FORECASTING SHORT-RUN FED

CATTLE MARKETINGS

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Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
DOCTOR OF PHILOSOPHY
December, 1995

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ACKNOWLEDGEMENTS

A dissertation is in actuality a synthesis of ideas and energies from numerous individuals; some of which I have had the privilege of working with during my time at Oklahoma State University, some of which I only know through texts and journal articles. To all of these individuals, I owe a special thanks. I would especially like to thank Dr. James Trapp for serving as both advisor and mentor during this arduous task. The ball is officially out of my court! In addition, I owe my appreciation to Drs. Steve Koontz, Francis Epplin and Kenneth Lusby for their helpful, if somewhat frustrating comments throughout the dissertation process. I also owe a special thanks to all the faculty members who have taken the time to answer numerous questions along the way; namely Drs. Wade Brorsen, Derrel Peel, and Brian Adam. Dr. James Osborn is also due a special thanks for his willingness to commit funding for a student with non-traditional preparation, and for his insights into the profession. I would also like to thank Dr. Ron Plain of the University of Missouri for his encouragement of my entering the Ph.D. program (perhaps curse is more realistic).

A special thanks is owed to Tom Tippens, President of Professional Cattle Consultants (PCC), for access to his data set and his willingness to participate in a joint venture effort resulting in this dissertation. I'm not sure that the original question was answered in the manner that was intended, but I believe the final product was worth the effort. I should also extend thanks to Todd Koontz, PCC's former Marketing Director, for his assistance with the data and help with understanding PCC's operation.

Graduate school would be tough to bear without the moral support and friendship of other graduate students. In particular, I would like to thank Randy Little, James Larson, David Marcouiller, Jung-He Lee, Steve Meyer, and Karen Halliburton for their friendship, support, and ability to keep things in perspective.

I would also like to thank my wife, Larae Anne Watkins-Bacon, for her love and support especially through the semester from @#$! and through prelims. She, too, has been through the "mill," and is very aware of the rewards and frustrations associated with the hoops and hurdles of graduate life. I also owe her a debt for getting this through the masochistic graduate school style manual.

Finally, this effort is dedicated to the memory of C.E. Bacon, Sr. He hadn't much to give except the lesson of perseverance. It is that resolve that has allowed me to succeed thus far. Thanks Dad.

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CHAPTER I

INTRODUCTION

The feedlot industry operates on relatively small and volatile net returns (Cleveland). Feedlot managers must compete with other feedlots for placements of animals into the feedlot. In addition to competing on physical performance measures, managers face extensive competition for economic performance. Critical for economic performance is the role and ability of managers to use market information.

The USDA monthly Cattle on Feed report (COF report) provides significant market information to all levels of the cattle industry. Specifically, feedlot and packing plant managers use this report as a principal source of supply information when developing marketing strategies. Accurate and timely market information is essential to the price discovery process. Therefore, considerable effort has been spent by both public agencies and private industry to improve upon the accuracy and timing of this information (Grunewald et al.).

This report provides an estimate of the previous month's fed cattle marketings and feedlot placements, along with the current month's beginning inventory of cattle on feed. A principal limitation of this report is that it provides dated and incomplete information. Specifically, it does not provide information regarding the weight distribution of either placements or cattle on feed. This makes it difficult to make inferences with regard to the future flow of cattle through the feedlot process.

To date, the limited nature of the COF report has dictated the types of testable hypotheses and restricted the types of analyses that could be performed. A key question for researchers is if a more detailed data set were available, could the types of testable hypotheses be extended in a meaningful manner? If so, what are the most pertinent questions to be addressed and how might this affect the feedlot industry as a whole?

This study has access to the one of the most detailed private data sets in existence regarding feedlot cattle. This data set has been developed by Professional Cattle Consultants Incorporated (PCC) as part of their normal business operation. The data set represents between 22 and 25 percent of the volume of the USDA COF report. The significance of the data set is that it contains pen level physical performances and transactions recorded on a daily basis.

In reviewing the literature, conversing with Professional Cattle Consultants (PCC), and communicating with industry experts, three issues have come to the forefront. First, can pre-release forecasts of the USDA COF report be significantly improved by augmenting current procedures with a private data set such as the PCC data set? Secondly, what information can be obtained by studying the flows of the cattle through the feedlot process? More specifically, can information regarding flows be used to help detect growing or declining stocks of feedlot cattle? If so, what impact do such stock changes have on marketing decisions? The third area involves questions of short-run price predictions (intra-month). Would the availability of more detailed data about weight distributions of cattle on feed and showlist size enhance short-run price predictions? Research in this last area has been limited to time series analysis due to data limitations. All three issues fit under the umbrella of improving feedlot managers economic performance.

Problem Statement

This study is concerned with increasing feedlot managers ability to make efficient and timely marketing decisions. Once cattle have been placed in the feedlot, an anticipated marketing date is established. However, feedlot managers do have some flexibility to adjust marketings around this expected date. The industry refers to this flexibility as a "marketing window." The industry may either "back up" or "run green" by adjusting their stocks of cattle. Backing up refers to holding cattle past their expected marketing date in anticipation of a higher future price. Running green refers to marketing cattle before their expected marketing date in anticipation of a lower future price. The flexibility of the feedlot managers in adjusting the short-run timing of marketings is limited by the price discounts associated with over or under finished cattle, the physical performance of the cattle, and feedlot capacity. All of these factors must be weighed against the expected change in the marketing price.

The key to managing the flexibility present within the marketing window is anticipating short-run price changes. In the short-run, cattle supply is more volatile than demand. Thus, accurate supply forecasts should help in detecting price movements, if the market is accurately reflecting all relevant information (Fama). Price movements in the fed cattle market are sensitive to the release of the USDA's COF report (Hoffman; Schroeder, et.al.). Therefore, having accurate advanced forecasts of this report has potential value.

In addition, implicit in the analysis of short-run fed cattle slaughter are industry questions of feedlot currentness. Cattle have traditionally been considered a nonstorable commodity. Therefore, current supply is assumed to be equal to the current volume of marketings. However, the industry is aware that price signals respond not only to the current marketings, but also to the volume of cattle that are within the marketing window. This volume or stock is referred to as a "showlist". Showlist is an industry term for cattle ready for sale that are shown to buyers.

Critical to the decision process is the ability to anticipate the flow of cattle onto and off of the showlist. Managers use their own knowledge of the industry and informal information networks to monitor showlist conditions. All of this information forms the marketing decision framework of the feedlot manager. This suggests the relevance for an empirical approach to validate the qualitative framework currently in place within the industry.

Previous research efforts have provided significant insights to several key management decisions. Models using public data have been very useful in detecting cycles and trends within the industry (Franzmann). Because of the importance of the COF report in providing short-run supply information, many efforts have been made to forecast it prior to its release. However, due to data limitations, these studies have stopped short of the central issue facing the feedlot manager: timing marketings to take advantage of short-run market dynamics. Such a modelling process would require information that reflects intra-month marketing decisions, primarily changes in supply.

Objectives

The seminal objective of this study is to aid sellers of feedlot cattle in making timely and efficient marketing decisions. The specific objectives are:

1. To determine if forecasts of U.S. fed cattle marketings can be improved by supplementing the USDA monthly Cattle on Feed Report with private information.
2. To develop a quantitative measure of showlist that is consistent with industry subjective assessments.
3. To determine whether USDA federally inspected slaughter or showlist size is more strongly correlated with price.

A desired result of this study is a clearer understanding of the impact of biological constraints and economic forces on the pattern of fed cattle marketings. An additional anticipated outcome will be the specification of a new framework for short-run slaughter cattle price forecasting.

Procedures

Agricultural economists generally use one of two methods to forecast conditions in the fed cattle market. The first method involves structural econometric supply and demand equations (Stillman; Brown and Brandt) and the second uses time series models (Zapata and Garcia). This research presents and evaluates a third, complimentary method of modelling short-run fed cattle marketings: a discrete delay growth simulation model. The approach is to model animal growth using primary data on pen transactions from eighty-five feedlots (PCC). This data source has considerably more detail regarding the timing and weights of feedlot placements and marketings than the COF report.

The data set used in this study contains detailed biological and economic inforamtion for every pen of cattle placed and sold by approximately eighty-five feedlots from January, 1986, through the present. The data set reports the number of cattle in each pen and their sex, as well as the placement date, average placement weight, and the slaughter date for the pen. Models will be estimated which predict days on feed for each pen as a function of placement weight, sex, feedlot location, and seasonal factors. A discrete delay simulation model will then be constructed to model the flow and inventory of cattle on feed by the number of days on feed remaining. Historical pen-level data will be used to validate the model. The days on feed prediction model and the simulation model will be used to forecast future marketings and inventories of cattle on feed from these feedlots. This simulated/forecasted pen slaughter data can then be aggregated to generate weekly, monthly and quarterly estimates of cattle on feed and marketings. A final step will be to link the simulated data to reported USDA fed cattle marketings and cattle on feed. This linkage will be made using econometric models which predict USDA marketings and cattle on feed based on marketings and cattle on feed from the sample of feedlots.

For forecasts beyond the current month, the modelling process occurs in two separate stages. First, the private data set is run through the simulation model. The output of this model is the short-range projections of cattle on feed and marketings in the private data set for one, two, three, and four months into the future. This information will serve as input to an econometric time-series model that contains both public and private data. The output of the econometric model are the short range projections of marketings as publicly reported in the COF report. Forecasts for the current month's COF report do not require the output of the simulation model. However, extending the forecast of the COF beyond the current month is based on output from the simulation model, and hence is conditional on the accuracy of the simulation model.

Scope And Limitations

The use of private data in economic analysis provides a rich opportunity to address issues concerning public data availability. To a large extent, the credibility of the private data is enhanced because the feedlot managers know that the data is being kept confidential and the analysis performed by PCC is expected to give them a competitive edge. On the other hand, the opportunity to use this information to address industry level questions provides a low cost approach to determine the usefulness of such data. Questions of usefulness include whether additional data should be collected publicly, which variables are most significant, and how should it be collected.

This study does not address the value of the private data. The data set was collected as part of PCC's normal business operations. Thus, a study concerning the value of this information would be necessary before considering changes in the current public data collection procedures.

Organization of Remaining Chapters

Chapter II provides a synthesis of past research efforts in the areas of forecasting, value of information, risk, and biological modeling that are relevant to the stated objectives, along with a discussion of the necessary underlying economic theory. The theory of simulation is also presented.

Chapter III describes both the public and private data sets used in the analysis and their respective collection procedures. The inventory accounting simulation model and the time series models are presented and discussed in detail. In addition, a framework for data management from collection through forecast is presented.

Chapter IV reports the result of incorporating the simulation and the time series model for the purpose of forecasting. Results of additional applications of the simulation and the time series model involving the secondary objectives are discussed.

Chapter V summarizes the research, presents the conclusions, and suggests areas for further study.

CHAPTER II

THEORETICAL CONSIDERATIONS AND LITERATURE REVIEW

The seminal objective of this dissertation is to improve the feedlot manager's ability to make efficient and timely marketing decisions. Theoretical considerations underlying the econometric and simulation procedures used are discussed in this chapter. In addition, a review of the pertinent literature is presented.

This chapter begins by discussing current sources of market information available to feedlot managers and the dynamic nature of the short-run marketing problem they face. Following this background discussion, the remaining three sections of the chapter are structured around the three specific objectives of this dissertation, which have been integrated together to provide a deeper understanding of short-run fed cattle market dynamics. Relevant literature and theoretical underpinnings for each of these objectives are discussed. The first of the three objectives is an effort to improve the forecasts of the monthly marketings reported in the monthly USDA Cattle on Feed (COF) report. The second objective uses a simulation approach to model the daily inventory and marketings flows of feedlot cattle as reported in a private data set. The purpose of this modeling effort is to develop a dynamic stocks and flows model of fed cattle supply. With this model, projections of fed marketings and showlists can be made. These projections in turn can be used to supplement traditional forecasts of the monthly COF report and to develop a better understanding of why inefficiencies (wrecks) can exist within the industry. The final objective integrates the dynamic stocks and flows simulation model results with observed cash price data in an attempt to develop an improved understanding of the relationship between fed cattle marketings, showlist sizes and price.

The Market Information Problem

This study focuses upon marketing decision problems of feedlot managers (the sellers of feedlot cattle). It is assumed that the feedlot manager acts rationally on the available information set. Thus, the approach taken in attempting to improve upon the feedlot manager's decision making ability is to improve upon the available information set. Specifically, information in the form of improved forecasts of the future availability of market ready cattle are sought. While this is not a study of market efficiency, per se, it does address a key assumption of market efficiency: the availability and interpretation of relevant information.

Outlook Reports

Several studies have examined the importance of outlook information for agricultural products in the formation of price expectations (Sumner and Mueller, Schroeder et. al.; Hoffman; Grunewald et al.). The rationale for such studies has arisen both as a recognized goal of improving market efficiency and as a response to criticisms generated about perceived inadequacies of current information programs. The first rationale has been the skepticism of the value of such programs based on the implications of the efficient market hypothesis (Sumner and Mueller). The second rationale is that agricultural producers have a strong belief that outlook reports, specifically USDA reports, tend to have a negative impact on market prices (Kohl and Uhl; Schroeder, et al.).

Most of these studies have used the futures market as a proxy for expected price. Schroeder et al. concluded that the USDA livestock inventory reports did not exert a persistent upward or downward influence on futures prices. This research did, however, conclude that inventory reports resulted in significant increases in price variation immediately following the report release. In the case of live cattle and feeder cattle, the increased variation was found to last one day. For live hogs, the variation lasted for two days. Their assessment was that this represented the time delay to incorporate the new information into prices (Schroeder et al.). Hoffman found that the USDA Cattle on Feed and Hogs and Pigs reports provided significant information to the cash market but not to the futures market. Grunewald et al. argued that previous studies in the livestock area have not adequately tested the efficient market hypothesis in that information is not partitioned into unanticipated and anticipated responses. Irwin et al. argued that previous studies evaluating the accuracy of forecasts generated by outlook programs fail to address the market timing ability such methods might offer.

Factors Affecting Supply

In the short-run, the US demand for beef is relatively stable. Thus, given basic microeconomic theory of supply and demand, short-run shocks in price must be created by shifts in supply. McConnell offers six determinants of supply; 1) technology, 2) input prices, 3) taxes and subsidies, 4) price of other goods, 5) the number of sellers and buyers in the market, and 6) price expectations. Adjustments in any one of these factors will cause a shift in the supply curve and thus, given a stable demand, result in a change in price.

In the case of beef supply, determinants one and three of the above list (technology and taxes and subsidies) can be assumed constant in the short-run. Likewise, beef's supply response to the price of substitute goods (other meats) is expected to be negligible in the very short-run due to buffering effects at the wholesale and retail levels (Meyer). Furthermore, input prices tend to be relatively stable, and the elasticity of response to a given percentage change of an input price is significantly less than that for a similar change in the own price and/or the number of buyers and sellers. Hence, the first four factors are hypothesized to have only a minor consequence on short-run beef supply numbers.

The last two determinants of supply, number of sellers and buyers and price expectations, are expected to play a major role in short-run shifts in beef supply.

The number of sellers (feedlots actively marketing cattle) at a given point of time may vary for numerous reason including weather, labor disputes, or irregular placement patterns. In addition, feedlots are not normally run at full capacity according to PCC. This allows feedlot managers to adjust placements numbers and weights and/or marketings to take advantage of favorable purchasing or marketing conditions. Some flexibility exists in determining the exact marketing date of slaughter cattle without serious changes in product quality occurring. Thus, price expectations are hypothesized to play a major role in short-run marketing decisions. Price expectations are referred to in the broader context of what influences market psychology. It is this latter term that serves as a focal point for this study: particularly, the role market psychology plays in determining short-run supplies.

Market psychology is most clearly defined in the futures market. Purcell refers to market psychology as the "herd complex". According to Purcell, commercial firms and professional speculators react quickly to supply side shocks. Next, the occasional traders are drawn into the bidding process further escalating futures prices. Finally, novices, recognizing lost opportunity, enter the market late in the cycle as prices have risen near or to their peak. The problem is formally defined as the fallacy of composition; a correct decision for the individual (micro-view) is <u>not</u> necessarily good for the group or whole (macro-view) (McConnell).

In general, this is the case within the fed cattle industry. If the industry correctly anticipates increases (decreases) in short run supplies, it can either sell cattle early (sell later) to avoid sharp shifts in the volume of fed cattle marketings. However, if market psychology generates a false response (for example holding cattle too long in an expectation of a price increase) market failures can occur (PCC). In these instances, price signals are unable to produce a rational response in market behavior. The cattle industry refers to these occurrences as "wrecks". The difficulty is in determining when these wrecks are most likely to occur, and what their level of magnitude will be (Antonovitz and Green). Much of this limitation is perceived to be due to the lack of detailed information about the movement of cattle within the feedlot industry.

One of the objectives of this dissertation is to develop a framework to determine if augmenting public data with private data can yield a significantly improved forecast of the USDA monthly Cattle on Feed Report. If so, then the following assumption would appear valid; namely, that the flow (rate of marketings) in the private data set serves as a reliable proxy for the flow of cattle in the public data set. The significance of this assumption is that the private data set records daily marketings (flows) while the public data set reports the total for the previous month (stocks). Given this assumption, important theoretical insights regarding stocks and flows within the fed cattle industry can be explored for the first time using primary data. A significant aspect of the approach used is the ability to implicitly document behavior via the difference (as well as the direction) between observed and predicted marketing patterns.

Stocks and Flows

Fed cattle have long been considered a nonstorable commodity. While this is true in the long run, this study holds that in the short-run cattle are indeed storable. Hence, the concept of a showlist is sustained. Showlist is defined as the volume of cattle that are ready for marketing at a given point in time (i.e. an inventory of market ready cattle). These lists are revealed through marketing negotiations between packers and feeders. The significance of this concept is not lost on the industry. Indeed, the industry is quite aware of storage via showlists, and market news services such as PCC use showlists to help identify and explain market psychology.

To understand the importance of showlists it is helpful to define the relationship between stocks and flows. Clower et al. defines a stock variable as inventory. Thus a stock variable has no time dimension. Therefore, showlist represents an inventory (stock) of market ready cattle at a given point in time. Marketings and entries onto the showlists represent flow variables. They have an embedded time dimension. For example, marketings are defined as the number of cattle sold (exiting the showlist stock) per unit of time (per day, week, month, or quarter).

Economic theory suggests that stocks serve as a buffer towards price fluctuations. Under such a theory, one would expect the volatility of the stock quantity to be greater than the volatility of marketings.

As one moves across time periods, the stocks of market ready cattle may either decrease or increase. If the marketplace correctly anticipates the net changes in stocks, then market operations will continue in their normal fashion.

Forecasting Monthly Aggregates

The first part of the dissertation focuses on improving forecasts of information contained in the COF report. The feedlot industry uses this information to serve as a basis for developing supply expectations. Feedlot managers augment the COF report with private information concerning inventory levels and with their own perceptions about the "currentness" of the inventory, i.e. whether an abnormal number of cattle in the inventory are past their normal marketing date or have been sold before their normal marketing date.

The monthly COF report provides information of the volume of cattle entering the feedlot (placements), the volume of cattle already in the feedlot (cattle on feed), the volume of cattle exiting the feedlot via sales (marketings), and the volume of cattle exiting the feedlot via death or poor performance (disappearances). Placements and marketings are for the previous month while cattle on feed is the beginning inventory for the current month. Disappearances are determined as the residual difference between cattle on feed from the previous month plus placements, less marketings less the current months cattle on feed.

Placement patterns into the feedlots are a potential source of supply disruption. However, two factors work in the feedlot manager's favor. First, placements can readily be forecasted with a high degree of accuracy using publicly available data (Franzmann). Placements do follow a seasonal pattern (Figure 1), but Trapp has shown that feedlots have substantial ability to minimize this impact by altering the weight distribution of placements during the year and thus smoothing the potential disruptions in marketings. Second, feedlot managers have the opportunity to alter the marketing dates for incoming cattle through ration selection.

The monthly COF report provides feedlot managers with important, but limited, information regarding the potential future supply of fed beef. For example, the report provides only the aggregate number of cattle on feed, not the corresponding weight distribution. Thus, while it is useful to determine if feedlot inventories are growing in total volume, it is limited in explaining when the cattle will be ready for slaughter. By combining this information with the quarterly COF report, the feedlot manger can begin to infer an approximation of the weight distribution of cattle within the feedlot. The quarterly COF report (during the period of this study) delineates the status of the cattle on feed by breaking down the volume into six weight classes; under 500 pounds, 500-699 pounds, 700-899 pounds, 900-1099 pounds, and over 1100 pounds. If weight distributions are lighter (heavier) than normal, feedlot managers would anticipate a decrease (increase) in the volume of marketings and take appropriate marketing or placement actions. The historical monthly cattle on feed inventory pattern is present in Figure 2.

