producer or researcher can design and evalute a variety of systems.

The supplement can be changed during the period studied as Table XL shows. This run was made with short native grass as the forage. The first 150 days alfalfa hay was fed at the rate of six pounds per head per day. During the last 150 days the supplement was changed to cottonseed meal and supplement was fed only when needed to balance the animal's diet for protein. This demonstrates how a specific amount of supplement can be specified and how the supplement can be changed.

The net return from Table XL was compared to a run where a concentrate was fed during the winter. Table XLI indicates that higher gains and higher net returns per head were obtained from the concentrate. This is in spite of the compensatory growth shown by the cattle fed alfalfa hay.

Table XLII shows the predictions of the model when using a feedlot type ration. These predictions were compared to results from Nelson's beef projection program which appear in Table XLIII. Gains are higher in Nelson's model due to larger predicted intakes. This run illustrates that the stocker model designed here has reduced accuracy in a feedlot situation. This demonstrates the importance of using a model for the specific purpose it was designed.

The model can also be utilized to analyze short run problems such as determining how much supplement to feed on native grass in the winter months, or the profitability of supplements with different protein contents could be explored. Also a producer could determine whether he should purchase steers or heifers or decide on which weight of cattle

TABLE XL

PROJECTION OF CATTLE PERFORMANCE WHEN WINTERED ON NATIVE GRASS AND ALFALFA HAY AND CARRIED THROUGH THE SUMMER

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	90.18	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

SHORT NATIVE WINTERED ON 6 LB ALF HAY

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
12 0	400.00						
12 15	404.80	8.81	0.32	0.49	6.00	-1.10	-1.10
12 30	409.65	8.91	0.32	0.47	6.00	-0.17	-0.64
1 15	414.08	8.95	0.30	0.47	6.00	-0.43	-0.57
1 30	418.52	9.04	0.30	0.46	6.00	-0.14	-0.46
2 15	422.78	9.10	0.28	0.45	6.00	0.15	-0.34
2 30	427.45	9.25	0.31	0.43	6.00	0.20	-0.25
3 15	432.30	9.38	0.32	0.42	6.00	0.24	-0.18
3 30	437.58	9.56	0.35	0.40	6.00	0.61	-0.08
4 15	444.43	9.91	0.46	0.37	6.00	1.05	0.04
4 30	451.73	10.13	0.49	0.35	6.00	0.51	0.09
5 15	486.93	14.06	2.35	0.15	0.00	1.27	0.20
5 30	522.24	15.05	2.35	0.14	0.00	0.54	0.23
6 15	551.88	15.15	1.98	0.14	0.00	-0.25	0.19
6 30	580.77	15.80	1.93	0.14	0.00	0.01	0.18
7 15	599.60	14.85	1.26	0.15	0.04	0.08	0.17
7 30	618.16	15.22	1.24	0.14	0.00	-0.02	0.16
8 15	633.56	15.07	1.03	0.15	0.14	-0.21	0.14
8 30	648.72	15.35	1.01	0.14	0.11	-0.50	0.10
9 15	664.37	15.77	1.04	0.14	0.00	-0.76	0.06
9 30	679.78	16.06	1.03	0.13	0.00	-0.59	0.02

STEER CLOSEOUT AFTER 300 DAYS.	POUNDS	$
ADG= 0.93 LB/DAY... INTAKE=12.27 LB/DAY		
AVG HD/AC= 0.29 MIN HD/AC= 0.13		
CATTLE AT $ 90.18/CWT.........	400.00	360.71
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0		
EQU= 3 PICK-UP= 6 MIN= 8 PEST= 3)		20.01
INTEREST @ 12 PERCENT...........		41.63
COST OF SUPPLEMENT AT $ 3.51/CWT........	904.43	31.77
PASTURE COST AT $ 0.39/CWT D.M.....	2,867.48	11.31
D.L=10.59 +MED= 4.85 +COM= 3.50 +TRK= 1.36		20.30
TOTAL SPECIFIED COSTS		485.74
SALE VALUE @ $ 72.52/CWT.............	679.78	492.97
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		7.23
BREAKEVEN SALE PRICE...............		71.46