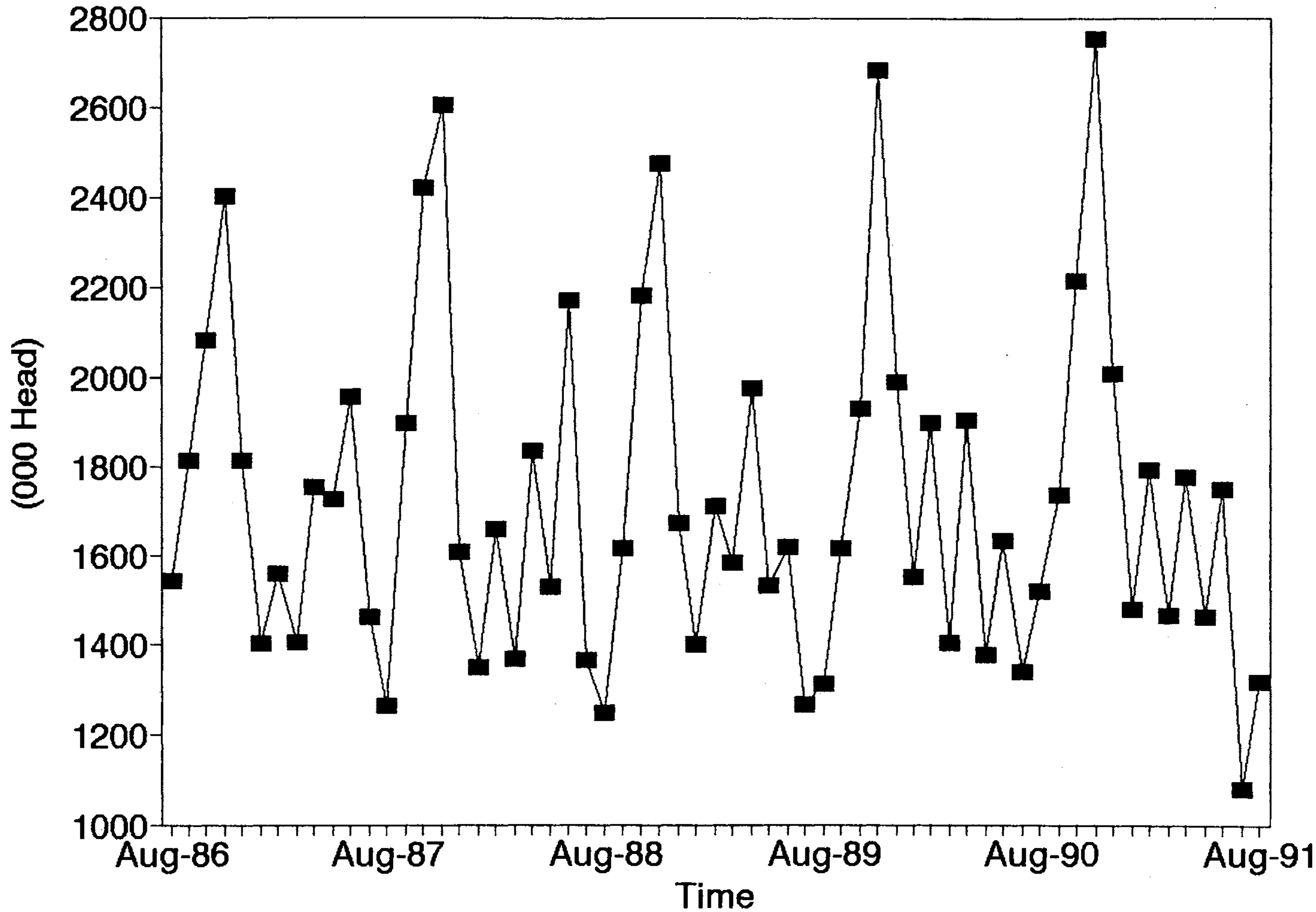

Figure 1. Historical Placement Patterns

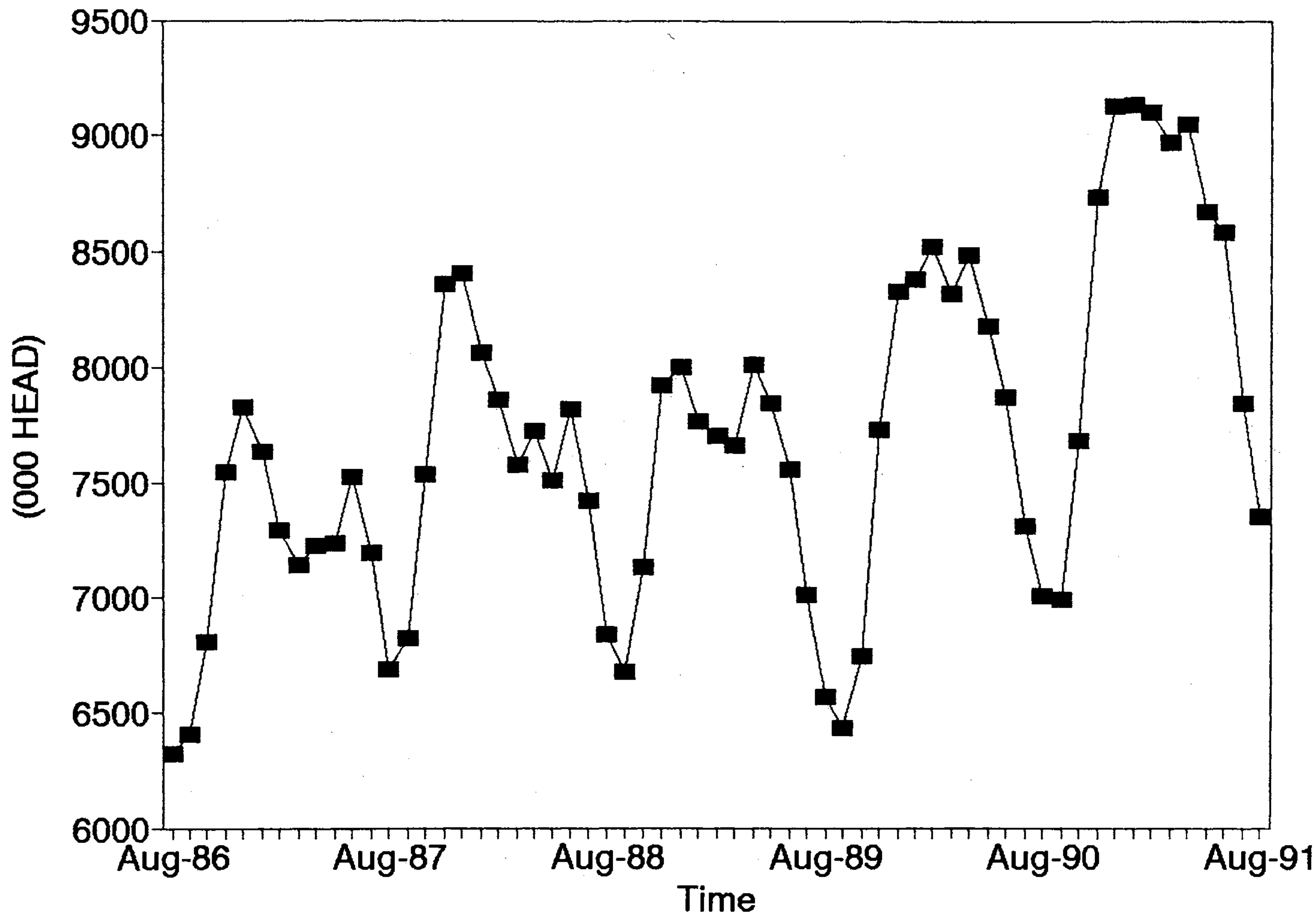

Figure 2. Historical Cattle on Feed Patterns

The marketings component of the monthly COF report also follows a seasonal pattern (Figure 3). It is hypothesized to be the most difficult component of the report to accurately forecast. The logic suggesting this hypothesis is that marketings fluctuate due to both biological variance and managerial choice. This hypothesis is tested and the results are given in Chapter IV. The biological performance of cattle can vary for numerous reasons, including weather, breed type, frame size, entry weight and condition, location, seasonality, health, and feed rations. Although the feedlot manager has direct control over some of the sources of variance, others can not be controlled. In general, the feedlot manager is faced with the tasks of accepting heterogeneous weight classes of cattle. The feeding process then follows a biological delay that is predictable.

The length of the feeding period (days on feed) was found to follow a normal distribution. Statistical theory states that 95 percent of the cattle will be marketed within two standard deviations of the mean number of days spent in the feedlot. This variation can be partitioned into two sources; biological and managerial. The managerial portion is assumed to represent the feedlot manager's flexibility in choosing an optimal marketing date. Thus, cattle marketings may be either pulled back from the succeeding month (marketed early) or pushed forward into the succeeding month (marketed late) depending upon the underlying marketing conditions.

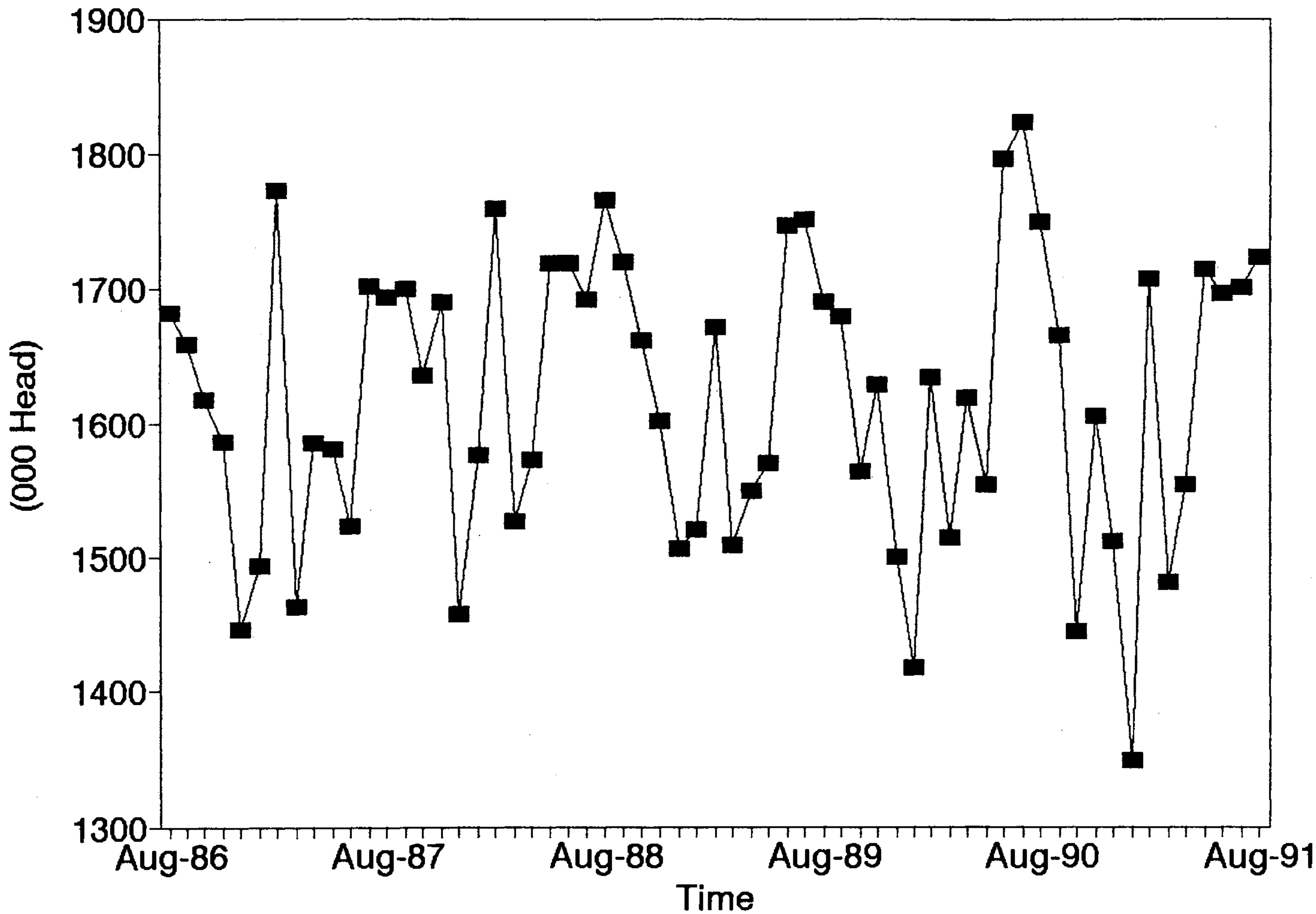

Figure 3. Historical Marketings Patterns

Simulation Modelling

Research in the agricultural economics is often hampered by a lack of appropriate data (Trapp). This often results in simplification of the underlying relationships or in ignoring them altogether. Keith and Purcell offer a solid example of voids in data and their impact on denoting cattle cycles and the forecast of beef supplies.

A perceived limitation of the monthly COF report is that it does not provide information on weight distributions. Trapp has shown that quarterly forecasts of cattle on feed and marketings can be significantly improved by incorporating simulated data on growth rates, placement weights, and sex into a growth and inventory model of cattle on feed. It is hypothesized that similar incorporations in monthly forecasts would provide substantial improvements in the ability to forecast marketings.

Simulation modelling is a process; not a procedure. It has its roots in engineering. In essence, simulation modelling is a process in which reality is emulated in an environment in which key variables can be easily measured (Mapp and Helmers). Simulation models may be either physical or abstract. An example of a physical simulation model would be measuring drag on a scale model of a car in a wind tunnel. An example of an abstract model would be POLYSIM, which is an agricultural policy simulation model (Ray and Richardson).

The advantage of simulation models are numerous. Physical simulation models provide decision makers with factual data at a fraction of the cost of full scale models. Additionally, physical simulation models can be used for training in situations where reality would pose an undue risk or cost, such as in the training of fighter pilots.

Abstract simulation modelling can also be very useful in situations where adequate data does not exist (Trapp). Consider the case of forecasting the impact of a change in the import tax in a developing nation. Often, adequate data is nonexistent; other times available data is subject to political manipulation in an attempt to meet a governmental plan. In such instances, the best information available may be theoretical understandings of elasticity. Trapp has shown how elasticities can be used to form the basis of a simulation model via the Generalized Econometric Spreadsheet Simulation (GESS) model.

A third area in which simulation modelling is useful is in capturing time dynamics. Production literature has relied heavily on the use of static theory, i.e. production is assumed monoperiodic (Beattie and Taylor). However, optimizing a monoperiodic objective function can lead to false conclusions if constraints imposed by the time path of adjustment are not considered. Trapp captured the essence of the debate between static and dynamic theory. Static theory is a like a grocery list; the production function denotes the ingredients but not their usage. Dynamic theory, on the other hand, is like a recipe. It not only includes the ingredients, but it provides the directions for their usage.

Simulation modelling lends itself extremely well to modelling biological growth via time dynamics. In the case of feedlots, it is first necessary to develop an econometric equation of expected length of time required for a pen of cattle between entry into the feedlot and exit from the feedlot via marketings. This delay length is referred to as days on feed (DOF).

The simulation model used in this study is modeled, in principal, after queuing theory. The objective of the simulation model is to accurately reflect the flow of cattle throughout the feedlot process. The que is represented by an array whose elements are broken down into individual days. These elements are refereed to as cohorts. Entries into the que are assigned to their respective cohort in the array based on their expected DOF. The simulation model can accept both multiple entries (placements of pens of cattle) and multiple exits (marketings of pens of cattle). Multiple placements into the same cohort are aggregated (Figure 4).

After all placements and marketings occur on a given day, the simulation model iterates forward one day in time. The model tracks movements by physically moving the contents of each cohort forward (towards marketings) one day (one cohort). When cattle complete the feeding cycle (remaining days on feed reaches zero), they are considered to be marketings, and the volume and date are posted to a marketings tableau.

At any point in time, the analyst can stop the simulation model and identify the distribution of cattle within the feedlot array. In addition, the expected future

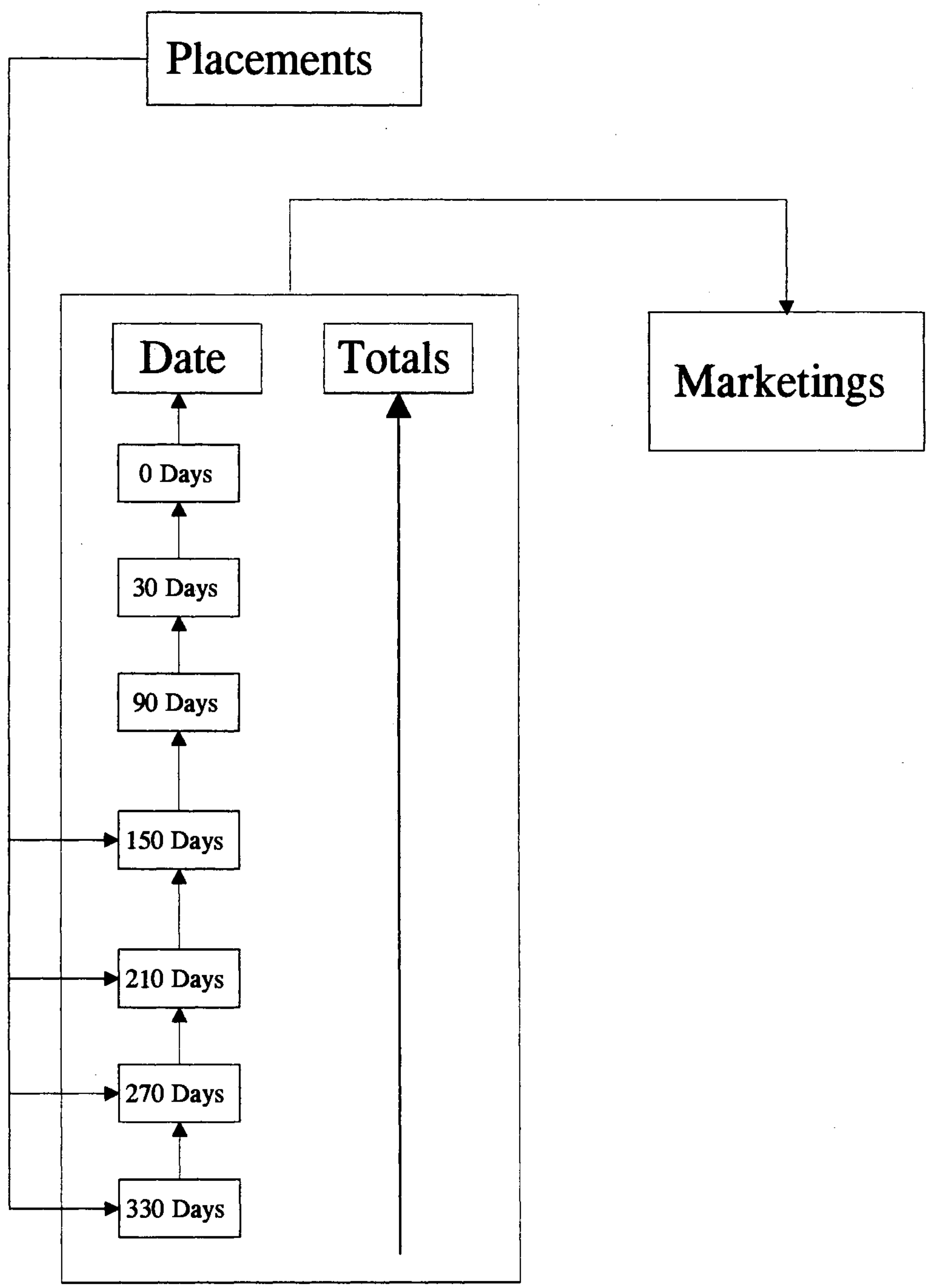

Figure 4. Simulation of Feedlot Process

schedule of marketings can also be examined. The marketings schedule reflected by the inventory que is an expected schedule, since predicted versus actual marketings dates are used to place cattle into the cohorts of the que. This is believed to be the first study to have primary data from which to compare the distribution of actual and expected marketings along with the distribution of actual and expected days on feed.

Inputs into the simulation model are daily records of feedlot placements and marketings collected by PCC. It is assumed that the primary data set provides a representative sample of the feedlots surveyed by the National Agricultural Statistics Service for the monthly COF report. This assumption is based primarily on the historical ability of PCC's data set to accurately track the COF report (PCC Cattlegram).

Marketing Window

Another area of study opened up by intra-month dynamics is the previously mentioned concept of storage. Associated with a forecast of days on feed is the standard error of the Y-estimate. The time frame represented by one standard deviation of the forecasted marketing date is hypothesized to represent what is referred to by the industry as the marketing window.

Cattle within the marketing window are, in effect, hypothesized to be in storage. These cattle, by definition, constitute the showlist. Implicitly the feedlot manager attempts to determine the point at which the value of the marginal product produced from continued feeding is equal to the marginal cost of continued feeding. This is the economically optimal point at which to sell, ceteris paribus. However, because of uncertainty regarding physical production, this point can not be precisely determined. Additionally, feeding trials and industry experience have established that this point is "nearly" satisfied over a rather wide weight range (i.e. one to two hundred pounds). Thus with regard to optimal physical marketing conditions, feedlot managers tend to "satisfice" rather than optimize. This results in a marketing window being established for feedlot cattle rather than an optimal marketing date. The endpoints of this window are practically defined as the earliest and latest possible marketing dates for a pen of cattle that will not result in a significant price penalty for over or under finished cattle. Within this window, it is contended that cattle are essentially "storable." Cattle within this window continue to grow, but this growth is predictable and, as defined, does not significantly affect quality or price.

Within the marketing window, market conditions rather than physical attributes of the animal become the primary marketing consideration. Stated alternatively, the marketing decision becomes one of short-run inventory management rather than production control. The key market condition is believed to be price expectations, as affected by perceived industry wide showlist sizes and the current psychological relations between buyers and sellers in the transactions negotiations process, i.e. the "tone of the market".

Implicit in this analysis is the fact that cattle can be valued simultaneously as capital goods (i.e., assets to be retained) and consumption goods (i.e., goods for sale). Therefore changes in current and expected prices affect both capital and market value. This leads to the economic rationale for delayed or accelerated sales. If the value of the cattle as a capital value exceed their market values and also exceed the capital value of feeder cattle, then the feedlot manager should retain the cattle in the feedlot. If either of these conditions are violated, the feedlot manager should sell the fed cattle. Replacements (feeders) are only purchased if their capital value is positive. Efforts in simultaneously viewing cattle as capital and consumption goods can be traced back to Jarvis, and Nelson and Spreen.

The existence of a marketing window allows both the feedlot manager and the packing plant manager to accomplish several objectives. Transactions costs can be lowered since it is possible to sell several pens from different points within the marketing window on the same date. Additionally, feedlot managers may either sell cattle early or hold them late in the marketing window depending upon short-run price expectations. On the other side of the market, packing plant managers have a strong incentive to maintain a uniform flow of quality cattle through the packing plant in an effort to operate at the lowest point on their average cost curve. Thus, the showlist provides a buffering mechanism that is expected to increase the operational efficiency of the industry.

During normal marketing patterns, cattle are sold near the center of their marketing window (close to the expected marketing date). However, during abnormal marketing situations (which may develop for numerous reasons including weather, market psychology, exogenous shocks, etc), cattle may not be sold close to their expected marketing date and may even be sold outside of the marketing window. When this happens, cattle are said to be "green" (early) or "backed up" (held past the end of the marketing window), and the showlist will become abnormally large or small. Such periods often result in considerable price volatility. Thus, it is important to both buyers and sellers to anticipate when such abnormalities will occur and take defensive strategies to avoid the potential consequences.

Short-Run Price Determination

Supply and demand research in grain markets has long recognized that supply is the sum of production plus inventories. Likewise the basic market clearing assumption for grain markets does not force production to equal consumption; rather it forces beginning inventories plus production to equal consumption plus ending inventories. Supply and demand model specifications for livestock markets depart from those for grain markets because livestock products are generally viewed as being nonstorable. Hence, the basic market clearing assumption normally made for livestock is that production must equal consumption.

This effort investigates the validity of the assumption that the appropriate market clearing condition for the beef market is that production equals consumption. More specifically, this research will consider the weekly market for slaughter cattle and attempt to determine if weekly slaughter is the best proxy of supply, or whether "showlist size" (i.e. market ready inventories of cattle) is a better proxy of supply. In a study of the Canadian beef sector, Tryfos found that inventories (showlist) should be included as an explanatory variable in short-run supply equations and that price and inventory levels are negatively correlated.

The third objective of this dissertation is to determine if and to what extent showlist size (or showlist size combined with weekly slaughter) is a better measure of short-run beef supply than weekly slaughter alone. The primary hypothesis to be tested in making this determination is whether showlist size or weekly slaughter is more strongly correlated with weekly changes in price. Past studies of short-run beef market behavior have been unable to test this hypothesis and have thus ignored slaughter cattle inventories (showlist size) because no data series exists for slaughter cattle inventories. Three sources of data are available to determine if slaughter cattle prices are more strongly correlated with showlist size as opposed to slaughter levels. They are the PCC data set detailing the physical attributes of placements and marketings for approximately eighty-five feedlots feeding twenty-two to twenty-five percent of the cattle in the nation, the <u>COF</u> report from which a proxy showlist variable can be developed, and a data set generated by an experimental economics simulator of the fed cattle market.

Chapter Summary

This chapter provides a review of the relevant literature as it applies to the problem statement outlined in Chapter I. A review of technical terms as applied to the cattle industry is supplied as needed. Due to the nature of the research problem, the chapter was subdivided into sections. Figures of historical information were provided to acquaint the reader with the nature of the fed cattle industry.

CHAPTER III

DATA AND PROCEDURES

This chapter begins with a discussion of the data series used in the study. Discussion of the modelling procedures used follows the data discussion. The procedural discussion is separated into three sections. These section are: a) forecasting monthly marketings; b) simulation modelling and showlist development, and c) modelling applications. Appropriate cross linkages between procedures are developed and discussed as needed. Statistical issues of relevance to the study are reviewed in each section. The chapter concludes with a brief summary.

Data Sources

Several data sources are utilized in this study. These included the USDA monthly Cattle on Feed (COF) report, the USDA federally inspected slaughter reported in the Livestock, Meat, and Wool Market News, Omaha cash market prices, simulation data from the Packer-Feeder Simulation Game developed at Oklahoma State University (Koontz et al.), and primary feedlot data collected by Professional Cattle Consultants (PCC). A brief discussion of each data source is provided below. Additional comments on the PCC data set are included in Appendix A.

USDA Cattle on Feed Data

The National Agricultural Statistics Service (NASS) conducts monthly and quarterly surveys of the cattle feedlot industry. The monthly survey contains data from the seven historically largest cattle feeding states. These states are Arizona, California, Colorado, Iowa, Kansas, Nebraska, and Texas. Collectively, these states account for over 70 percent of the US fed cattle marketings. The quarterly report adds six states, and covers over 85 percent of the fed cattle marketings. The six additional states are Idaho, Illinois, Oklahoma, Minnesota, South Dakota, and Washington. The monthly survey collects the number of cattle on feed at the beginning of the current month along with the number of cattle placed and marketed during the previous month. The quarterly survey collects the same data and, in addition, collects the number of cattle on feed by type and weight class. The type categories include steers, steer calves, heifers, heifer calves, and cows. The weight categories, in pounds, are under 500, 500-699, 700-899, 900-1099, and 1100 and over.

Numerous people have a stake in the accuracy of the NASS estimates of the number of cattle on feed. The USDA/NASS estimates are indicative of the supply of beef, and therefore, of prices producers will receive for beef cattle, of price traders and processors will be paying for beef cattle and beef, and the price consumers will be paying for beef products. Given the importance of these reports as a supply benchmark, it becomes apparent as to the industry's desire to develop accurate forecasts.

Federally Inspected Slaughter Data

The USDA Livestock, Meat and Wool Market News report contains an estimate of the number of steers, heifers, dairy and non-dairy cows and bulls slaughtered under federal inspection during the previous week. Steers and heifers were separated out to provide a comparable data series to the monthly COF report.

Cash Price Data

Price information was collected from the Omaha cash market for 1100-1300 pound steers. A weekly average for steers grading either select or choice was used.

Experiential Data

A semester of output from the Packer-Feeder Simulation game was used for the experiential data section. The Packer-Feeder Simulator is an experiential learning model developed at Oklahoma State University (Koontz et al.). The objective of the Packer-Feeder Simulator is to provide instruction on the structure, conduct, and performance of the fed cattle market; specifically, in the timing of transactions and the role of market information. Participants learn in an experiential or "hands on" environment by performing either the role of a feedlot manager or a packing plant manager. The participants' objective is assumed to be profit maximization through the selling (buying) of cattle. Placements and boxed beef demand are exogenous. Through negotiations, the players endogenously determine the timing of cattle sales and slaughter cattle prices. Feedlots have a five week window in which to market their cattle; failure to market the cattle within this time frame results in severe price penalties. Both feedlots and packers are supplied with respective cost information. It is up to the individual feedlot and packing plant to determine their exact costs and negotiate cattle transfers accordingly. In addition, the game includes a futures market and forward contracting is allowed. The simulation time is six to eight weeks of simulated time per one hour class session.

PCC Data

The private data set was collected by Professional Cattle Consultant (PCC) as a normal part of their business operations. This data set contains pen level "closeout" data for approximately eighty-five feedlots feeding between 22 and 25 percent of the cattle reported in the monthly COF report. The following variables for each pen of cattle are included: average placement weight and purchase price as well as the placement date and sex of the animals; the slaughter weight, date and sales price; death losses; days-on-feed; average daily rate of gain; feed fed per pound of gain; feed price; and total feed cost.

PCC is a private Oklahoma based consulting firm that has been collecting and analyzing feedlot performance data for a number of years. For this study, data was available from January 1986 through June of 1993. PCC specializes in providing member feedlots with marketing information and comparative performance reports. Information is made available to clients through a monthly comparative animal performance report and newsletters.

The comparative analysis reports detail how a given feedlot is performing in relation to other firms within a given geographic location and the sample area as a whole. Specific areas reviewed for the individual feedlot include factors such as capacity utilization, finished cattle sales, labor cost and efficiency, ration cost, average daily gain, and cost of gain. In order to promote accurate reporting, all individual data is kept confidential.

The PCC Newsletter reports performance averages by geographical region and for the entire clientele base for all the items in the comparative analysis report. Other sections include information on grain costs, cattle supply, market trends, and industry profitability. In addition, the newsletter gives detailed weight breakdowns of each month's placements. PCC is the only source of market information to provide this data.

PCC market news is released through the PCC Cattle-Gram. This report is compiled from a telephone survey to all member feedlots the first of each month.

It is normally available to the clientele by the 7th day of each month. The Cattle-Gram provides three basic pieces of information. The first piece of information is a projection of the monthly COF report at least 10 days before the report is released. Second, summaries (as reported by the member feedlots) of marketing intentions for the next four months and contracted sales for the coming two months are reported by region and in total. Third, the actual data of PCC feedlots for cattle on feed, placements, and marketings during the previous month are reported.

In addition to the telephone survey, member feedlots are required to submit separate monthly reports that list for each pen of cattle, the expected sales and placements for the month; actual placement and closeout performance data; and the feedlot capacity. The service area includes feedlots in Kansas, Texas, Oklahoma, Colorado, Nebraska, New Mexico, Iowa, and South Dakota. The heaviest concentration of fed cattle in the PCC data set is in Kansas, Texas, and Oklahoma with increasing volume in Nebraska.

Predictions of Monthly Cattle on Feed Report

To date, understanding of short-run marketing conditions within the beef industry has been limited due to the lack of publicly available data. Supply modelling efforts have centered on quarterly or monthly forecasts. Conventional research has restricted supply and demand as being equal. Such a restriction requires the use of time series analysis to implicitly capture short-run stocks and the measurement of intra-month flow of cattle. The procedures used in this study are explicitly able to measure short-run stocks and intra-month flows. While it is recognized that explicit measurement may not supersede time series approaches, it is thought that formal specification of a stocks and flows model of fed cattle supply may lead to a better understanding of the underlying forces in the relationship between fed cattle supply and price.

The first part of this study will use aggregate growth models for predicting the information in the COF report. The second part will use simulation modelling to capture intra-month flows of cattle from the private data set through the feedlot process. The simulation model will be designed to provide: a) a proxy for showlist size; and b) forecasts of future marketings at one, two, three, and four month intervals into the future. These forecasts of monthly marketings in part two will then be linked to part one to develop a conditional forecast for COF marketings. The final part of the study will be an effort to do short-run price analysis using information about the intra-month flows of cattle provided by the simulation model.

Aggregate Growth Models

Although the primary focus of this dissertation revolves around marketings, separate equations will also be developed to estimate the placements and cattle on feed components of the monthly COF report. The estimation of each component will be performed first using only publicly reported data and then augmented with privately reported data. The hypothesis to be tested is whether the addition of the private data significantly improves the forecast of the respective component.

The placements (PLAC) model using only public data is given by equation 1 and the augmented placement model (AUGPLAC) is given by equation 2. The public data marketings model (MKTG) is given by equation 3, and the augmented marketings model (AUGMKTG) is given by equation 4. The public data cattle on feed model (COF) is given by equation 5 and the augmented cattle on feed model (AUGCOF) is given by equation 6. Results of these models are reported in Chapter IV.

$$PLAC = f(TRD, MONTH) \tag{1}$$

$$AUGPLAC = f(PCCP, TRD, MONTH) \tag{2}$$

$$MKTG = f(TRD, MONTH, USDAP_4, USDAP_5, USDAP_6, USDAP_7) \tag{3}$$

$$AUGMKTG = f(PCCM, TRD, MONTH, USDAP_4, USDAP_5, USDAP_6\ USDAP_7) \tag{4}$$

$$COF = f(TRD, MONTH, USDAO_1, USDAO_2) \tag{5}$$

$$AUGCOF = f(PCCO, TRD, MONTH, USDAO_1, USDAO_2) \tag{6}$$

For all the models, TRD is a time trend variable and MONTH is a set of monthly dummy variables to correct for seasonality (with January as a base). The PLAC model suggest that placements are seasonally driven. The variable PCCP in the augmented placement model (AUGPLAC) represents PCC's monthly ratio of placements divided by total feedlot capacity.

A time series approach was used to predict fed cattle marketings, as reported in the monthly COF report. The marketings models are time series in the sense that the underlying principle is the biological lag in the production process. Specification of the marketings models show that this biological lag is from four to seven months (lag on placements shown as $USDAP_i$ where $i = 4$ to 7). Essentially, these models are aggregate growth models.

The first specification of the marketings model (MKTG), the public data model (Equation 3), relies solely on public data. Marketings are expressed as a function of placements reported four to seven months earlier, seasonal factors, and a time trend. This specification is based on the fact that the normal feeding period is four to seven months in length. Further, there may be some variation in the number of marketings given average placements due to season of the year and trend forces, i.e. different weights of feeder animals may be placed at different times in the year, and different feeds and feeding programs may be followed. Lastly, a trend variable is included to capture any shifts in the average volume of marketings over time.

An alternative specification, the AUGMKTG (Equation 4), is used in which the public data model was augmented with information from the PCC data set (shown as PCCM). This model is used to test if this private source of information accurately represents the occurrences in the monthly COF report. This information is available prior to the release of the USDA report. However, it reflects actions by a subset of the cattle feeding industry. The AUGMKTG model uses the aggregate data growth model as specified by Equation 3 augmented with the PCC marketings numbers weighted by the total capacity of PCC subscriber feedlots. The base capacity and cattle marketings reported to PCC varies over time as the number of subscribers vary. Therefore, it is necessary to use a marketings number weighted by the capacity of feedlots in the sample.

The public data cattle on feed model (COF) is a 2 period lag model for cattle on feed reported in the COF report ($USDAO_1$ and $USDAO_2$). The private data cattle on feed model (AUGCOF) augments the public model with the variable PCCO which represents PCC's ratio of cattle on feed to capacity.

The sample period to be modelled is from January 1986 through December 1990. Twenty out-of-sample observations are available for post sample analysis. The estimation results are presented in Chapter IV.

Simulation Model Development

In order to simulate the flow of feedlot marketings given placements, it is necessary to forecast the expected days on feed (DOF) and the expected death loss for each pen of cattle placed on feed. Once these two predictions have been made, they are incorporated into a simulation that models the expected flow of cattle through the feedlot from placement through marketing.

Days on Feed

To capture the intra-month marketing patterns of the fed cattle industry, it is necessary to use a model that can capture time dynamics. The PCC data set contains daily placement and closeout information. Using this data allows for the development of a daily level feedlot simulation model. Since the historical placement and closeout date for each pen of cattle is known it is possible to model the feedlot in terms of days on feed remaining before marketing. The volume of cattle in each pen are placed inside of a cohort of a discrete delay. The cohort in which the pen volume is placed corresponds to the number of days on feed remaining. After all pens for a given day are placed, the model iterates forward one day. Cattle with 0 days remaining represent the current day's volume of marketings (See Figure 5).

The DOF prediction model is an aggregate growth equation based only on the information available the day the pen is placed. This model is specified as:

$$\text{DAYSON} = f(\text{UNITINWT, WTSQ, TIME, TIMESQ, SEX, MONTH, IDYARD}) \tag{7}$$

UNITINWT is the average per head weight upon entry into the feedlot; WTSQ is the UNITINWT squared; TIME is a time trend variable; and MONTH is a set of dummy variables for months of the year with January as the base; and IDYARD is a dummy variable for feedlot identification. The sign on UNITINWT is hypothesized to be negative suggesting that animals with heavier entry weights

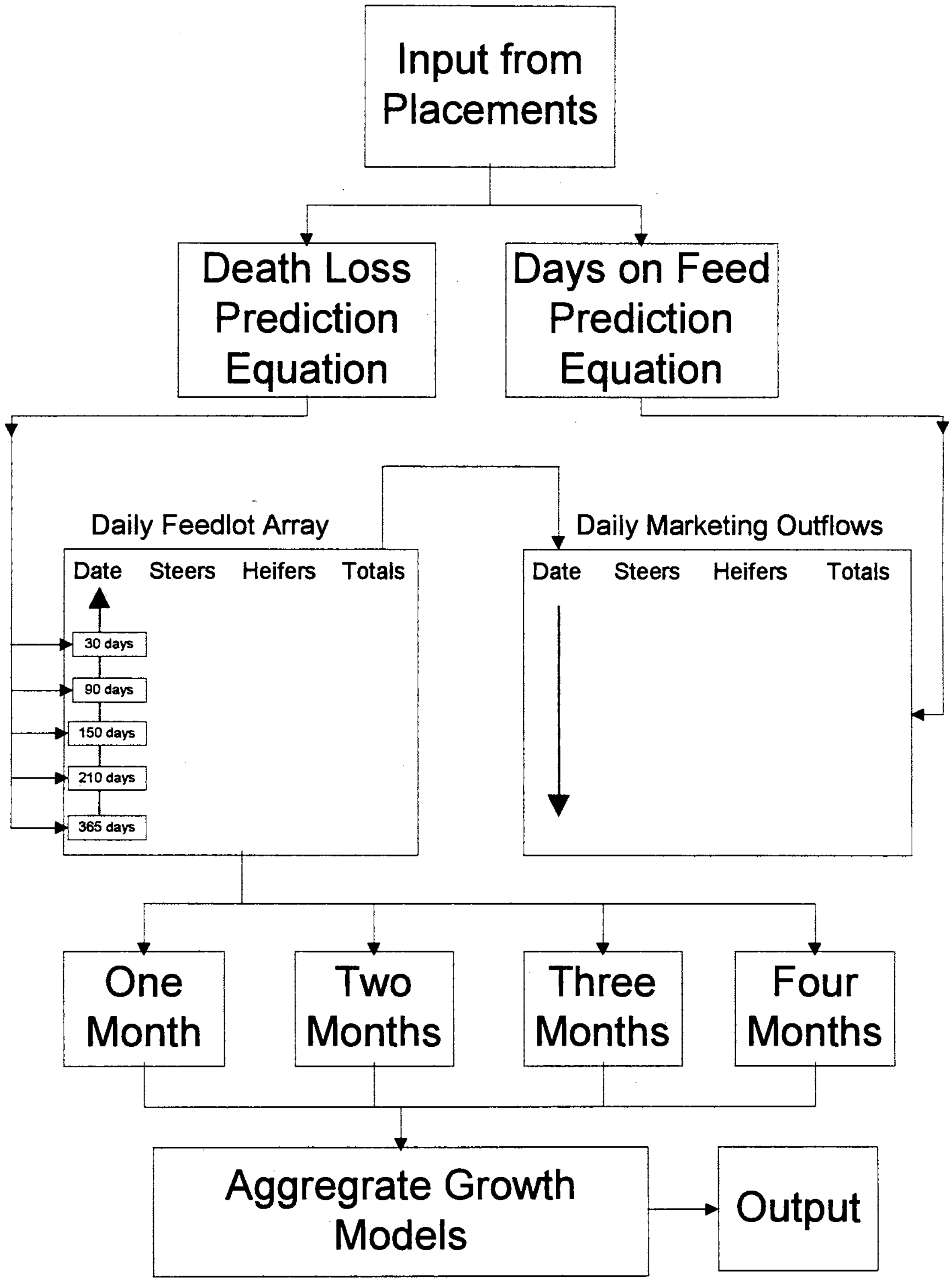

Figure 5. Simulation Model

require less time in the feedlot. The sign on WTSQ is hypothesized to be positive and denoting that the relationship between entry weight and days in the feedlot is non-linear. An intuitive explanation of this sign is that animals with heavier entry weights tend to have larger frame sizes. Thus, these animals will have a higher finished weight in order to grade choice. The sign on TIME is hypothesized to be negative suggesting that management practices and/or breed selections are improving over time, thus lowering the days on feed required to reach the desired grade of select or choice. The TIMESQ variable is hypothesized to have a positive sign suggesting that although days on feed are decreasing, they are decreasing at a decreasing rate. The DOF equation was estimated separately for steers and heifers in each state. The results are reported by state by sex in Chapter IV.

Death Loss

Death loss in this study is defined as both animals that die in the feedlot and animals that are removed from the feedlot and sold due to poor performance. This latter category is referred to as "railers" (PCC). Accurate projection of death loss is of only minor importance to this study since, death loss is less than one percent of total placements in the PCC data set and is reasonably stable for aggregate numbers of cattle.

A major reason for death loss being included is for model credibility. A principal limitation in model adaptation by private industry has been in understanding the modelling process (Trapp). The industry is aware that death loss occurs. Failure to include it in a modelling effort would limit the model's credibility with end users.

For the problem of modeling death loss, certain factors are known a priori. Death loss is distributed between 0 and 100 percent, with a heavy concentration at 0. Given the minimal impact upon the study and the computational cost of building a model for death loss, a more applied approach will be taken. The data set will be sorted by state, sex, season, and weight class. The seasons of the year are winter, summer, spring, and fall. Six separate weight classes will be established. The weight classes will be under 550 pounds; 550 to 649 pounds; 650 to 749 pounds; 750 to 849 pounds; 850 to 949 pounds; and over 950 pounds. Means will then be taken on the resulting categories. The resulting set of means will then be regressed against survivability (100-percentage death loss) to determine an expected death loss by sex and weight.

Figure 5 provides a graphic representation of the simulation model. The process begins with placements from the PCC data set. The computer program listed in Appendix C will be used for predicting death loss and days on feed. The output of this computer program will then become input into the simulation model. The placements will enter the feedlot array based on the predicted number of days on feed. After cattle complete the feeding process, they will enter the daily marketings array. In the interim, it will be possible to look back into the feedlot array one, two, three or four months to determine the expected number of marketings during the respective time period. These values can be used to provide conditional forecasts of the marketings component of the COF report using the aggregate growth model. This linkage is discussed in more detail in the model application section. These results are presented in Chapter IV.