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	51.0	50.8	50.5	51.2	64.0	62.0	58.0	56.6	57.0	0.0	0.0	51.5
DP	5.3	5.3	5.3	5.4	6.7	5.9	5.3	5.0	4.9	0.0	0.0	5.4
DM	270	275	284	301	437	464	451	456	477	0	0	266

TABLE XLI

PROJECTION OF CATTLE PERFORMANCE WHEN WINTERED ON NATIVE GRASS AND CONCENTRATES AND CARRIED THROUGH THE SUMMER

F E E D   D A T A

	EN. M. /CWT.	EN. G. /CWT.	PROT. /CWT.	WEIGHT /PUR. UN.	MOIST %	:SIS-PR /CWT.	LBS. I RATN	% IN RATN
1 CORN	104.00	67.00	7.50	0.56	11.00	4.13	3000.00	75.00
4 CSM	77.00	50.00	36.30	1.00	8.50	12.10	1000.00	25.00
9 TOTAL	97.25	62.75	14.70	0.67	10.38	6.12	4000.00	100.00

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	90.18	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

SHORT NATIVE WINTERED ON 4 LB CONCENTRATE

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
12 0	400.00						
12 15	419.75	10.79	1.32	0.23	4.00	-0.53	-0.53
12 30	438.73	11.16	1.27	0.22	4.00	0.34	-0.09
1 15	456.32	11.41	1.17	0.21	4.00	-0.00	-0.06
1 30	473.56	11.77	1.15	0.20	4.00	0.27	0.02
2 15	490.01	12.05	1.10	0.20	4.00	0.55	0.13
2 30	506.06	12.36	1.07	0.19	4.00	0.58	0.20
3 15	521.25	12.58	1.01	0.19	4.00	0.53	0.25
3 30	536.15	12.87	0.99	0.18	4.00	0.87	0.33
4 15	553.03	13.52	1.13	0.17	4.00	1.35	0.44
4 30	569.75	13.87	1.11	0.16	4.00	0.64	0.46
5 15	601.44	16.75	2.11	0.13	0.00	0.46	0.46
5 30	632.81	17.53	2.09	0.12	0.00	0.12	0.43
6 15	658.58	17.30	1.72	0.13	0.00	-0.48	0.36
6 30	684.48	17.95	1.73	0.12	0.00	-0.26	0.32
7 15	701.53	16.82	1.14	0.13	0.00	-0.16	0.29
7 30	718.84	17.24	1.15	0.13	0.00	-0.25	0.25
8 15	733.44	17.06	0.97	0.13	0.00	-0.38	0.21
8 30	748.30	17.42	0.99	0.12	0.00	-0.67	0.17
9 15	764.34	17.99	1.07	0.12	0.00	-0.95	0.11
9 30	780.53	18.37	1.08	0.12	0.00	-0.75	0.06

STEER CLOSEOUT AFTER 300 DAYS.	POUNDS	$
ADG= 1.27 LB/DAY... INTAKE=14.84 LB/DAY		
AVG HD/AC= 0.16 MIN HD/AC= 0.12		
CATTLE AT $ 90.18/CWT.........	400.00	360.71
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0 EQU= 3 PICK-UP= 6 MIN= 8 PEST= 3)		20.01
INTEREST @ 12 PERCENT...........		42.27
COST OF SUPPLEMENT AT $ 6.12/CWT........	600.00	36.71
PASTURE COST AT $ 0.38/CWT D. M.....	3,914.02	15.05
D. L=10.70 +MED= 4.85 +COM= 3.50 +TRK= 1.36		20.41
TOTAL SPECIFIED COSTS		495.16
SALE VALUE @ $ 65.90/CWT.............	780.53	514.33
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		19.17
BREAKEVEN SALE PRICE...............		63.44

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	58.7	57.8	57.1	57.8	64.0	62.0	58.0	56.5	57.0	0.0	0.0	60.1
DP	6.0	5.7	5.5	5.4	5.7	5.3	4.9	4.7	4.7	0.0	0.0	6.4
DM	348	366	382	411	514	529	511	517	545	0	0	329

TABLE XLII

PROJECTION OF CATTLE PERFORMANCE WHEN FED A FEEDLOT RATION

FEED DATA

	EN. M. /CWT.	EN. G. /CWT.	PROT. /CWT.	WEIGHT /PUR. UN.	MOIST %	ASIS-PR /CWT.	LBS. I RATN	% IN RATN
1 CORN	104.00	67.00	7.50	0.56	11.00	4.13	850.00	85.00
3 SBM	88.00	59.00	43.80	1.00	11.00	13.00	100.00	10.00
6 ALFHAY	56.00	25.00	12.70	20.00	10.00	3.47	50.00	5.00
9 TOTAL	100.00	64.10	11.39	1.58	10.95	4.98	1000.00	100.00

SX	BUYWT	BUYPR	RUM	IMPLANT	PADG	CHWT
S	400.00	88.57	1.00	1.00	1.00	1050

COMM	TRKRT	VETMED	OTH/DY	INTRT	$EQUITY
3.50	0.34	4.85	0.07	0.12	0.00

FEEDLOT COMPARISON

DATE	WEIGHT	FD/DY	GAIN/DY	HD/AC	LB. SUP.	MR-MC	PROF/DY
11 0	400.00						
11 15	437.64	9.18	2.51	99.00	10.30	-0.08	-0.08
11 30	476.57	10.04	2.60	99.00	11.27	0.81	0.37
12 15	516.76	10.93	2.68	99.00	12.28	0.88	0.54
12 30	558.16	11.85	2.76	99.00	13.31	0.52	0.53
1 15	600.71	12.80	2.84	99.00	14.38	0.31	0.49
1 30	641.67	13.50	2.73	99.00	15.16	0.26	0.45
2 15	680.93	14.13	2.62	99.00	15.87	0.28	0.43
2 30	718.50	14.70	2.50	99.00	16.51	-0.03	0.37
3 15	754.42	15.22	2.39	99.00	17.09	-0.33	0.29
3 30	788.78	15.70	2.29	99.00	17.63	0.14	0.28
4 15	821.68	16.13	2.19	99.00	18.12	0.63	0.31
4 30	853.21	16.54	2.10	99.00	18.57	-0.29	0.26
5 15	883.49	16.92	2.02	99.00	19.00	-1.22	0.14
5 30	914.68	17.59	2.08	99.00	19.75	-1.75	0.01

STEER CLOSEOUT AFTER 210 DAYS.	POUNDS	$
ADG= 2.45 LB/DAY... INTAKE=13.95 LB/DAY		
AVG HD/AC=99.00 MIN HD/AC=99.00		
CATTLE AT $ 88.57/CWT.........	400.00	354.27
MISC. COSTS AT $ 0.07/DAY...(LABOR= 0 EQU= 2.1 PICK-UP= 4.2 MIN= 5.6 PEST= 2.1)		14.01
INTEREST @ 12 PERCENT...........		31.97
COST OF SUPPLEMENT AT $ 4.98/CWT........	3,288.85	163.78
PASTURE COST AT $ 0.00/CWT D.M.....	0.00	0.00
D.L= 8.67 +MED= 4.85 +COM= 3.50 +TRK= 1.36		18.38
TOTAL SPECIFIED COSTS		582.40
SALE VALUE @ $ 63.89/CWT.............	914.68	584.34
NET RETURNS TO $ 0 EQUITY, MGMT, RISK. & UNPAID LAND & LABOR		1.94
BREAKEVEN SALE PRICE...............		63.67