Model Application

After the procedures for forecasting USDA marketings and simulating the flow of cattle through PCC's member feedlots were established, the efforts of this dissertation focus on applying and understanding these results. In total, five areas are addressed with varying degrees of success. The first two areas related directly to Objective 1 in Chapter I. These areas are: a) extending the forecast of the marketings component of the cattle on feed report beyond the current period; and b) linkage of the structural forecasting model with the feedlot simulation model. The second two areas relate directly to Objective 2 of Chapter I. These areas are: c) derivation of a marketing window; and d) derivation of showlist. The final area corresponds with the third objective stated in Chapter I. This area is: e) application of showlist for determining price movements.

Extension of USDA Forecast

Given that the public data marketings equation (MKTG) is not dependent on anything other than USDA Placements lagged four periods and time defined variables, it is readily apparent that this forecast can be extended three additional periods into the future without any loss in forecast accuracy. To the extent that there are no significant revisions in the COF report, a forecast made in the current period of the marketings for period T+1 will be identical to the forecast made in the previous period for marketings for period T.

Linkage of Simulation and Aggregate Growth Models

With one additional assumption (constant capacity of the PCC customer base), it is possible to use the anticipated marketings from the simulation model to extend the forecast of marketings up to three months into the future. Analysis of the PCC data set shows that nearly all of the cattle are placed in the feedlot with over 90 days before being marketed. Further examination shows that less than one percent are placed with under 60 days to marketing. The only caveat is the stability of the PCC customer base. While this does show some variation with the cattle price cycle, it is relatively stable over the span of two to three months. If PCC's customer base was growing or shrinking over the forecast horizon, this could create a nonstationarity problem in the forecast of marketings. Recall that Equation 4 (AUGMKTG) differs from the Public data model for marketings by only one variable, PCCM or PCC's marketings divided by capacity. With capacity held constant, the PCC model should significantly out perform the Public data model if PCC's marketings are contributing useful information.

Marketing Window

A key concept to be developed conceptually and quantitatively in this thesis is that of a marketing window. It is suggested that cattle within the marketing window are, in effect, in storage. These cattle are of an acceptable market weight and carcass quality, and are available for sale subject to the feedlot managers choice of timing.

Previous research by Bacon estimated the marketing window to be twenty-two to twenty-eight days in length and the average days on feed to be 147 days (twenty-one weeks). A marketing window length of twenty-eight days (four weeks) was selected for this study.

Showlist

A second major concept to be developed and quantified in this thesis is that of a "showlist." Showlist, as previously defined, is the portion of cattle within the marketing window. It provides a buffer stock to smooth marketings. It is hypothesized that inventories of market ready fed cattle (showlists) have a stronger influence on weekly slaughter cattle prices than do slaughter levels.

A criticism of the NASS estimates of fed cattle marketings is that they are of limited use in explaining price movements (Peel). This study hypothesizes that price is not only a function of slaughter quantity but of showlist size as well. Failure to reject this hypothesis should provide insight to the problem of using only slaughter quantity in short-run price forecasting within the fed cattle market. In effect, what the hypothesis suggests is that the industry is responding to their expectations of what should be available.

Thus it is assumed that cattle enter the marketing window, i.e. go on the showlist, four weeks in advance of their expected slaughter date. Therefore, cattle going onto the showlist consist, on average, of cattle placed on feed seventeen weeks ago (i.e. twenty-one minus four). Given these assumptions a showlist proxy variable can be specified as follows:

$$SHOWLIST_t = \sum_{i=t-4}^{t} M_i \tag{8a}$$

$$SHOWLIST_{t+1} = SHOWLIST_t + P_{t-17} - M_t \tag{8b}$$

. . . .

. . . .

. . . .

$$SHOWLIST_n = SHOWLIST_{n-1} + P_{n-17} - M_n \tag{8n}$$

Where: P_{t-17} ------- is placements lagged seventeen weeks

M_t ---------- is marketings during the current week

$SHOWLIST_t$ --- is the showlist proxy variable

Application of Showlist

This section relates to the third objective stated in Chapter I, which is to determine the ability to predict intra-month (weekly) prices as a function of short-run supply. To accomplish this objective, it is first necessary to determine what constitutes the best measure of short-run supply. This section examines whether fed cattle slaughter, showlist size, or some combination of the two is the best measure.

The focus of this section is highly influenced by the work of Koontz et al. on the Packer-Feeder game developed at Oklahoma State University. Over the course of development and implementation of the Packer-Feeder game, questions arose concerning hypotheses once considered untenable due to data restrictions. Some of these hypotheses can now be empirically tested. Significant among these are the correlation between showlist and price versus the correlation between slaughter and price. However, to validate the hypothesis testing done with the Packer-Feeder game, it is deemed necessary to determine if the results could be duplicated using "real world" data. Two types of real world data will be used to validate the hypothesis originally tested with the experiential model. The first of these consists of publicly reported data and the second consists of private data collected by PCC.

Thus, in total, three data sources will be used to test the relative correlation strength between showlist and price versus slaughter and price. These sources are: a) output from a fed beef market experiential learning simulator; b) publicly reported data; and c) private data from feedlot closeout records. The publicly reported data and the private data set use the same price series (Omaha cash market for 1100-1300 pound steers), and the same federally inspected slaughter series. As will be discussed shortly, only the definition of showlist is different.

The first step in price prediction is to determine the impact of lagged values of price. Price as a function of lagged values of price will become the base model. Next, lags of showlist will be added to the base model. Then lags of slaughter will be added to the base model. The next step will be to combine both lags of showlist and slaughter into the base model. The final step will be to include contemporaneous values of showlist and slaughter. Lag values are added based on Akaike's information criterion (AIC). This criterion is of the form

$$AIC(n)=\ln\sigma^2{}_n+2\frac{n}{T} \qquad (9)$$

where σ^2 is the maximum likelihood estimator for the normal variance term, n is the number of lags, and T is the number of observations. The objective is to select the number of lags that minimize this criterion (Judge et al.). The microcomputer program, SHAZAM, will automatically calculate this criterion when the ANOVA option is selected and the number of lags are specified (White).

Thus, for the three data sets, four separate equations explaining price will be estimated: the base, with federally inspected slaughter, with showlist, and with both federally inspected slaughter and showlist. A more comprehensive overview of each of the data sources is provided in the following section.

Experiential Data Model. The showlist, slaughter price, and marketings data generated by the experiential learning model will be used to test the basic hypothesis of whether showlist and price, or slaughter and price, are more strongly correlated. Within the experiential simulation model it is possible to know at all times the cattle which, according to the game's rules, are available for sale (i.e. are on the showlist). The timing of the sale of showlist cattle, as well as the slaughter price received for the cattle sold, are endogenously determined by the players in the simulation. Feeder cattle supplies, feeder cattle prices, cost of gain, and boxed beef demand are exogenous to the game.

Public Data Model. To employ the same framework used with data from the experiential learning model using publicly available data, it is necessary to develop weekly showlist and weekly fed cattle marketings data series. This will be accomplished in two steps. First, a weekly marketings and placements series will be developed from the monthly COF report. This approach is obviously limited in that only total monthly placements and marketings are reported, and nothing is known about the weekly distribution of placements or cattle on feed. One might assume that marketings are strongly correlated with federally inspected slaughter, which is reported daily, and thus impose a similar distribution on marketings. However, there is significant debate about the level of correlation between the two (Peel). Thus, following Meyer, data from the monthly COF report will be transformed to form a weekly data set assuming a uniform distribution of marketings and placement throughout the month. The procedure differs from Meyer's in that a five week centered moving average will then be used to smooth the resulting data series. This will be done to avoid sharp shifts between months.

Private Data Model. Concurrent to the development of the Packer-Feeder experiential learning simulator, a biologically based fed cattle marketings forecasting model will be developed. This model will utilize the private data set previously described. To be consistent between data sets, data from February, 1988, through December, 1990, will be used, resulting in 148 observations. The core of the model consists of an equation to predict the expected days on feed (DOF) of each incoming pen of cattle. The equation will predict days on feed as a function of placement weight, sex of the animals, location of the feedlot, and month of the year. Given a predicted number of days on feed, each pen of cattle will be placed into a queuing model to simulate its movement through time (growth) to its eventual slaughter date. Different weights, sexes, etc. of cattle will enter the que with different expected days on feed. Thus, cattle projected to be slaughtered on a given day will likely have been placed on many different days. However, the queuing model will be capable of discerning this fact and generating one aggregate daily marketings figure with the proper delay imposed for each pen of cattle. Each simulated day's volume of cattle exiting the feedlot que will be summed to determine a weekly marketings series.

For the purposes of this study, the fed cattle marketings simulation model described above will be used to simulate the expected date cattle would go on the showlist. Cattle are assumed to be placed on the showlist four weeks prior to their expected slaughter date.

Actual marketings will be determined from the private data set itself according to the reported marketings date. In reality, the easiest method found to aggregate the private data set into a set of daily marketing figures was to run the queuing simulation model and replace the forecasted DOF value with the true DOF value. Given the showlist entry (placement) and exit data (marketings) series described above, the showlist proxy model described by Equation 8n will be used to develop a showlist proxy variable for the private data set. The results are reported in Chapter IV.

Chapter Summary

Chapter III discussed the data and procedures to be used in this study. This dissertation is unique in that it is the first known study of its type to have access to such an extensive private data set. The procedures are discussed in three basic parts: a) developing and extending the range of forecasts of the components in the monthly COF report; b) the development of a simulation model to capture the time dynamics of feedlot operations; and c) the application of the knowledge gained from the time dynamics of feedlot operations to the question of short-range price forecasting. Statistical issues and data limitations are discussed as appropriate.

CHAPTER IV

RESULTS

Chapter IV begins by giving the empirical results of the regression models used to forecast the components of the Cattle on Feed report (COF), and then proceeds to the results of the simulation model. This chapter also provides the results of linking the forecast and simulation models together. Measures of model performance are presented in detail.

Regression Models

Ordinary least squares (OLS) regression models were used to estimate the placements, cattle on feed, and the marketings components of the monthly COF report. Autocorrelation was tested for and corrected as necessary.

Placements

Table I reports the final results of the placement models. In general, placements were lower in late winter and mid summer. Both the public (PLAC) and augmented data model (AUGPLAC) had significant first-order autocorrelation.

TABLE I

PREDICTING THE PLACEMENTS COMPONENT OF THE COF REPORT
JANUARY 1986 - DECEMBER 1990
(t-values in parentheses)

Variables	PLAC	AUGPLAC
Intercept	1679.4	475.33
	(17.89)*	(3.90)*
Trend	.9354	3.6225
	(.53)	(3.95)*
PCCP	-------	5777.4
		(10.69)*
February	-267.90	-166.68
	(-3.10)*	(-3.65)*
March	155.91	-56.804
	(1.58)	(-.01)
April	-168.97	-9.9764
	(-1.65)	(-.18)
May	132.33	-41.320
	(1.28)	(-.75)
June	-351.48	-99.90
	(-3.39)*	(-1.73)**
July	-371.14	-238.68
	(-3.59)*	(-4.43)*
August	26.632	-61.305
	(.27)	(-1.21)
September	456.30	282.94
	(4.65)*	(5.40)*
October	871.76	441.17
	(8.97)*	(6.92)*
November	106.03	341.07
	(1.13)	(6.44)*
December	-275.91	70.743
	(-3.29)*	(1.31)
R-Square %	89.75	97.39
Adj-R-Square %	86.69	96.52
Durbin Watson	1.845	1.868
YBAR	1756.3	1756.3
RMSE	140.26	71.706

*significant at $\alpha=.05$, two-tail test **significant at $\alpha=.1$, two-tail test

These models were re-estimated using the AUTO command in SHAZAM which corrects for first-order correlation using the Cochrane-Orcutt procedure (Kennedy).

Much of the placement pattern was captured by the monthly dummy variables, and can be readily explained via calving programs, backgrounding operations, and typical weather patterns of the central and southern great plains. The AUGPLAC model was able to explain over three-fourths of the remaining variation in-sample with an R-Square of .9739 versus an R-Square of the public data model (PLAC) of .8975.

The post-sample analysis of the placement models yielded less dramatic results. The F-Statistic for the reduction in mean square errors F-Test (with the null hypothesis stating that there was no significant differences in the mean square errors between the two models) failed to reject the null hypothesis. The resulting F-Statistic reported in Table II is 1.961 with a P-Value (probability level) of .191 (Ashley et al.).

Cattle on Feed

Table III reports the results of the model to forecast the cattle on feed component of the COF report. Both models (COF and AUGCOF) did equally as well in sample. The augmented data model (AUGCOF) did have significant first-order autocorrelation problems while the public data model (COF) did not. Thus, the private data model was re-estimated using AUTO option in SHAZAM to

TABLE II

OUT-OF-SAMPLE FORECAST OF PLACEMENTS
JANUARY 1991 - SEPTEMBER 1992

Statistics	PLAC	AUGPLAC
Mean Square Error	35440	18777
Reduction in Mean Square Error F-Test and P-Value	-----	1.961 (.191)
Root Mean Square Error	188.23	137.029
Root Mean Square Percent Error		
Out-of-Sample R-Square %	85.20	92.30
Theil Inequality Coefficient	.297	.246
Coefficient Decomposition		
Bias	.1125	.0944
Regression	.0127	.0087
Disturbance	.8723	.9043

TABLE III

PREDICTING THE CATTLE ON FEED COMPONENT OF THE <u>COF</u> REPORT
JANUARY 1986 - DECEMBER 1990
(t-values in parentheses)

Variables	COF	AUGCOF
Intercept	1828.6	1035.9
	(2.82)*	(1.35)
Trend	4.4586	3.7627
	(2.45)*	(1.47)
PCCO	-------	1286.1
		(2.55)*
$USDA_1$	1.2877	.8986
	(9.47)*	(6.35)*
$USDAO_2$	-.5693	-.2090
	(-4.12)*	(-1.47)
February	256.65	92.308
	(2.15)*	(1.01)
March	128.46	-29.736
	(116.04)*	(-.30)
April	463.88	185.06
	(3.83)*	(1.60)
May	-47.822	-166.33
	(-.44)	(-1.67)
June	270.16	-64.644
	(2.22)*	(-.49)
July	-283.42	-505.85
	(-2.45)*	(-4.51)*
August	-111.86	-421.34
	(-.75)	(-2.82)*
September	116.78	-198.40
	(.72)	(-1.17)
October	424.47	217.47
	(2.69)*	(1.31)
November	621.36	505.72
	(4.30)*	(3.27)*
December	58.993	161.46
	(.04)	(1.61)
R-square %	.9608	.9747
ADJ R-Square %	.9463	.9662
Durbin Watson	1.8275	1.7751
YBAR	7555.6	7555.6
Root Error Variance	148.45	134.21

*significant at α=.05, two-tail test

correct the autocorrelation. The time trend variable (TRD) was no longer significant in the AUGCOF model (Equation 6). Both the in-sample results and the post-sample analysis showed that the addition of the private information did not significantly improve the forecast of the cattle on feed component. In particular, the F-Test, as described in the previous section, yielded an F-Statistic of 1.1773 associated with a P-Value of .347. These results can be found in Table IV. Again, there was insufficient evidence to reject the null hypothesis of no significant difference between the two models (Ashley et al.).

Marketings

Table V reports the regression results for the aggregate data growth models used to describe fed cattle marketings. Durbin-Watson statistics revealed no significant first-order serial correlation. Table V also shows that marketings were highly influenced by placement lagged four to seven months. This lag time on placements represented the typical biological delay associated with finishing cattle. In both models, the variables $PLAC_{t-4}$ and $PLAC_{t-7}$ were considerably larger in magnitude than $PLAC_{t-5}$ and $PLAC_{t-6}$. This was believed to be because the tails of the placement distribution provide more information (and may be more variable) than the middle of the distribution. However, all but one of the signs on the lagged placement were positive. Positive values were expected, because placements become marketings as they move through the feeding process.

TABLE IV

OUT-OF-SAMPLE FORECAST OF CATTLE ON FEED
JANUARY 1991 - SEPTEMBER 1992

Statistics	COF	AUGCOF
Mean Square Error	22038	15098
Reduction in Mean Square Error F-Test and P-Value	----	1.1773 (.347)
Root Mean Square Error	166.77	122.87
Root Mean Square Percent Error		
Out-of-Sample R-Square %	96.08	97.43
Theil Inequality Coefficient	.3734	.288
Coefficient Decomposition		
Bias	.1277	.1062
Regression	.0566	.0240
Disturbance	.8157	.8697

TABLE V

PREDICTING THE MARKETINGS COMPONENT OF THE <u>COF</u> REPORT JANUARY 1986 - DECEMBER 1990 (t-value in parentheses)

Variables	MKTG	AUGMKTG
Intercept	1131.1	491.97
	(5.51)*	(2.26)*
PCC Marketings Ratio	——	3284.0
		(4.31)*
USDA $PLAC_{t-4}$	.188	0.1005
	(2.81)*	(1.82)**
USDA $PLAC_{t-5}$	-.014	0.0240
	(-.20)	(.44)
USDA $PLAC_{t-6}$	.076	0.0307
	(1.04)	(0.53)
USDA $PLAC_{t-7}$	.746	0.1586
	(1.06)	(2.75)*
Trend	-0.289	1.2115
	(-0.04)	(2.11)*
February	-304.89	-168.88
	(-5.53)*	(-3.18)*
March	-146.64	-94.617
	(-1.70)**	(-1.40)
April	-98.938	-2.1328
	(-.96)	(-.03)
May	-71.056	-115.87
	(-.76)	(-1.58)
June	103.17	29.124
	(1.56)	(.54)
July	30.559	-28.259
	(.59)	(-.67)
August	59.638	-15.684
	(1.02)	(-.32)
September	-80.338	-31.462
	(-1.54)	(-.08)
October	21.772	-4.4179
	(.29)	(-.75)
November	-146.11	-69.506
	(-1.95)**	(-1.15)
December	-173.73	-142.720
	(-2.81)*	(-2.96)*
R-Square %	83.17	90.34
ADJ R-Square %	72.81	83.78
Durbin Watson	1.94	1.94
YBAR	1613.5	1613.5
Root Error Variance	51.078	39.448

*significant at $\alpha=.05$, two-tail test **significant at $\alpha=.1$, two-tail test

One-third of the remaining variation was explained by adding the private data. The coefficient on the PCC marketings as a percent of capacity variable was statistically significant. An increase (decrease) in marketings as a percent of capacity of 1 percent suggests USDA seven states markets will increase (decrease) by 3284.0 thousand head. The distributed lags on USDA placements four and seven months prior remained significant. However, the reduction in the coefficient size on the four month lagged placement variable suggested that PCC member feedlots generally feed cattle for four months. A portion of the seasonal factors remained significant and the trend variable was also significant in this model. For this sample, the total capacity of PCC feedlots was shrinking relative to the total number of USDA reported marketings.

The reduction in mean square error F-Test was able to reject the null hypothesis of no significant differences in the out-of-sample results at the P-Value (probability level) of .013. This evidence was supported by the change in the root mean square percent error. Forecast errors of the private data model were 3.21 percent of the actual marketing levels. This was an improvement from 4.96 percent in the simple aggregate data growth model. The decomposition of the Theil inequality coefficient suggested no systematic biases in the forecast were introduced when the PCC information was used in the forecast. The forecast error was largely due to the model disturbance. These results are reported in Table VI.

Post-sample statistics for the MKTG model revealed that the root mean square error of the one-month-ahead marketings forecast was 70.91 thousand head.

TABLE VI

OUT-OF-SAMPLE FORECAST OF MARKETINGS
JANUARY 1991 - SEPTEMBER 1992

Statistics	MKTG	AUGMKTG
Mean Square Error	5028.3	3183.5
Reduction in Mean Square Error F-Test and P-Value	-- -	5.151 (0.013)
Root Mean Square Error	70.91	56.42
Root Mean Square Percent Error	4.96	3.21
Out-of-Sample R-Square %	68.92	77.21
Theil Inequality Coefficient	0.552	0.481
Coefficient Decomposition		
Bias	0.0009	0.0070
Regression	0.0348	0.0423
Disturbance	0.9643	0.9507

Marketings were more volatile during the post-sample period than the sample period. The root error variance from the regression was considerably smaller than the root mean square error of the post-sample forecast; the model root error variance was 51.078. The R-square between the predicted and actual marketings suggested the model explains 68.9 percent of the variation in actual marketings in the post-sample period. This also reflected the marketings volatility in the post-sample period. However, the root mean square percent error suggested the forecast errors are only 4.96 percent of the size of the actual marketings. Thus, this simple model provided relatively accurate forecasts of fed cattle marketings during the post-sample period. The Theil inequality coefficient was 0.552. The range of this statistic was between zero and one with values closer to zero indicating smaller forecast errors. More importantly, the decomposition of the Theil coefficient suggested there was very little systematic pattern in the forecast error. Little forecast error was due to bias or regression error; most was due to the model disturbance.

According to Kennedy, the appropriate measures of model performance for forecasting depends largely on the type of problem under study. Kennedy suggests using mean absolute percentage errors when the cost of the error is more closely related to the percentage error than to the numerical size of the error. This can be seen in Figure 6, where in the out-of-sample region the absolute percentage errors for marketings forecast was greater for the public data model (MKTG) than the private data model (AUGMKTG).