NUTRIENT REQUIREMENTS TDN=% DP=% DM=LB/ACRE

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TDN	84.5	84.5	84.5	84.5	84.5	0.0	0.0	0.0	0.0	0.0	84.5	84.5
DP	8.6	7.8	7.3	6.9	6.6	0.0	0.0	0.0	0.0	0.0	10.3	9.4
DM	395	433	464	490	518	0	0	0	0	0	288	342

TABLE XLIII

SIMULATION OF CATTLE PERFORMANCE FROM OSU'S
BEEF PROJECTION PROGRAM

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                              F E E D     D A T A
              EN.M.    EN.G.   PROT.   WEIGHT  MOIST ASIS-PR  LBS.I    % IN
              /CWT.    /CWT.   /CWT.   /PUR.UN.   %    /CWT.   RATN     RATN
      1 CORN  102.00   67.00   10.00    0.56  15.00    4.29   850.00   85.00
      3 SOM    87.00   59.00   48.90    1.00  10.00   13.00   100.00   10.00
      4 ALFY   57.00   27.00   20.60   20.00  17.00    0.01    50.00    5.00
      9  TOTAL 83.89   54.84   12.48    1.32  12.44    4.94  1000.00  100.00
        DAY   WEIGHT  FD/DY    GAIN/DY    FD$/DY  FD#/#GN PRICE   PROF/DY
        DAY   WEIGHT  FD/DY    GAIN/DY    FD$/DY  FD#/#GN PRICE   PROF/DY
                              F E E D     D A T A
              EN.M.    EN.G.   PROT.   WEIGHT  MOIST ASIS-PR  LBS.I    % IN
              /CWT.    /CWT.   /CWT.   /PUR.UN.   %    /CWT.   RATN     RATN
      1 CORN  102.00   67.00   10.00    0.56  15.00    4.29   850.00   85.00
      3 SOM    87.00   59.00   48.90    1.00  10.00   13.00   100.00   10.00
      4 ALFY   57.00   27.00   20.60   20.00  17.00    0.01    50.00    5.00
      9  TOTAL 83.89   54.84   12.48    1.32  12.44    4.94  1000.00  100.00
SX BUYWT BUYPR  SELLWT SELLPR GNGRADE  COMM  TRKRT VETMED YDG/DY INTRT $EQUITY
S 400.00  88.571050.00  68.00    4.30   3.50   0.34   4.85   0.07   0.12   1.00
        DAY   WEIGHT  FD/DY    GAIN/DY    FD$/DY  FD#/#GN PRICE   PROF/DY
         15   449.03   14.87     3.27      0.74     4.55   81.03   -1.18
         45   547.10   16.22     3.27      0.80     4.96   78.31    0.35
         75   644.72   18.75     3.25      0.93     5.76   74.45    0.42
        105   739.11   20.68     3.15      1.02     6.57   70.83    0.34
        135   828.03   21.94     2.96      1.08     7.40   67.75    0.23
        165   910.13   22.60     2.74      1.12     8.26   65.18    0.12
        195   984.70   22.75     2.49      1.12     9.15   68.00    0.26
        213 1,024.76   22.52     2.23      1.11    10.12   68.00    0.24
      STEER CLOSEOUT AFTER  213 DAYS.                 POUNDS       $
        CATTLE AT $ 88.57 /CWT.........              400.00     354.28
        LOT CHARGE @  .067 PER DAY...........                    14.27
        INTEREST @  12 PERCENT...........                        41.93
        FEED COST @ $ 4.94329 /CWT............... 4,316.35      213.37
        D.L=12.42 +MED= 4.85 +COM= 3.50 +TRK= 1.36               22.13
        TOTAL COST OF SLAUGHTER ANIMAL             1,024.76     645.99
        TOTAL COST OF GAIN...(ADG=2.93#/DAY)         624.76      46.69
        SALE VALUE @ $ 68 /CWT.............        1,024.76     696.84
        NET RETURNS..........................          4.96      50.85
        BREAKEVEN SALE PRICE...............                      63.04
        AVE. FEED/LB. GAIN @ 90%DRYMATTER =.......                6.05
        PERCENT RETURN TO EQUITY OF $ 1 =.......              8,713.81%
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to buy. There are numerous times that a producer could use this model in decisionmaking. This chapter illustrated some questions that can be answered and gave predictions of the model under alternative conditions in order to demonstrate the model's flexibility and accuracy.