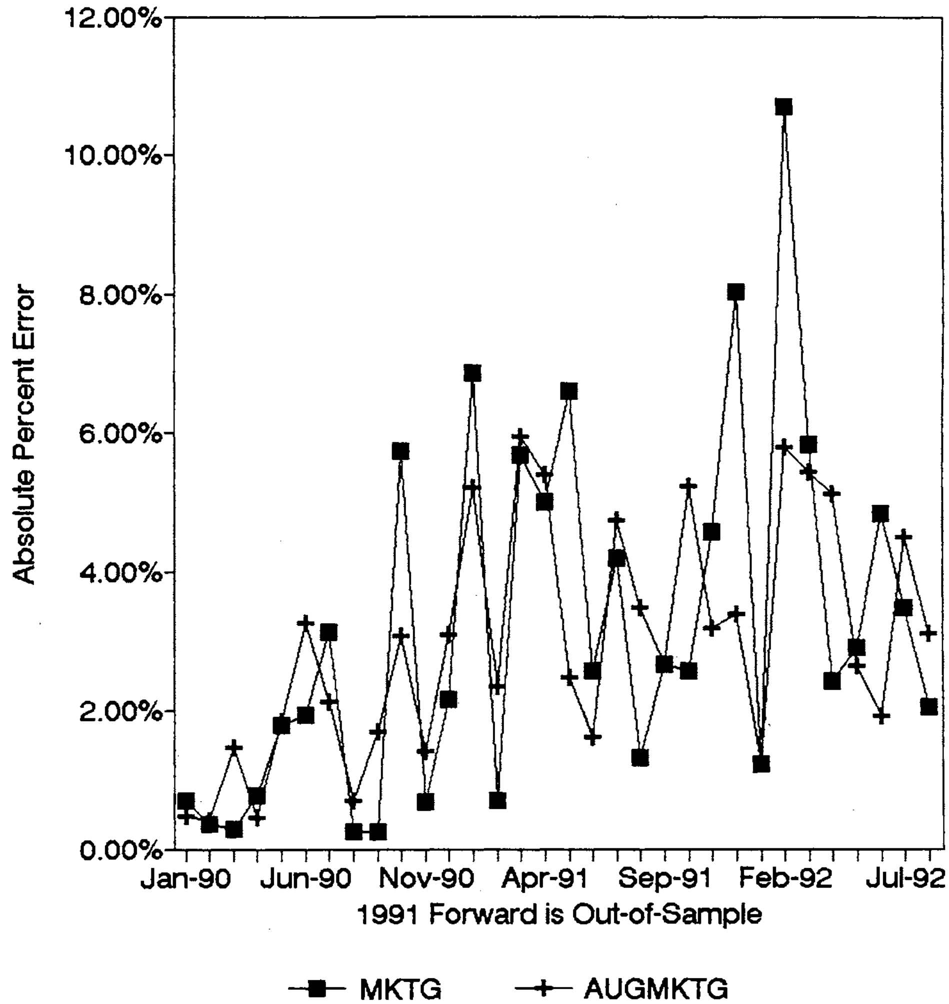

Figure 6. Comparison of Absolute Percent Errors

The conclusion of this section is that private information is useful in predicting COF reports of marketings but does not result in a significant improvement in the ability to predict placements or cattle on feed. One justification of this result is that the market may be less able to anticipate the timing of cattle exiting the feedlot than it is in determining placements and cattle on feed.

Simulation Model

A simulation model was developed to simulate the feedlot process. The key parameter of this model is the prediction of days on feed for each pen of cattle. The volume of cattle in each pen are adjusted for expected death loss. The outputs of the simulation model are both the expected pattern of marketings and the anticipated pattern of future marketings. Anticipated marketings can be determined by examining the cohorts of the simulation model to see what will be available for marketing for the next three to four months. These projected marketings can then be used to make predictions of future COF marketings.

Days On Feed Prediction Model

Separate days on feed (DOF) prediction model were developed for each state and sex resulting in a set of sixteen equations. Ordinary least squares was used to estimate these equations. The specification of the days on feed prediction model was given in Chapter III.

A complete set of parameter listings can be found in Appendix C. For purposes of discussion, only the continuous variables and monthly dummy variables to correct for seasonality along with key statistics are presented in Tables VII to XIV. The t-values are in parentheses in each table.

The sign on TIME was positive while the sign on TIMESQ was negative but not offsetting over the relevant range. This implied a function that was increasing at a decreasing rate. This was somewhat surprising in that the opposite was expected, i.e. shorter feeding times but at a decreasing rate due to technology and genetic impacts. Part of the explanation may be that cattle were being fed to heavier weights than before or that the type of cattle being fed was changing thus requiring longer feeding periods. The relevant range refers to the time horizon under study; it does not imply that this condition would continue indefinitely (Figure 7). The sign on UNITINWT was negative as expected, showing that in general there was an inverse relationship between entry weight and days on feed. The sign on WTSQ was positive as expected, showing that even cattle with heavy placement weights required a given feeding horizon in order to reach the desired level of carcass marbling. This suggested a functional relationship between days on feed and entry weight that was convex to the origin as depicted in Figure 8.

Death Loss

Death loss, in this study, referred to cattle that exit the feedlot after placement but before closeout. As such, death loss included both actual death and

TABLE VII

COLORADO DAYS ON FEED PREDICTION MODEL
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
OBSERVATIONS	4330	2825
INTERCEPT	529.0534	545.2175
	(57.90)*	(39.18)*
UNITINWT	-.8356	-.9584
	(-33.17)*	(-23.93)*
WTSQ	.0004	.0005
	(23.08)*	(17.39)*
TIME	.3231	.3347
	(6.02)*	(4.67)*
TIMESQ	-.0027	-.0020
	(-3.13)*	(-1.81)**
FEB	-1.6843	-.1233
	(-1.70)**	(-.09)
MAR	1.3706	1.2168
	(1.37)	(.96)
APR	.6467	3.2297
	(.61)	(2.34)*
MAY	3.0669	2.7928
	(2.96)*	(2.15)*
JUN	1.1469	2.5761
	(1.09)	(1.91)**
JUL	2.5845	1.9473
	(1.52)	(1.49)
AUG	2.5689	2.5867
	(1.91)**	(1.88)**
SEP	7.7769	8.434
	(5.37)*	(6.48)*
OCT	9.4855	8.6746
	(8.21)*	(6.99)*
NOV	5.6447	7.5125
	(4.79)*	(5.31)*
DEC	3.6613	.1244
	(.56)	(.08)
R-SQUARE	.8048	7330
ADJ. R-SQUARE	.8036	.7303
Y-MEAN	139.27	128.26
RMSE	9.714	14.204

*significant at α=.05, two-tail test **significant at α=.1, two-tail test

TABLE VIII

IOWA DAYS ON FEED PREDICTION MODEL
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
OBSERVATIONS	163	119
INTERCEPT	362.6540	261.6028
	(7.56)*	(2.15)*
UNITINWT	-.3438	-.1862
	(-3.16)*	(-.43)
WTSQ	.0001	-7.7480E-06
	(1.62)	(-.23)
TIME	-.9405	2.4879
	(-1.09)	(1.46)
TIMESQ	.0222	-.0166
	(2.26)*	(-.17)
FEB	-6.2131	-4.5529
	(-1.07)	(-.90)
MAR	-6.9725	-20.2936
	(-1.16)	(-1.32)
APR	-8.8821	-10.8881
	(-1.55)	(-1.90)**
MAY	-12.7605	-11.4578
	(-2.05)*	(-2.51)*
JUN	-3.2377	-8.7042
	(-.52)	(-4.05)*
JUL	-4.29	-8.2769
	(-.63)	(-1.77)**
AUG	-8.0443	-2.7464
	(-1.37)	(-3.05)*
SEP	-4.1322	-7.7257
	(-.07)	(-2.17)*
OCT	-4.6743	-9.6508
	(-.92)	(-1.61)
NOV	-15.4699	-.6191
	(-3.04)	(-3.25)*
DEC	-13.2407	1.1366
	(-2.72)*	(3.93)*
R-SQUARE	.7082	.7177
ADJ. R-SQUARE	.6742	.6702
Y-MEAN	121.72	109.48
RMSE	14.08	12.59

*significant at $\alpha=.05$, two-tail test **significant at $\alpha=.1$, two-tail test

TABLE IX

KANSAS DAYS ON FEED PREDICTION MODEL
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
OBSERVATIONS	22911	15673
INTERCEPT	548.3645	592.2331
	(110.38)*	(120.58)*
UNITINWT	-.9686	-1.1720
	(-73.20)*	(-79.68)*
WTSQ	.0005	.0007
	(58.28)*	(61.52)*
TIME	.2877	.3225
	(14.53)*	(13.36)*
TIMESQ	-.0007	-.0010
	(-2.33)*	(-3.93)*
FEB	.3318	-.2692
	(.87)	(-.48)
MAR	1.9767	.2798
	(5.27)*	(.53)
APR	3.6650	.7986
	(9.30)*	(1.47)
MAY	4.4289	.7833
	(11.82)*	(1.51)
JUN	4.0335	-.1836
	(9.92)*	(-.33)
JUL	1.3490	-2.0935
	(3.53)*	(-3.81)*
AUG	3.0264	-.4744
	(7.78)*	(-.86)
SEP	4.8935	3.158
	(12.82)*	(5.67)*
OCT	4.8524	4.798
	(13.31)*	(8.99)*
NOV	4.2834	5.4406
	(10.65)*	(9.82)*
DEC	.4588	2.5519
	(1.11)	(4.50)*
R-SQUARE	.6906	.7215
ADJ. R-SQUARE	.6900	.7207
Y-MEAN	132.14	129.25
RMSE	12.04	13.68

*significant at α=.05, two-tail test

TABLE X

NEBRASKA DAYS ON FEED PREDICTION MODEL
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
OBSERVATIONS	2299	1976
INTERCEPT	579.8719	511.2257
	(37.14)*	(28.30)*
UNITINWT	-.9343	-.7901
	(-22.67)*	(-15.82)*
WTSQ	.0046	.0004
	(16.86)*	(11.10)*
TIME	.2947	.1771
	(2.96)*	(2.02)*
TIMESQ	.0010	.0019
	(.67)	(1.34)
FEB	2.6134	-3.4164
	(1.63)	(-2.13)*
MAR	3.5287	-3.1851
	(2.19)*	(-1.99)*
APR	4.1841	-3.5760
	(2.52)*	(-2.18)*
MAY	5.1653	-4.0131
	(3.19)*	(-2.44)*
JUN	1.2843	-3.7407
	(.75)	(-2.21)*
JUL	-.0169	-6.5453
	(-.01)	(-3.96)*
AUG	-1.3671	-4.9988
	(-.83)	(-3.21)*
SEP	3.3994	-.9788
	(2.13)*	(-.62)
OCT	9.4819	5.1778
	(6.38)*	(3.29)*
NOV	6.9910	4.6159
	(4.47)*	(2.88)*
DEC	3.7309	.6966
	(2.15)*	(.41)
R-SQUARE	.7725	.7322
ADJ. R-SQUARE	.7690	.7275
Y-MEAN	134.67	123.88
RMSE	16.12	14.23

*significant at $\alpha=.05$, two-tail test

TABLE XI

NEW MEXICO DAYS ON FEED PREDICTION MODEL
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
OBSERVATIONS	811	739
INTERCEPT	574.4627	551.5070
	(26.67)*	(20.65)*
UNITINWT	-.9217	-.9427
	(-14.47)*	(-10.95)*
WTSQ	.0005	.0005
	(9.51)*	(7.01)*
TIME	.3342	.6831
	(2.22)*	(4.72)*
TIMESQ	-.0018	-.0090
	(-.66)	(-3.57)*
FEB	.4713	-1.7566
	(.13)	(-.51)
MAR	-8.3774	-6.6175
	(-2.42)*	(-2.01))*
APR	-6.1166	-2.4839
	(-1.69)**	(-.73)
MAY	-3.6156	.1199
	(-1.17)	(.04)
JUN	-6.6600	-3.1003
	(-2.00)*	(-1.03)
JUL	7.2362	3.0175
	(2.17)*	(1.02)
AUG	12.6020	11.1459
	(4.02)*	(3.97)*
SEP	12.9989	11.6046
	(4.21)*	(4.01)*
OCT	7.1794	12.4946
	(2.28)*	(4.38)*
NOV	3.1868	14.08233
	(.82)	(4.53)*
DEC	-1.7646	7.6075
	(-.50)	(2.31)*
R-SQUARE	.8404	.7963
ADJ. R-SQUARE	.8370	.7915
Y-MEAN	173.62	178.01
RMSE	16.82	17.04

*significant at $\alpha=.05$, two-tail test **significant at $\alpha=.1$, two-tail test

TABLE XII

OKLAHOMA DAYS ON FEED PREDICTION MODEL
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
OBSERVATIONS	6178	3607
INTERCEPT	570.29516	565.0695
	(57.43)*	(55.05)*
UNITINWT	-.9673	-1.0522
	(-35.30)*	(-35.41)*
WTSQ	.0005	.0006
	(26.83)*	(27.55)*
TIME	.2661	.3571
	(5.93)*	(7.33)*
TIMESQ	-.0031	-.0039
	(-4.46)*	(-5.04)*
FEB	-.1716	-1.3976
	(-2.00)*	(-1.42)*
MAR	2.6838	-.1702
	(3.31)*	(-.18)
APR	3.35658	1.1704
	(3.84)*	(1.18)
MAY	4.7218	.8858
	(5.94)*	(.96)
JUN	2.8572	-.5974
	(3.22)*	(-.60)
JUL	3.4807	-1.9462
	(4.17)*	(-1.93)*
AUG	3.2091	.6381
	(4.01)*	(.66)
SEP	3.7009	3.8482
	(4.57)*	(4.15)*
OCT	4.4719	4.9656
	(5.61)*	(5.47)*
NOV	4.4592	7.8214
	(5.05)*	(7.51)*
DEC	3.7002	3.6381
	(4.32)*	(3.40)*
R-SQUARE	.7107	.7616
ADJ. R-SQUARE	.7097	.7601
Y-MEAN	133.99	129.02
RMSE	13.23	11.42

*significant at $\alpha = .05$, two-tail test

TABLE XIII

SOUTH DAKOTA DAYS ON FEED PREDICTION MODEL
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
OBSERVATIONS	822	735
INTERCEPT	394.3504	459.4326
	(35.11)*	(23.90)*
UNITINWT	-.4298	-.6359
	(-19.30)*	(-13.35)*
WTSQ	.0001	.0003
	(11.78)*	(9.16)*
TIME	-7003	-.4223
	(-4.91)*	(-2.93)*
TIMESQ	.0135	.0105
	(5.45)*	(4.23)*
FEB	-.0474	2.9223
	(-.02)	(1.31)
MAR	6.3364	1.3586
	(2.58)*	(.59)
APR	8.4992	4.4349
	(3.38)*	(1.84)*
MAY	8.0886	7.2060
	(3.14)*	(2.77)*
JUN	1.5426	-.6056
	(.52)	(-.21)
JUL	-.0570	-4.0005
	(-.02)	(-1.29)
AUG	2.4189	-5.6528
	(1.02)	(-2.12)*
SEP	6.6772	-3.2353
	(2.97)*	(-1.30)
OCT	7.0122	-.3054
	(2.87)*	(-.13)
NOV	4.3439	-.2308
	(1.66)**	(-.09)
DEC	1.1808	-2.3066
	(.45)	(-.96)
R-SQUARE	.7399	.7606
ADJ. R-SQUARE	.7344	.7549
Y-MEAN	124.72	117.55
RMSE	15.36	14.60

*significant at $\alpha=.05$, two-tail test **significant at $\alpha=.1$, two-tail test

TABLE XIV

TEXAS DAYS ON FEED PREDICTION MODEL
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
OBSERVATIONS	25015	9991
INTERCEPT	571.4720	585.6276
	(130.95)*	(76.40)*
UNITINWT	-.9842	-1.080
	(-81.76)*	(-47.04)*
WTSQ	.0051	.0006
	(59.34)*	(33.63)*
TIME	.6577	.5426
	(28.23)*	(14.82)*
TIMESQ	-.0068	-.0068
	(-17.35)*	(-11.01)*
FEB	-.7515	-3.1936
	(-1.51)	(-3.92)*
MAR	-1.5746	-6.8605
	(-3.46)*	(-9.09)*
APR	1.5275	-5.7602
	(3.11)*	(-7.40)*
MAY	3.1047	-5.3920
	(6.98)*	(-7.52)*
JUN	1.4280	-5.8573
	(2.86)*	(-7.60)*
JUL	.7813	-6.0969
	(1.62)	(-7.69)*
AUG	5.0022	.0131
	(10.33)*	(.02)
SEP	6.4567	5.8224
	(13.89)*	(7.54)*
OCT	6.6940	6.1954
	(15.43)*	(8.48)*
NOV	7.7292	7.2024
	(15.20)*	(8.60)*
DEC	3.4433	3.9078
	(6.44)*	(4.45)*
R-SQUARE	.7883	.7771
ADJ. R-SQUARE	.7879	.7760
Y-MEAN	146.92	144.50
RMSE	14.82	14.96

*significant at $\alpha=.05$, two-tail test

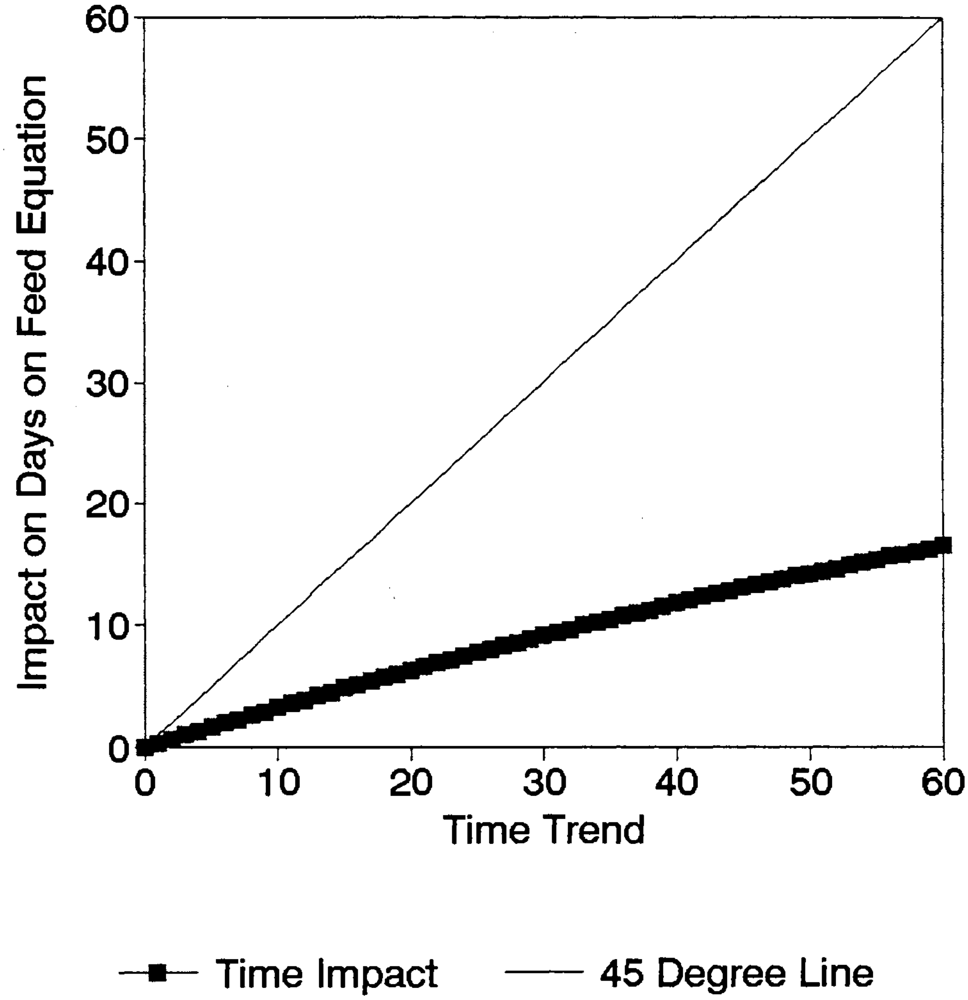

Figure 7. Impact of TIME on DOF Equation

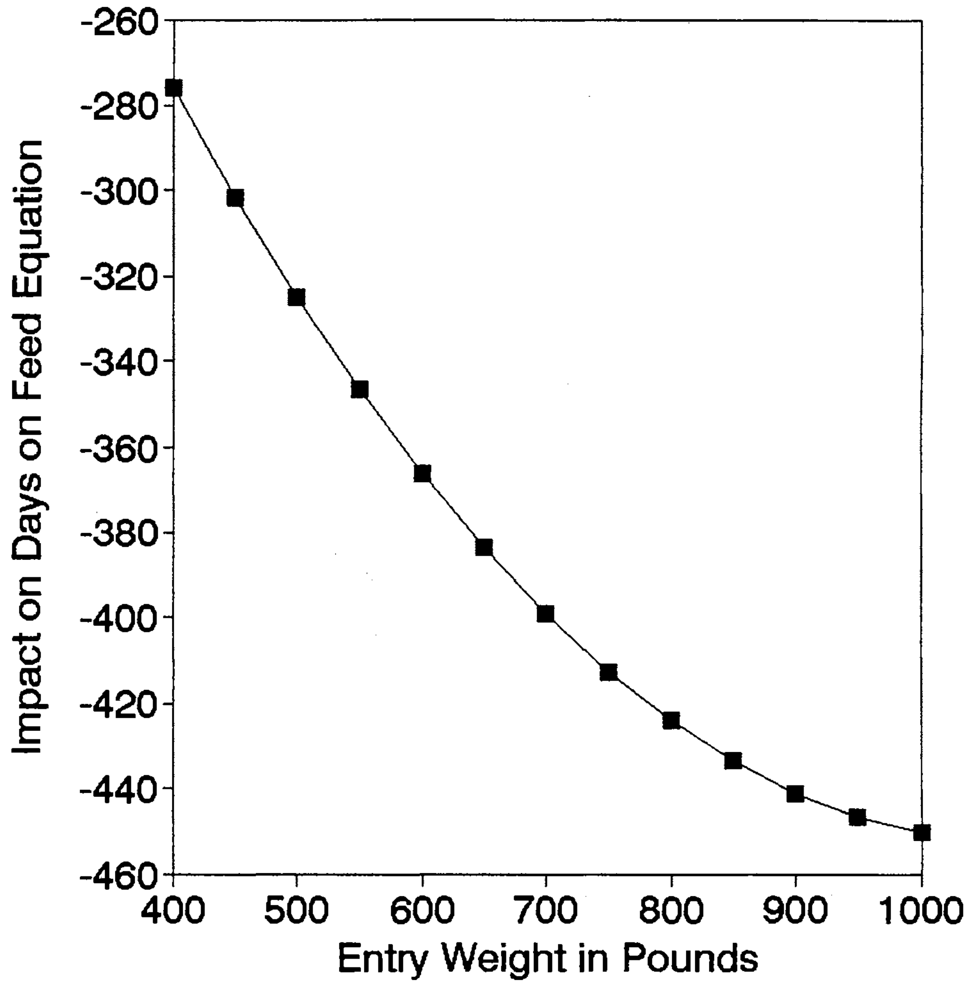

Figure 8. Impact of UNITWT on DOF Equation

the volume of cattle removed from the feedlot due to poor performance. This latter category was referred to by the industry as railers. The equation for death loss was actually stated in terms of survivability, or one less percent death loss.

After calculating the means for survivability by state, sex, six weight classes, and four seasons, ordinary least squares was performed on the pooled data set (Ray). On average, death loss was less than 3/4 of one percent. As expected, death loss was highest for the lightest and heaviest placement weights. Additionally, death loss was highest for fall placements. The results are specified in Tables XV through XXII.

The four seasons were specified as SEABAR1 (December, January, February), SEABAR2 (March, April, May), SEABAR3 (June, July, August), and SEABAR4 (September, October, December). The six weight classes consisted of placements under 550 pounds (WTBAR1), and increased in 100 pound increments through WTBAR5. Animals with placement weights greater than 950 pounds were in category WTBAR6. SEABAR1 and WTBAR1 were used as the base.

After developing both a DOF prediction model and a death loss model, the historical placement data series from PCC's closeout records was entered into a Quick Basic program (See Appendix C) to prepare the data for a feedlot simulation model. The feedlot simulation model kept an inventory via a system of discrete delay cohorts of when each pen of cattle was placed along with the pen's expected marketing date. By simulating each day's placement of cattle and associated marketing, it was possible to develop a flow of expected marketings. The results

TABLE XV

DEATH LOSS FOR COLORADO
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
DEATHINT	.9667 (305.41)*	.9707 (222.75)*
SEABAR2	.0003 (.09)	.0098 (2.45) *
SEABAR3	-.0003 (-.10)	.0045 (1.14)
SEABAR4	-.0036 (-1.28)	-.0020 (-.50)
WTBAR2	.1572 (4.24)*	.0134 (2.71)*
WTBAR3	.02553 (6.88)*	.0159 (3.23)*
WTBAR4	.02823 (7.61)*	.01771 (3.44)*
WTBAR5	.02641 (7.12)*	.0132 (2.56)*
WTBAR6	.0263 (7.44)*	.0192 (3.71)*
R-Square	.8500	.6144
Adj R-Square	.7751	.4329

*significant at $\alpha = .05$, two-tail test

TABLE XVI

DEATH LOSS FOR IOWA
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
DEATHINT	.9863 (158.15)*	.9863 (159.15)*
SEABAR2	.0072 (2.15)*	.0072 (1.82)**
SEABAR3	.0067 (2.01)*	.0067 (1.73)**
SEABAR4	.0027 (.01)	.0027 (.05)
WTBAR2	-.0033 (-.53)	-.0033 (-.68)
WTBAR3	.0027 (.44)	.0027 (.79)
WTBAR4	.0046 (.74)	.0046 (.82)
WTBAR5	.0022 (.35)	.0022 (.72)
WTBAR6	.0027 (.44)	.0027 (.71)
R-Square	.6245	.6345
Adj. R-Square	.3741	.4251
Y-Mean	.9905	.9908

*significant at $\alpha=.05$, two-tail test **significant at $\alpha=.1$, two-tail test

TABLE XVII

DEATH LOSS FOR KANSAS
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
DEATHINT	.9796	.9715
	(414.51)*	(183.22)*
SEABAR2	.0042	.0141
	(1.97)*	(2.19)*
SEABAR3	.0024	.0059
	(1.13)	(1.26)
SEABAR4	-.0015	.0055
	(-.69)	(1.15)
WTBAR2	.0036	.0112
	(1.34)	(1.85)**
WTBAR3	.0011	.0065
	(4.08)*	(1.07)
WTBAR4	.0144	.0077
	(5.32)*	(1.28)
WTBAR5	.0114	.0028
	(4.06)*	(.36)
WTBAR6	.0074	-.0054
	(2.61)*	(-.85)
R-Square	.7235	.4212
Adj R-Square	.6007	.1640
Y-Mean	.9890	.9807

*significant at $\alpha=.05$, two-tail test **significant at $\alpha=.1$, two-tail test

TABLE XVIII

DEATH LOSS FOR NEBRASKA
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
DEATHINT	.9782 (295.96)*	.9782 (377.75)*
SEABAR2	.0010 (.33)	.0004 (.18)
SEABAR3	-.0006 (-.19)	.0017 (.71)
SEABAR4	-.0006 (-2.14)*	-.0040 (-1.63)**
WTBAR2	.0082 (2.14)*	.0083 (2.79)*
WTBAR3	.0140 (3.63)*	.0149 (4.99)*
WTBAR4	.0187 (4.87)*	.0165 (5.53)*
WTBAR5	.01714 (4.46)*	.0168 (5.61)*
WTBAR6	.0184 (4.78)*	.0162 (5.41)*
R-Square	.7707	.7911
Adj. R-Square	.6397	.6796
Y-Mean	.9899	.9899

*significant at α=.05, two-tail test **significant at α=.1, two-tail test

TABLE XIX

DEATH LOSS FOR NEW MEXICO
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
DEATHINT	.9758	.9699
	(195.44)*	(148.96)*
SEABAR2	.0060	.0144
	(1.26)	(1.93)**
SEABAR3	.0037	.0122
	(.79)	(1.64)
SEABAR4	-.0083	.0032
	(-1.71)**	(.43)
WTBAR2	-.0029	.0015
	(-.52)	(.19)
WTBAR3	.0099	.0071
	(1.79)**	(.86)
WTBAR4	.0139	.0035
	(2.40)*	(.42)
WTBAR5	.0082	-.0057
	(1.41)	(-.69)
WTBAR6	.0193	----[a]
	(2.64)*	(--)
R-Square	.6739	.3732
Adj. R-Square	.5000	.0356
Y-Mean	.9833	.9782

a. There were no observations in this weight category.

*significant at $\alpha=.05$, two-tail test **significant at $\alpha=.1$, two-tail test

TABLE XX

DEATH LOSS FOR OKLAHOMA
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
DEATHINT	.9839 (600.33)*	.9871 (425.49)*
SEABAR2	.0013 (.84)	.0079 (3.63)*
SEABAR3	.0001 (.06)	.0045 (2.29)*
SEABAR4	-.0025 (-1.63)	-.0025 (-1.17)
WTBAR2	.0049 (2.59)*	.0067 (2.52)*
WTBAR3	.0088 (4.67)*	.0090 (3.40)*
WTBAR4	.0105 (5.54)*	.0082 (3.07)*
WTBAR5	.0107 (5.64)*	.0049 (1.85)**
WTBAR6	.0119 (6.27)*	-.0040 (-1.51)
R-Square	.8093	.8132
Adj. R-Square	.7076	.7136
Y-Mean	.9914	.9875

*significant at α=.05, two-tail test **significant at α=.1, two-tail test

TABLE XXI

DEATH LOSS FOR SOUTH DAKOTA
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
DEATHINT	.9856	.9794
	(165.83)*	(178.00)
SEABAR2	.0040	.0070
	(.83)	(1.38)
SEABAR3	.0034	.0080
	(.70)	(1.57)
SEABAR4	-.0045	-.0051
	(-1.01)	(-.99)
WTBAR2	-.0080	.0033
	(-.12)	(.52)
WTBAR3	.0031	.0087
	(.44)	(1.34)
WTBAR4	.0077	.0085
	(1.10)	(1.32)
WTBAR5	.0074	.0071
	(1.07)	(1.16)
WTBAR6	.0072	.0100
	(1.04)	(1.54)
R-Square	.4211	.4910
Adj. R-Square	.0648	.2365
Y-Mean	.9905	.9871

*significant at α=.05, two-tail test

TABLE XXII

DEATH LOSS FOR TEXAS
(t-value in parentheses)

VARIABLE	STEERS	HEIFERS
DEATHINT	.9776 (344.01)*	.9801 (370.91)*
SEABAR2	.0038 (1.47)	.0039 (1.40)
SEABAR3	-.0001 (-.04)	.0005 (1.74)**
SEABAR4	-.0024 (-.94)	.0014 (.50)
WTBAR2	.0083 (2.56)*	.0043 (1.27)
WTBAR3	.0134 (4.29)*	.0075 (2.33)*
WTBAR4	.0158 (4.64)*	.0031 (.91)
WTBAR5	.0164 (5.04)*	-.0042 (-1.22)
WTBAR6	.0107 (3.14)*	.0095 (2.52)*
R-Square	.6863	.5701
Adj. R-Square	.5468	.3551
Y-Mean	.9890	.9856

*significant at $\alpha=.05$, two-tail test **significant at $\alpha=.1$, two-tail test

of these flows for both the true historical values and the predicted values are presented in Table XXIII.

Table XXIII presents a number of statistics describing the accuracy of the simulation model. On average, PCC member feedlots had approximately 286,700 head of cattle on feed to be marketed within the next 30 days. The simulation model yielded a mean percent error of .76 percent. It was likely that large positive errors are canceling large negative errors, so the root mean square error (RMSE) may be a more appropriate measure of model performance. The RMSE for the current, one (the next 30 days) and two (30-60 days) month forecasts of PCC marketings were very constant, at just over 21000 head or an error of 7.34 percent. As expected, all measures of model performance began to deteriorate rapidly (under estimation) after three months out. This is due to some cattle being placed with between 90 and 120 days of expected time in the feedlot, and thus not yet included in the projections for slaughter.

Linkage of Regression and Simulation Models

A conditional forecast of the marketings component of the COF report could be made using the output of the simulation model. This forecast was conditional on two factors; the accuracy of the prediction of PCC marketings via the simulation model, and the assumption of constant feedlot capacity in the PCC data set over the time for which predictions are made. These results are given in Figures 9 and 10. Predictions of USDA marketings for the monthly COF report

TABLE XXIII

SIMULATION MODEL RESULTS OF FORECASTING PCC MARKETINGS
(Months into the Future)

	One	Two	Three	Four
Mean Percent Error	-.76	-.76	-.91	-9.01
Mean Absolute Percent Error	5.72	5.72	5.76	9.55
Root Mean Square Percent Error	7.34	7.34	7.42	13.75
Average Monthly Volume	286372	286681	284923	260816
Late Placements	------	-51	-1809	-25916

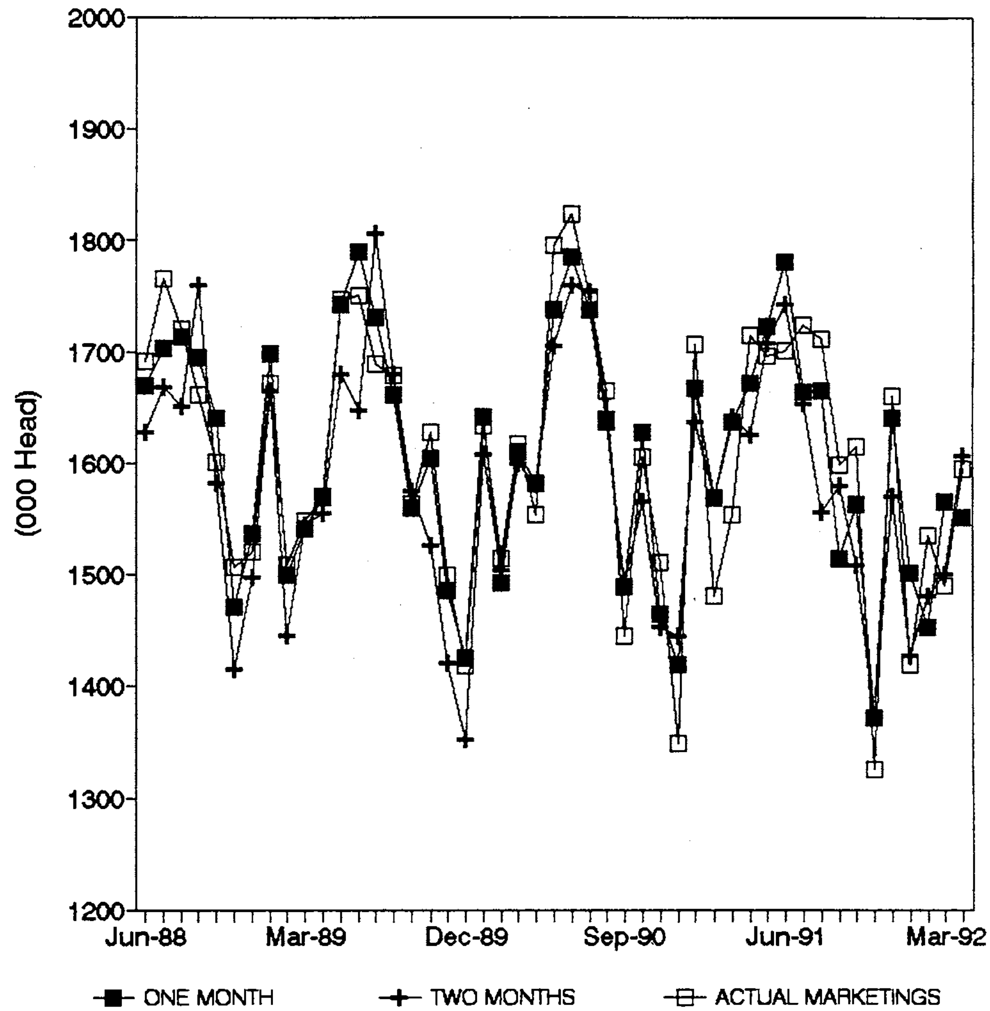

Figure 9. Predictions of COF Marketings for 1-2 Months

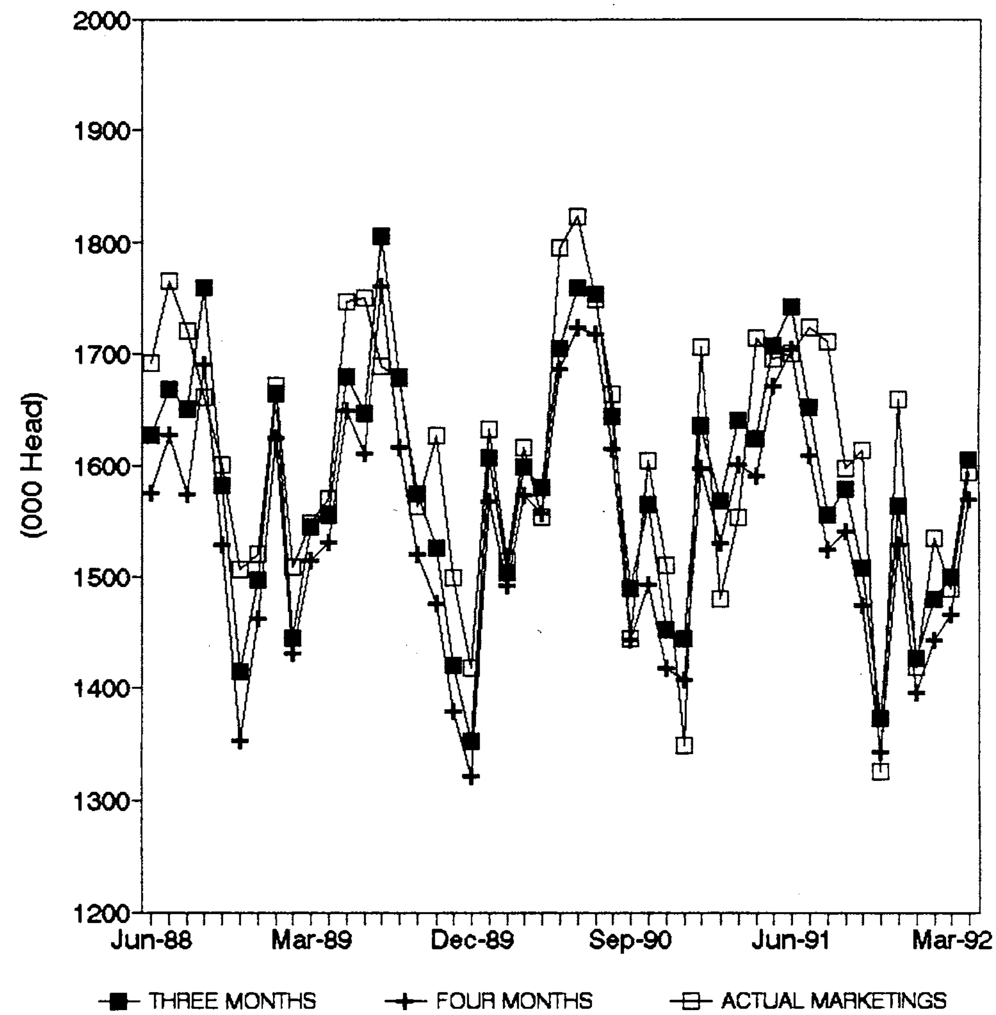

Figure 10. Predictions of COF Marketings for 3-4 Months

were made for one, two, three, and four months into the future using the projected marketings flow from the simulation model and the AUGMKTG model. The absolute mean percent errors were 2.35%, 3.38%, 3.47%, and 4.63%, respectively, over the period June 1988 through April 1992. These projected flows of marketings were then used to develop a proxy variable for showlist as described in Chapter III.

Market Inventories

This section presents the results from showlist application; namely, do inventories of market ready fed cattle (showlists) have a stronger influence on weekly slaughter cattle prices than do slaughter levels.

To test this hypothesis, fed cattle prices, showlist, and federally inspected slaughter were first tested for unit roots using the Dickey-Fuller test statistic given by the COINT option in SHAZAM. This was done to determine if the data set was stationary. The null hypothesis is that unit roots occur. The finding of a unit root in time series analysis indicates nonstationarity. The decision rule was that the null hypothesis of unit roots can be rejected if the calculated t-statistic is smaller than the critical value (White; Brorsen). The results of these tests are presented in Table XXIV.

The showlist term used in the first approach, the public data model, was calculated solely from the USDA data set as described in Chapter 3. In the second approach, the augmented model, publicly reported data was augmented with data

TABLE XXIV

TEST FOR UNIT ROOTS

	Test Statistic	Critical Value	Lags
PRICE	-2.4475	-3.15	0
SLG	-2.8661	-3.15	9
S4	-3.15	-3.85	12
SHOW	-2.727	-3.15	10
HIST	-2.835	-3.15	3
P*	-2.4219	-3.18	4
SLGV	-2.5593	-3.17	1
SHOWP-F	-1.0802	-3.17	0

Variable Definitions:

PRICE = Omaha Cash Price for 1100-1300 pound steers
SLG = USDA federally inspected slaughter
S4 = USDA proxy showlist
SHOW = PCC proxy showlist from predicted marketings
HIST = PCC proxy showlist from actual marketings
P* = Price from Packer-Feeder game
SLGV = Slaughter volume from Packer-Feeder game
SHOWP-F = Showlist from Packer-Feeder game

from PCC. In this approach, two versions of showlist were used. The first was determined from the predicted days on feed equations and the simulation model. The second was calculated from the actual flow of cattle, i.e. with days on feed known rather than estimated. The historical showlist model was included only as a reference because in real world applications, actual marketing patterns cannot be known a priori. The base and slaughter model in both the public model and the augmented model were identical, since all variables included are publicly reported. In addition, analysis was done on the experiential model as a method of comparison.

As can be determined from Table XXIV, the null hypothesis of unit roots could not be rejected for the variables being considered. The next step was to determine if any if the independent variables were cointegrated with the dependent variable. This test was performed using the augmented Dickey-Fuller test, as described by White. The test statistics were constructed from the residuals (u) of the cointegrating regression (Equation 10). This test is essentially a unit root test on the residuals. The order of the lags involved are given by the subscripts. The new error term is given by v_t.

$$\Delta \hat{u}_t = \alpha_* u_{t-1} + \sum_{j=1}^{p} \Phi_j u_{t-1} + v_t \qquad (10)$$

SHAZAM reports both a z-test and a t-test (for when $\alpha_* = 0$). If the appropriate test statistic is less than the critical value, then there is evidence of cointegration. The results were also reported in SHAZAM for a model with and without a time trend variable. Only the trend model is reported in Table XXV. However both the trend and the no-trend models reached the same conclusion; the null hypothesis of cointegration could be rejected.