CHAPTER VI

SUMMARY AND IMPLICATIONS FOR FURTHER STUDY

Summary

The model outlined in this work was designed to simulate stocker cattle production in Oklahoma. The main purpose of this study was to develop a framework for producers to analyze their stocker cattle operations. Stocker cattle producers will be able to more accurately predict the consequences of their decisions by using the model. Stocker cattle production is simulated by operating the computer model which was developed for use on the Radio Shack TRS-80 mini-computer.

The basis for the equations and data used to form the model were results of animal science and agronomy research projects. The animal's energy requirements for maintenance and gain were based upon net energy. Voluntary intake was defined as a function of the total digestible nutrients (TDN) of the diet and body weight. An animal's energy required for gain was based on the animal's stage of maturity and not directly on body weight. Also, the protein requirements of the animal are always met. Compensatory growth effects were demonstrated by adjusting intake and energy requirements. The effects of growth stimulants were shown by increasing the net energy available for gain. The digestibility of feedstuffs was shown to be increased by feeding Rumensin.

Data on eight typical Oklahoma pastures were compiled from results of forage experiments. Monthly values were obtained for TDN, crude protein and dry matter to be consumed. TDN was converted to net energy by equations developed from research experiments. Cattle were assumed to be stocked at the optimum rate so dry matter available had no effect upon gain.

Price data for cattle and feedstuffs used in the analysis were 1979 average prices. Cattle prices were adjusted for seasonality with 5-year seasonal price indexes. The charge made for pasture was based on the pounds of TDN consumed, the cash costs of pasture per acre, and the use of TDN produced per acre.

An analysis was made to explore the historical relationship between light and heavy feeder steers. A significant relationship was found between the ratio of feeder calf and feeder steer prices, cattle numbers and feed prices.

Charges were included in the model for trucking, veterinary medicine, interest, equipment, pick-up, mineral and pest control. Costs of land and labor can also be included, if desired.

The computer output includes a table of the forage data used, a printout of input data about the cattle, a table of cattle performance and economic data for 15-day intervals, an economic summary for the simulation and a table of nutrient requirements. The predictions of the model were compared to the results of actual experiments. The model predictions were not significantly different ($.4 < p < .5$). Therefore, the theoretical framework of the model was concluded to be valid since the model was able to simulate reality.

Additional runs of the model were made to demonstrate the model's flexibility and accuracy. Results were obtained from using different forages and adjustment factors. It was demonstrated that the model would allow cattle to be fed entirely on hay or concentrate and cattle could be shifted from one forage to another.

The initial objective of this research effort was to develop a framework for producers to analyze stocker cattle production alternatives. The computer program that was used to model stocker cattle production gives producers an efficient method to determine expected outcomes. Therefore, the objective of this research effort was accomplished.

Implications for Further Study

Price of the cattle and average daily gain are the two most important variables in determining profit in a stocker cattle operation. Accurate long range predictions of cattle prices would aid producers in their decisions. Monthly nutrient values for forages were difficult to obtain. Forage data values need to be for what cattle consume and not what is available. Long range weather forecasts could help to predict forage quality more accurately. More research is needed to determine expected values for forage quality and quantity.

There are additional implications for further study. Coupled with other techniques such as linear programming, the model could be used to determine the profit maximizing enterprise mix for an endogenously determined pasture program. The effects of protein and energy supplementation of cattle on pasture need to be determined. How Rumensin affects the gains of stocker cattle and its effect on protein requirements is another important question. Some of the additional factors affecting voluntary intake such as palatability of the forage need to be quantified and determined. Even with these and other questions left unanswered the model is still a valuable decision tool.

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