The next step was to take the first differences of each of the variables in the data sets. Then, as discussed in Chapter III, pricing models were developed. The base model expressed as the change in price (DPRICE) as a function of lagged changes in price. Only a one period lag was found to be significant using Akaikes Information Criterion. From the base model, two separate models were developed. The first included a one period lag of the change in federally inspected slaughter (SLG1), and the second used a one period lag of the change in showlist. The variable name for showlist differed depending on the data set being used as discussed previously and as noted in the tables. The next model incorporated lagged changes in price, slaughter, and showlist. Finally, contemporaneous values (current changes) were added for showlist to create the full model. These results are reported in Tables XXVI through XXVIII.

In the public data model, only the lagged changes in price (DPRICE1) was significant. The hypothesis was that the current change in price should be positively related to the lagged change in price. This would allow the use of a one-tailed t-test as noted in Tables XXVI through XXVIII. The variable for changes in showlist and slaughter were not significant although slaughter did return

TABLE XXV

TEST FOR COINTEGRATION
(Regressand = Price)

	Test	Test Statistic	Critical Value	Lags
SLG	z-test	-28.85	-23.19	1
	t-test	-2.42	-3.50	
SHOW	z-test	-12.44	-23.19	0
	t-test	-2.48	-3.50	
HIST	z-test	-12.79	-23.19	0
	t-test	-2.54	-3.50	
S4	z-test	-15.81	-23.19	1
	t-test	-3.12	-3.50	
SLGV	z-test	-3.01	-17.04	1
	t-test	-.84	-3.05	
SHOWP-F	z-test	-4.20	-23.19	7
	t-test	-1.41	-3.50	

TABLE XXVI

PUBLIC DATA RESULTS

	Variable	Coefficient	T-Ratio	Elasticity at Means
Base	CONSTANT	.0056	(.08)	.5877
	DPRICE1	.1547	(1.92)*	.4123
Slaughter	CONSTANT	.0053	(.07)	.5216
	DPRICE1	.1568	(1.94)*	.4178
	DSLG1	-.182 E-08	(-.54)	.0606
Showlist	CONSTANT	-.1455	(-.30)	-14.258
	DPRICE1	.1544	(1.91)*	.41
	DS41	.0003	(.31)	14.846
Combined	CONSTANT	-.1623	(-.33)	-15.904
	DPRICE1	.1562	(1 93)*	.4170
	DS41	.0003	(.34)	16.424
	DSLG1	-.189 E-08	(-.56)	.0629
Full	CONSTANT	-.0789	(-.16)	-7.7281
	DPRICE1	.1524	(1.87)*	.4061
	DS4	.0002	(.81)	13.062
	DS41	-.966 E-04	(-.09)	-4.7963
	DSLG1	-.171 E-08	(-.50)	.0568

*significant at $\alpha=.05$, one-tail test

TABLE XXVII

PRIVATE DATA RESULTS

	Variable	Coefficient	T-Ratio	Elasticity at Means
Base	CONSTANT	.0056	(.08)	.5877
	DPRICE1	.1547	(1.92)*	.4123
Slaughter	CONSTANT	.0053	(.07)	.5216
	DPRICE1	.1568	(1.94)*	.4178
	DSLG1	-.182 E-08	(-.54)	.0606
Showlist	CONSTANT	.0055	(.072)	.5400
	DPRICE1	.1518	(1.88)*	.4046
	DSHOW1	-.623 E-05	(-1.07)***	.5543
Combined	CONSTANT	.0048	(.06)	.4672
	DPRICE1	.1540	(1.90)*	.4103
	DSHOW1	-.637 E-05	(-1.09)***	.0567
	DSLG1	-.197 E-08	(-.59)	.0657
Full	CONSTANT	.0049	(.06)	.4825
	DPRICE1	.1524	(1.87)*	.4061
	DSHOW	.240 E-05	(.283)	-.0286
	DSHOW1	-.811 E-05	(-.96)	.0721
	DSLG1	-.204 E-08	(-.60)	.0679
Historical	CONSTANT	-.0016	(-.02)	-.1571
	DPRICE1	.1278	(1.58)**	.3406
	DHIST1	-.127 E-04	(-1.97)*	.8165

*significant at $\alpha=.05$, one-tail test **significant at $\alpha=.1$, one-tail test
***significant at $\alpha=.15$, one-tail test

TABLE XXVIII

EXPERIENTIAL DATA RESULTS

	Variable	Coefficient	T-Ratio	Elasticity at Means
Base	CONSTANT	.0686	(.52)	1.7885
	DPRICE1	-.0218	(-1.75)**	-.7885
Slaughter	CONSTANT	.0653	(.50)	1.7012
	DPRICE1	-.0296	(-1.75)**	-1.0678
	DSLG1	-.0002	(.68)	.3665
Showlist	CONSTANT	.0640	(.49)	1.6683
	DPRICE1	.0387	(1.00)	1.3969
	DSHOW1	-.0004	(-1.65)*	-2.0652
Combined	CONSTANT	.0621	(.48)	1.6193
	DPRICE1	.0313	(.73)	1.1286
	DSHOW1	-.0004	(-1.55)**	-1.9756
	DSLG1	.0001	(.42)	.2277
Full	CONSTANT	.0650	(.49)	1.6949
	DPRICE1	.0275	(.60)	.9921
	DSHOW	-.0001	(-.25)	.0684
	DSHOW1	-.0003	(-1.36)**	-1.8595
	DSLG1	.0001	(.44)	.2409

*significant at $\alpha=.05$, one-tail test **significant at $\alpha=.1$, one-tail test the expected sign. If changes in slaughter are large, one would hypothesize seeing an opposite change in price.

In the augmented data model, DPRICE1 remained significant. In addition, changes in showlist returned the expected sign as noted in Tryfos, showing an inverse relationship between showlist and price. The change in showlist was significant at the .15 level in the showlist and combined models, and at the .025 level in the historical model (DHIST1) for a one-tailed t-test with over 120 degrees of freedom. The t-values on the lagged changes in showlist were nearly twice as large as the t-values on the lagged values of slaughter. These results are reported in Table XXVII.

The experiential model yielded similar but more pronounced results. results. In general, the t-values were stronger on changes in showlist and weaker on changes in slaughter than in the other two modelling approaches.

Perhaps more useful for interpretive purposes were the elasticities at the means. For the *i*th coefficient, the elasticity is evaluated as:

$$\epsilon_i=\hat{B}\frac{\bar{X}}{\bar{Y}} \qquad (11)$$

The interpretation of the elasticities was as follows. If $\epsilon_i = 1.5$, then about the mean of the variables, a one percent increase in X_i would lead to a one and a half percent increase in the dependent variable. The elasticity on lagged value of showlist (S41) appeared to be dramatically larger than the showlist elasticities reported in either of the other two tables. This was because the COF report is given in thousands of head rather than actual head. In comparing the elasticities of changes in federally inspected slaughter and changes in showlist in both the public and augmented data models, there did not appear to be much difference after adjusting for the way the public data is reported. However, there was substantial difference in the experiential model.

The conclusion drawn from these results is that the theory behind showlists as an explanatory variable in a price prediction model is sound as evidenced by the experiential data approach, but that practice of using showlist as an explanatory variable in a price model appears to be only a marginal improvement over using federally inspected slaughter.

Chapter Summary

Chapter IV presented the results of the dissertation in three basic sections. The first section explored the results of the regression models used to forecast the components of the monthly COF report. The addition of the private information provided no noticeable improvement for the forecast of cattle on feed and only marginal improvement to the forecast of placements. However, the private information provided significant improvement to the forecast of marketings.

The next section discussed the development of the simulation model and the necessary equations. A partial listing of the parameter values and associated t-statistics were provided in a set of tables. A complete set of parameter values were included in a computer program listing in Appendix C. In general, it was found that the simulation model could provide reasonable projections of PCC marketings for 90 days (three months) into the future. This was based on comparisons of patterns of estimated days on feed with historical patterns. Projections for 120 days began to be less accurate due to late placements. Additionally, the simulation model provided the user with both the actual and expected flow of marketings. This provides a mechanism for exploring abnormal marketing periods, i.e. are showlists growing or shrinking at a faster rate than expected.

The third part of the dissertation used the results of the simulation model, public information, and an experiential market simulator to determine the relationship between price and slaughter versus price and showlist. Due to nonstationarity problems, first difference models were used. In general, lagged changes of both showlist and slaughter showed an inverse relationship with price. The t-values tended to be stronger on the showlist variables than the slaughter variables, suggesting some evidence that the relationship between showlist and price was stronger that the relationship between slaughter and price. However, except in the experiential model, this conclusion was modest.

CHAPTER V

SUMMARY AND CONCLUSIONS

This dissertation developed out of a joint venture project with Professional Cattle Consultants (PCC). PCC performs comparative analysis reports for member feedlots throughout the central and southern great plains region. Member feedlots provide PCC with placement, marketings, and cost of production information. In turn, PCC provides the members with individualized performance reports as well as comparative reports to other feedlots based on size, and geographic location. In addition, PCC provides forecasts of the monthly COF report 10 to 14 days in advance of the release of the report. This source of supply information is believed to be significant in that the COF report is the primary source of public information regarding supplies to the fed cattle industry.

A natural outgrowth of PCC's activities was the question of whether the collection and use of this private data set would allow for the development of models that could improve the accuracy and increase the range of these forecasts. Thus, the motive for this study was developed. Could PCC's data set provide opportunities for superior marketing information, or was this information already revealed to the industry via the actions of the market participants, principally the feedlot and packing plant managers? This corresponds to the seminal objective discussed in Chapter I, which is to aid sellers of feedlot cattle to make timely and efficient marketing decisions.

Major Findings

This dissertation is organized into three major sections. These sections are Prediction of Monthly Cattle on Feed reports, Simulation Model Development, and Model Applications. The discussion of these sections corresponds with the specific objectives listed in Chapter I. A brief summary of each of these sections and the corresponding results are presented below.

Prediction of Monthly Cattle on Feed Reports

Ordinary Least Squares (OLS) was used to build aggregate growth models of placements, cattle on feed, and marketings as reported in the monthly COF report. The principal interest to PCC was the prediction of marketings, but this part of the project also reviewed the possibilities for predicting both placements and cattle on feed. Both placements and cattle on feed were found to follow significant seasonal patterns as to be expected, but there was no clear improvement in the out-of-sample forecasts when incorporating the private data set versus just the public data set, as shown via the reduction in mean squares error test (Ashley et al.). The inclusion of the private data set did cause a significant reduction (α = 1.3%) in mean square errors of the out-of-sample forecast of marketings. In addition, graphical analysis was also done on the out-of-sample forecast of marketings. The inclusion of the private data yielded an out-of-sample forecast that had a lower average percent error than the base model.

Simulation Model Development

After addressing the first question of the study, the next step was in determining if the range of predictions, specifically marketings, could be extended beyond the current time period. The modelling approach developed to meet this objective hinged on taking thorough advantage of the volume of data collected by PCC. PCC services, on average, over 80 feedlots per month. These feedlots range in size from small part time operations to large commercial feedlots that have one-time capacities in excess of 100,000 head. All the PCC member feedlots were included in this study. The goal was to capture the unexpected supply movements in the feedlot industry, which were directly correlated with capturing the impact of the small feedlot operator.

The approach used was to simulate the flow of cattle through the feedlot process from the time of placements until marketings. This required two fundamental pieces of information. The first was a prediction of the expected feeding horizon or days on feed (DOF), and the second was the formation of an expected death loss.

The modelling process was restricted to only consider the information known on the date of placement into the feedlot. This included the weight, month of placement, and feedlot. A time trend variable was also include to capture animal performance changes. A quadratic function was imposed on both the weight and time trend variables given the hypothesized relationship to DOF. The month variable represented a correction for seasonality. Historical management practices and geographic location were captured via a set of feedlot dummy variables.

Death loss in this study was defined as animals placed in the feedlot but not marketed. This included actual death loss as well as animals sold due to poor performance. Death loss, as defined, was typically less than one percent of the animals placed. The actual impact on this study of including versus excluding death loss was fairly minor given the other sources of variation. The principal reason for inclusion was one of model validity; it occurs, thus it should be captured. The approach to death loss consisted of regressing survivability (actual marketings divided by placements) on season and weight class for each state and sex.

After both the DOF equation and the Death Loss equation were completed, historical placement dates, expected closeout dates, and expected closeout volumes were derived for over 100,000 in sample observations and over 35,000 out-of-sample observations from PCC's feedlot closeout files. The resulting data file was then simulated from placement to marketings via a feedlot simulator. This feedlot simulator placed each individual pen of cattle in a discrete delay cohort with a delay length of the expected marketing date. Each cohort would accept multiple placements and keep a combined running total. As the model iterated forward, elements in each cohort move forward to the next cohort, to eventually enter a marketings array.

Model Application

Several applications of the results from the simulation model were made. The first was that the simulation model provided the expected volume of marketings significantly in advance of the actual marketing date. This was due to the biological delay associated with feedlot production. In general, cattle were placed such that they require between four and seven months in the feedlot to reach the desired weight and quality grade. By having an early measure of upcoming marketings, a conditional forecast was made for the marketings section of the COF report for up to three months into the future with very little degradation in accuracy. Beyond that time horizon, the accuracy began to deteriorate rapidly due to some cattle being place with short feeding lengths.

Accomplishing the second specific objective stated in Chapter I was made possible by the results of the simulation model. By using the flows generated by the simulation model it was possible to develop a quantitative measure/estimate of the aggregate showlist size from feedlots in the PCC data set. This showlist was then used as a proxy for the industry wide showlist. The length of time that cattle could be on showlist was determine by the width of the marketing window. The marketing window was defined by both economic and physical constraints, and could vary in length. The length of this showlist was estimated to be 28 days.

The final application of the results of the simulation model involved intra-month price predictions. First, it was shown that there is no significant relationship between changes in federally inspected slaughter and changes in price. Yet, federally inspected slaughter is the only publicly reported series with information regarding intra-month supplies. The conclusion behind this result was that packers and feeders are much more sensitive to what is about to happen rather than what has already happened. Thus, the industry has coined its own measure of intra-month supplies, namely showlists. Both the experience of PCC and the results of an experiential learning model, i.e., The Packer-Feeder Game, strongly supported the hypothesis that showlist is of much greater consequence in forecasting short-run price movements than federally inspected slaughter.

This study confirms the stated hypotheses that changes in showlist are more significant than changes in federally inspected slaughter in predicting price changes. In the experiential model and the private data model, changes in showlist have more significant t-values than changes in slaughter. The opposite was true in the public data model, but that was believed to be due to the difficulty of adequately specifying the weekly showlist proxy variable. The hypothesized reason that changes in showlist are more strongly correlated with price is that during price negotiation between feedlots and packers, more emphasis is given to the potential number of cattle that could be sold than to the actual number sold.

Implications

Several significant implications follow from this study. The first is that forecasts of cattle on feed marketings can be significantly improved with private data detailing the weight distribution of cattle on feed beyond that of public data. This is clearly shown for forecasts of marketings one month into the future. Traditional econometric or time series models projecting marketings two and three months in advance were not developed and tested against the forecasting method developed here. Thus no statistically based evidence of the superiority of the marketings forecasting method developed here for extended time periods can be given. However, it is strongly suspected that since the simulation model's ability to project marketings up to three months into the future declines very little, this forecasting methods would compare favorably to traditional methods.

A second implication evolving from this study is that showlist size is a potentially useful short-run price forecasting variable. It is contended that in order to do useful short-run price forecasting, timely, accurate, and publicly available data on showlist size are needed. It is the author's contention that to date, very little if any useful short-run price analysis has been done in the beef market. While other forecasting approaches, namely ARIMA models, have in many cases been shown to be statistically superior to structural econometric models in making short-run price forecasts, these approaches they fail to provide useful information about the underlying structure. It is the author's perception that a better understanding of the underlying structure will provide a clearer understanding of the role and usage of information in the fed cattle market. A good example of this contention is that the strong correlation shown between showlist and beef price implies that structurally based short-run beef price forecasting approaches should recognize that cattle, in the short-run, are a storable commodity.

Further Research

The final part of this study represented an initial effort to better understand the structure of short-run price forecasting in the fed cattle market. As such, it was meant to serve as a foundation for a more inclusive approach towards price forecasting. It remains unclear as to whether this approach will yield superior price forecasts over an ARIMA approach or whether a combined model will prove superior. What is clear however, is that the procedures followed in this study provides an avenue for directly testing hypotheses of market conduct considered to be relevant to the industry that can not be specified using ARIMA models.

An outgrowth of this study is the validation of Packer-Feeder Game as a hypothesis generating and testing tool. Conceptual and empirical validation of the Packer-Feeder game allows the applied economist to tackle a host of issues relating to market structure, conduct, and performance that can not be addressed readily using existing data series, due to either the lack of public data or the unwillingness of private firms to provide access to their data bases.

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APPENDIX A

DATA DESCRIPTION

Professional Cattle Consultants (PCC) began keeping records significantly before the advent of commercial data base programs. Thus, all their data is entered and manipulated by a programming language called COBOL (Common Business Oriented Language). Given the volume and complexity of PCC's data it was deemed appropriate to provide a synopsis of the organization and variables contained in the data set. In addition, the author's opinion on key limitations of the data set will be given.

The data is subdivided into four sections; Section A through Section D. Each section will be discussed separately. Each data set contains fields in which the variables are stored. Each field has a predetermined width which is established by the coding in PCC's COBOL program. Data used in this study has been extracted from the COBOL program in ASCII format with the fields and their respective widths being identical to the original COBOL program. While this data is readily usable in a mainframe format with the use of an input statement defining field widths and names, it proved to be inconvenient in a personal computer environment without first converting it to an ASCII comma delimited format.

Documentation of the field widths for the sections of data used in this study will be referred to in program listings as appropriate.

Section A

The Section A data set provides a monthly cattle movement summary. The purpose of this data set is to track the inventory levels of each individual feedlot on a monthly basis. In general, each individual feedlot provides a one line (record) summary of monthly changes in cattle inventory. The report field allows PCC to record if a feedlot made incremental reports of inventory changes during the month. The data set contains fifteen fields of which three are blank. The variables included are listed in Table XXIX.

Field width specifications for the variables in Section A are denoted in the computer code listed in Appendix B. Data from section A is used in this study to develop the forecast of USDA marketings, placements, and cattle on feed (Appendix D). In addition to this data set, the model described in Appendix D requires information regarding the one time feedlot capacity of each participating feedlot.

The principal restriction of Section A from an accounting perspective is that total ending inventories of steers and heifers summed across feedlots does not necessarily equal the total beginning inventory for the following month. The reason for this discrepancy is that only feedlots subscribing to PCC's services in the current month are included. However, to the extent that the customer base

TABLE XXIX

DESCRIPTION OF SECTION A

Field	Variable	Additional Description
1.	Feedlot ID Number	Identification Code
2.	Report number	Allows incremental reporting.
3.	Sex Code	1 = Steer, 2 = Heifer.
4.	Line Number	Not used.
5.	Year Month	(YYMM).
6.	Beginning Cattle on Feed	Beginning Inventory.
7.	Placements	Entries into the system.
8.	Transferred out	Exit to other feedlots etc.
9.	Deaths	
10.	Railers	Poor performers (sold early).
11.	Not Used	
12.	Cattle shipments	Marketings exiting the feedlot
13.	Sold but not shipped	Forward purchasing.
14.	Ending Steer Volume	Closing inventory for steers.
15.	Ending Heifer Volume	Closing inventory for heifers.

remains constant, Section A will provide an accurate description of cattle inventory stocks and flows. An additional limitation is that a breakdown of the sex composition in the beginning inventory is not available.

Section B

The Section B data set is divided into two subsections, one for steers and one for heifers. This section contains detailed daily pen level information on placements. Section B was not utilized directly in this study; instead placements were historically derived from the closeout series (Section C). The principal restriction of this series is that not all placement dates are known or provided. Unknown placement dates, at the time of recording, were assumed to be at the mid-point of the month. Procedures for working with this restriction are discussed in Section C. Both subsections, steers and heifers, contain identical field specifications. The variables are listed in Table XXX.

Section C

Section C is the most extensively used portion of the PCC data set in this study. This section contains the closeout performance data utilized in PCC's comparative analysis reports. Field width specifications are denoted within the program listing given in Appendix C. Section C includes twenty fields. Variables included in Section C are listed in Table XXXI.

TABLE XXX

DESCRIPTION OF SECTION B

Field	Variable	Additional Description
1.	Feedlot ID Number	Identification Code
2.	Report number	Allows incremental reporting.
3.	Sex Code	Not used (separate files).
4.	Line Number	Not used.
5.	Year Month	(YYMM).
6.	Placement Date	(MMDDYY)
7.	Pen ID	Identification code for each pen.
8.	Head Placed	
9.	Total Placement Weight	Weight after shrinkage.
10.	Total Cost	Purchase and shipping cost.
11.	Origin Code	Not used.
12.	Breed Code (Steers)	H = holstein, else beef.
13.	Purchase Weight	Before shrinkage.
14.	Exception Code	Used internally to PCC only.

TABLE XXXI

DESCRIPTION OF SECTION C

Field	Variable	Additional Description
1.	Feedlot ID Number	Identification Code.
2.	Report number	Allows incremental reporting.
3.	Sex Code	1 = Steer, 2 = Heifer.
4.	Line Number	For incremental reporting.
5.	Year Month	(YYMM).
6.	Pen ID	Identification code for each pen.
7.	Head Placed	Placement volume.
8.	Head Out	Closeout volume.
9.	Total Payweight	Pounds marketed per pen.
10.	Total Sales $	$ per pen.
11.	Yardage Charges	Cumulative feedlot charges against a pen.
12.	Total Pounds Gained	
13.	Total Head Days	Sum of days on feed for pen.
14.	Total Pounds of Feed fed.	
15.	Ration Moisture Level[a]	Average water content of feed.
16.	Date Closed	(DDMM).
17.	Origin Code	Not used.
18.	Breed Code (Steers)	H = holstein, else beef.
19.	Sex Code	S = Steer, H = Heifer.

a If 0 then ration reported on dry matter basis, else percent moisture in ration.

The principal restriction of this section is that not all closeout dates are known or reported. This is the case for approximately 3 to 5 percent of the closeouts in a typical month. At the time of recording, all unknown dates were assumed to be at the mid point of the month. Adjustments for this restriction were made by first determining the average daily closeout volume and the standard deviation of the closeout volume for the month. Days that had a closeout volume greater than 2.5 standard deviations from the mean were considered abnormally large. In all but a two cases this represented the mid point of the month. The volume on these "abnormal" days in excess of the mean was redistributed uniformly over the "normal" days of the month. Thus, it is hypothesized that the approximate shape of the true distribution of closeouts is retained. Use of the placements data set (Section B) would require the same restructuring.

Section D

Section D contains feedlot personnel, ration, and yardage data. This section was not utilized in this study. Section D contains 16 fields. Variables included in this section are listed in Table XXXII.

TABLE XXXII

DESCRIPTION OF SECTION D

Field	Variable	Additional Description
1.	Feedlot ID Number	Identification Code
2.	Report number	Allows incremental reporting.
3.	Sex Code	Not used.
4.	Line Number	Not used.
5.	Year Month	(YYMM).
6.	As Fed Ration Price	$ per pound
7.	Percent Moisture	Ration moisture level.
8.	Yardage Fee	Feedlot charges against pen.
9.	Feedlot Employees	Number of.
10.	Gross Payroll	Dollars.
11.	Protein NEp	Reported either as fed or dry matter basis.
12.	Energy NEm	Reported either as fed or dry matter basis.
13.	Protein NEp	Dry matter basis.
14.	Energy NEm	Dry matter basis.
15.	Calcium NEp	Dry matter basis.
16.	Calcium NEm	Dry Matter Basis.

APPENDIX B

QUICK BASIC PROGRAM FOR PLACEMENTS

The following is the Quick Basic program used to determine state level placements from Section A of the data set. It is provided to assist others who may wish to work with the data set at some point in the future.

```
DEFINT A-Z

DIM COPLACE!(100)
DIM IAPLACE!(100)
DIM KSPLACE!(100)
DIM NEPLACE!(100)
DIM NMPLACE!(100)
DIM OKPLACE!(100)
DIM SDPLACE!(100)
DIM TXPLACE!(100)

    OPEN "CO-A.TXT" FOR OUTPUT AS #31
    OPEN "IA-A.TXT" FOR OUTPUT AS #32
    OPEN "KS-A.TXT" FOR OUTPUT AS #33
    OPEN "NE-A.TXT" FOR OUTPUT AS #34
    OPEN "NM-A.TXT" FOR OUTPUT AS #35
    OPEN "OK-A.TXT" FOR OUTPUT AS #36
    OPEN "SD-A.TXT" FOR OUTPUT AS #37
    OPEN "TX-A.TXT" FOR OUTPUT AS #38

    OPEN "EXPORTA.DAT" FOR INPUT AS #30

    CLS

    DO WHILE (NOT EOF(30))
    LINE INPUT #30, PCC$
    IDYARD1! = VAL(MID$(PCC$, 1, 6))
    SEX = VAL(MID$(PCC$, 10, 1))
```

```
YEAR = VAL(MID$(PCC$, 16, 2))
MONTH = VAL(MID$(PCC$, 18, 2))
BEGIN1! = VAL(MID$(PCC$, 21, 7))
PLACE1! = VAL(MID$(PCC$, 29, 7))
TRANSFER1! = VAL(MID$(PCC$, 37, 7))
DEAD = VAL(MID$(PCC$, 45, 5))
RAILER = VAL(MID$(PCC$, 51, 5))
SHIP1! = VAL(MID$(PCC$, 63, 7))
SBNOSHIP1! = VAL(MID$(PCC$, 71, 5))
ENDSTR1! = VAL(MID$(PCC$, 77, 7))
ENDHFR1! = VAL(MID$(PCC$, 85, 7))


'    In order to conserve space in the appendix, the word "OUT" has been substituted for the
'    following in the statements below.
'    IDYARD1!, SEX, YEAR, MONTH, BEGIN1!, PLACE1!,
'    TRANSFER1!, DEAD, RAILER, SHIP1!, SBNOSHIP1!, ENDSTR1!, ENDHFR1!

IF IDYARD1! >= 150000 AND IDYARD1! < 155000 THEN WRITE #38, OUT
IF IDYARD1! >= 130000 AND IDYARD1! < 134000 THEN WRITE #35, OUT
IF IDYARD1! >= 141000 AND IDYARD1! < 143000 THEN WRITE #36, OUT
IF IDYARD1! >= 112000 AND IDYARD1! < 113000 THEN WRITE #31, OUT
IF IDYARD1! >= 731000 AND IDYARD1! < 732000 THEN WRITE #31, OUT
IF IDYARD1! >= 122000 AND IDYARD1! < 123000 THEN WRITE #33, OUT
IF IDYARD1! >= 251000 AND IDYARD1! < 252000 THEN WRITE #33, OUT
IF IDYARD1! >= 262000 AND IDYARD1! < 263000 THEN WRITE #34, OUT
IF IDYARD1! >= 711000 AND IDYARD1! < 712000 THEN WRITE #34, OUT
IF IDYARD1! >= 231000 AND IDYARD1! < 232000 THEN WRITE #32, OUT
IF IDYARD1! >= 281000 AND IDYARD1! < 282000 THEN WRITE #37, OUT
IF IDYARD1! >= 721000 AND IDYARD1! < 722000 THEN WRITE #37, OUT
IF IDYARD1! = 121015 THEN WRITE #34, OUT
IF IDYARD1! = 121022 THEN WRITE #33, OUT
IF IDYARD1! = 121037 THEN WRITE #34, OUT
IF IDYARD1! = 121040 THEN WRITE #33, OUT
IF IDYARD1! = 121060 THEN WRITE #34, OUT
IF IDYARD1! = 121077 THEN WRITE #34, OUT
IF IDYARD1! = 121082 THEN WRITE #34, OUT
IF IDYARD1! = 121095 THEN WRITE #34, OUT
IF IDYARD1! = 121105 THEN WRITE #34, OUT
IF IDYARD1! = 121114 THEN WRITE #33, OUT
IF IDYARD1! = 121121 THEN WRITE #33, OUT
IF IDYARD1! = 121136 THEN WRITE #33, OUT
IF IDYARD1! = 121149 THEN WRITE #33, OUT
IF IDYARD1! = 121150 THEN WRITE #34, OUT
IF IDYARD1! = 121169 THEN WRITE #34, OUT
IF IDYARD1! = 121176 THEN WRITE #33, OUT
IF IDYARD1! = 121181 THEN WRITE #34, OUT
IF IDYARD1! = 121194 THEN WRITE #33, OUT
IF IDYARD1! = 121204 THEN WRITE #33, OUT
```

```
    IF IDYARD1! = 121220 THEN WRITE #34, OUT
    IF IDYARD1! = 121235 THEN WRITE #34, OUT
    IF IDYARD1! = 121248 THEN WRITE #34, OUT
    IF IDYARD1! = 121259 THEN WRITE #33, OUT
    IF IDYARD1! = 121268 THEN WRITE #34, OUT
    IF IDYARD1! = 121275 THEN WRITE #34, OUT
    IF IDYARD1! = 121280 THEN WRITE #34, OUT
    IF IDYARD1! = 121293 THEN WRITE #34, OUT
    IF IDYARD1! = 121303 THEN WRITE #34, OUT
    IF IDYARD1! = 121312 THEN WRITE #34, OUT
    IF IDYARD1! = 121329 THEN WRITE #34, OUT

    LOOP

 CLOSE #30, #31, #32, #33, #34, #35, #36, #37, #38


' *****END PART 1****

' ********* COLORADO ***************
OPEN "COPLACE.TXT" FOR OUTPUT AS #41
OPEN "CO-A.TXT" FOR INPUT AS #31

    DO WHILE (NOT EOF(31))
    INPUT #31, IDYARD1!, SEX, YEAR, MONTH, BEGIN1!, PLACE1!, TRANSFER1!,
     DEAD, RAILER, SHIP1!, SBNOSHIP1!, ENDSTR1!, ENDHFR1!

    COPLACE!((12 * (YEAR - 86) + MONTH) - 1) = COPLACE!((12 * (YEAR - 86) +
     MONTH) - 1) + PLACE1!

 LOOP

    CLS
    FOR I = 0 TO 100
    TREND! = I + 1
    WRITE #41, TREND!, COPLACE!(I)
    NEXT I

CLOSE #31, #41

' ********* IOWA ***************
OPEN "IAPLACE.TXT" FOR OUTPUT AS #42
OPEN "IA-A.TXT" FOR INPUT AS #32

    DO WHILE (NOT EOF(32))

INPUT #32, IDYARD1!, SEX, YEAR, MONTH, BEGIN1!, PLACE1!, TRANSFER1!,
    DEAD, RAILER, SHIP1!, SBNOSHIP1!, ENDSTR1!, ENDHFR1!

IAPLACE!((12 * (YEAR - 86) + MONTH) - 1) = IAPLACE!((12 * (YEAR - 86) +
```

```
    MONTH) - 1) + PLACE1!

   LOOP

   CLS
   FOR I = 0 TO 100
   TREND! = I + 1
   WRITE #42, TREND!, IAPLACE!(I)
   NEXT I

CLOSE #32, #42

' ********* KANSAS ***************
OPEN "KSPLACE.TXT" FOR OUTPUT AS #43
OPEN "KS-A.TXT" FOR INPUT AS #33

   DO WHILE (NOT EOF(33))

 INPUT #33, IDYARD1!, SEX, YEAR, MONTH, BEGIN1!, PLACE1!, TRANSFER1!,
    DEAD, RAILER, SHIP1!, SBNOSHIP1!, ENDSTR1!, ENDHFR1!

KSPLACE!((12 * (YEAR - 86) + MONTH) - 1) = KSPLACE!((12 * (YEAR - 86) +
    MONTH) - 1) + PLACE1!

LOOP

   CLS
   FOR I = 0 TO 100
   TREND! = I + 1
   WRITE #43, TREND!, KSPLACE!(I)
   NEXT I

CLOSE #33, #43

' ********* NEBRASKA ***************
OPEN "NEPLACE.TXT" FOR OUTPUT AS #44
OPEN "NE-A.TXT" FOR INPUT AS #34

DO WHILE (NOT EOF(34))

INPUT #34, IDYARD1!, SEX, YEAR, MONTH, BEGIN1!, PLACE1!, TRANSFER1!,
    DEAD, RAILER, SHIP1!, SBNOSHIP1!, ENDSTR1!, ENDHFR1!

NEPLACE!((12 * (YEAR - 86) + MONTH) - 1) = NEPLACE!((12 * (YEAR - 86) +
    MONTH) - 1) + PLACE1!

 LOOP

   CLS
   FOR I = 0 TO 100
```

```
   TREND! = I + 1
   WRITE #44, TREND!, NEPLACE!(I)
   NEXT I

CLOSE #34, #44

' ********* NEW MEXICO ***************
OPEN "NMPLACE.TXT" FOR OUTPUT AS #45
OPEN "NM-A.TXT" FOR INPUT AS #35

   DO WHILE (NOT EOF(35))

INPUT #35, IDYARD1!, SEX, YEAR, MONTH, BEGIN1!, PLACE1!, TRANSFER1!,
    DEAD, RAILER, SHIP1!, SBNOSHIP1!, ENDSTR1!, ENDHFR1!

NMPLACE!((12 * (YEAR - 86) + MONTH) - 1) = NMPLACE!((12 * (YEAR - 86) +
    MONTH) - 1) + PLACE1!

LOOP

   CLS
   FOR I = 0 TO 100
   TREND! = I + 1
   WRITE #45, TREND!, NMPLACE!(I)
   NEXT I

CLOSE #35, #45

' ********* OKLAHOMA***************
OPEN "OKPLACE.TXT" FOR OUTPUT AS #46
OPEN "OK-A.TXT" FOR INPUT AS #36

   DO WHILE (NOT EOF(36))

INPUT #36, IDYARD1!, SEX, YEAR, MONTH, BEGIN1!, PLACE1!, TRANSFER1!,
    DEAD, RAILER, SHIP1!, SBNOSHIP1!, ENDSTR1!, ENDHFR1!

OKPLACE!((12 * (YEAR - 86) + MONTH) - 1) = OKPLACE!((12 * (YEAR - 86) +
    MONTH) - 1) + PLACE1!

LOOP

   CLS
   FOR I = 0 TO 100
   TREND! = I + 1
   WRITE #46, TREND!, OKPLACE!(I)
   NEXT I

CLOSE #36, #46
```

```
' ********* SOUTH DAKOTA ***************
OPEN "SDPLACE.TXT" FOR OUTPUT AS #47
OPEN "SD-A.TXT" FOR INPUT AS #37

   DO WHILE (NOT EOF(37))

INPUT #37, IDYARD1!, SEX, YEAR, MONTH, BEGIN1!, PLACE1!, TRANSFER1!,
    DEAD, RAILER, SHIP1!, SBNOSHIP1!, ENDSTR1!, ENDHFR1!

SDPLACE!((12 * (YEAR - 86) + MONTH) - 1) = SDPLACE!((12 * (YEAR - 86) +
    MONTH) - 1) + PLACE1!

LOOP

   CLS
   FOR I = 0 TO 100
   TREND! = I + 1
   WRITE #47, TREND!, SDPLACE!(I)
   NEXT I

CLOSE #37, #47

' ********* TEXAS ***************
OPEN "TXPLACE.TXT" FOR OUTPUT AS #48
OPEN "TX-A.TXT" FOR INPUT AS #38

   DO WHILE (NOT EOF(38))

INPUT #38, IDYARD1!, SEX, YEAR, MONTH, BEGIN1!, PLACE1!, TRANSFER1!,
    DEAD, RAILER, SHIP1!, SBNOSHIP1!, ENDSTR1!, ENDHFR1!

TXPLACE!((12 * (YEAR - 86) + MONTH) - 1) = TXPLACE!((12 * (YEAR - 86) +
    MONTH) - 1) + PLACE1!

LOOP

   CLS
   FOR I = 0 TO 100
   TREND! = I + 1
   WRITE #48, TREND!, TXPLACE!(I)
   NEXT I

CLOSE #38, #48
```

APPENDIX C

DATA MANAGEMENT PROGRAM

Appendix C provides the computer code for a quick basic program that converts the field separated ASCII output of PCC's COBAL program for Section C into a comma delimited ASCII file for use with the feedlot simulation model. In the process, the program below predicts the days on feed for each pen of cattle and adjust the historical placement volume by the expected death loss.

```
' SORTER.BAS
'       THIS IS A PROGRAM TO SORT PCC RECORDS BY STATE AND PREPARE THE
'       RECORDS FOR INPUT INTO THE SIMULATION MODEL.
'       WRITTEN BY: KEVIN J. BACON.      With THANKS TO BRENT TWEETEN
'       AND MIN FAH TEO FOR THEIR ASSISTANCE

DEFINT A-Z

   OPEN "CO-C.TXT" FOR OUTPUT AS #11
   OPEN "IA-C.TXT" FOR OUTPUT AS #12
   OPEN "KS-C.TXT" FOR OUTPUT AS #13
   OPEN "NE-C.TXT" FOR OUTPUT AS #14
   OPEN "NM-C.TXT" FOR OUTPUT AS #15
   OPEN "OK-C.TXT" FOR OUTPUT AS #16
   OPEN "SD-C.TXT" FOR OUTPUT AS #17
   OPEN "TX-C.TXT" FOR OUTPUT AS #18

   OPEN "C:\EXP-C\TRASH\TRASH.TXT" FOR INPUT AS #1

'       REM: the line above states the directory and name of the input file; change to
'       individualize as needed
   CLS
```

```
DO WHILE (NOT EOF(1))
LINE INPUT #1, PCC$
IDYARD! = VAL(MID$(PCC$, 1, 6))
SEX = VAL(MID$(PCC$, 8, 1))
YEARCLS = VAL(MID$(PCC$, 10, 2))
MONTHCLS = VAL(MID$(PCC$, 13, 2))
DAYCLS = VAL(MID$(PCC$, 23, 2))
HEADIN! = VAL(MID$(PCC$, 19, 5))
HEADOUT! = VAL(MID$(PCC$, 25, 5))
PAYWTOUT! = VAL(MID$(PCC$, 31, 10))
TOTDOL! = VAL(MID$(PCC$, 42, 12))
YARDAGE! = VAL(MID$(PCC$, 55, 12))
LBGAIN! = VAL(MID$(PCC$, 68, 9))
HEADDAY! = VAL(MID$(PCC$, 78, 9))
LBFEED! = VAL(MID$(PCC$, 88, 11))
INWT! = VAL(MID$(PCC$, 100, 9))
CLSDATE! = VAL(MID$(PCC$, 110, 8))
PLCDATE! = VAL(MID$(PCC$, 119, 8))
PLCYEAR! = VAL(MID$(PCC$, 128, 4))
PLCMONTH! = VAL(MID$(PCC$, 133, 3))
PLCDAY! = VAL(MID$(PCC$, 137, 3))
UNITDAY1! = VAL(MID$(PCC$, 141, 144))
BREED$ = MID$(PCC$, 146, 8)

'     To reduce space requirements in this appendix the word "OUT" is substituted for the
'     following string; IDYARD!, SEX, YEARCLS, MONTHCLS, DAYCLS, HEADIN!,
'     HEADOUT!, PAYWTOUT!, TOTDOL!, YARDAGE!, LBGAIN!, HEADDAY!,
'     LBFEED!, INWT!, CLSDATE!, PLCDATE!, PLCYEAR!, PLCMONTH!, PLCDAY!,
'     UNITDAY1!

IF IDYARD! >= 150000 AND IDYARD! < 155000 THEN WRITE #18, OUT
IF IDYARD! >= 130000 AND IDYARD! < 134000 THEN WRITE #15, OUT
IF IDYARD! >= 141000 AND IDYARD! < 143000 THEN WRITE #16, OUT
IF IDYARD! >= 112000 AND IDYARD! < 113000 THEN WRITE #11, OUT
IF IDYARD! >= 731000 AND IDYARD! < 732000 THEN WRITE #11, OUT
IF IDYARD! >= 122000 AND IDYARD! < 123000 THEN WRITE #13, OUT
IF IDYARD! >= 251000 AND IDYARD! < 252000 THEN WRITE #13, OUT
IF IDYARD! >= 262000 AND IDYARD! < 263000 THEN WRITE #14, OUT
IF IDYARD! >= 711000 AND IDYARD! < 712000 THEN WRITE #14, OUT
IF IDYARD! >= 231000 AND IDYARD! < 232000 THEN WRITE #12, OUT
IF IDYARD! >= 281000 AND IDYARD! < 282000 THEN WRITE #17, OUT
IF IDYARD! >= 721000 AND IDYARD! < 722000 THEN WRITE #17, OUT
IF IDYARD! = 121015 THEN WRITE #14, OUT
IF IDYARD! = 121022 THEN WRITE #13, OUT
IF IDYARD! = 121037 THEN WRITE #14, OUT
IF IDYARD! = 121040 THEN WRITE #13, OUT
IF IDYARD! = 121060 THEN WRITE #14, OUT
IF IDYARD! = 121077 THEN WRITE #14, OUT
IF IDYARD! = 121082 THEN WRITE #14, OUT
```

```
IF IDYARD! = 121095 THEN WRITE #14, OUT
IF IDYARD! = 121105 THEN WRITE #14, OUT
IF IDYARD! = 121114 THEN WRITE #13, OUT
IF IDYARD! = 121121 THEN WRITE #13, OUT
IF IDYARD! = 121136 THEN WRITE #13, OUT
IF IDYARD! = 121149 THEN WRITE #13, OUT
IF IDYARD! = 121150 THEN WRITE #14, OUT
IF IDYARD! = 121169 THEN WRITE #14, OUT
IF IDYARD! = 121176 THEN WRITE #13, OUT
IF IDYARD! = 121181 THEN WRITE #14, OUT
IF IDYARD! = 121194 THEN WRITE #13, OUT
IF IDYARD! = 121204 THEN WRITE #13, OUT
IF IDYARD! = 121220 THEN WRITE #14, OUT
IF IDYARD! = 121235 THEN WRITE #14, OUT
IF IDYARD! = 121248 THEN WRITE #14, OUT
IF IDYARD! = 121259 THEN WRITE #13, OUT
IF IDYARD! = 121268 THEN WRITE #14, OUT
IF IDYARD! = 121275 THEN WRITE #14, OUT
IF IDYARD! = 121280 THEN WRITE #14, OUT
IF IDYARD! = 121293 THEN WRITE #14, OUT
IF IDYARD! = 121303 THEN WRITE #14, OUT
IF IDYARD! = 121312 THEN WRITE #14, OUT
IF IDYARD! = 121329 THEN WRITE #14, OUT

LOOP

CLOSE #1, #11, #12, #13, #14, #15, #16, #17, #18


' *****END PART 1****

DIM SEASON!(12, 2)
Z! = 0

' THE NEXT 8 SECTIONS OR MODULES ARE DESIGNED TO PREP THE INDIVIDUAL
' STATE FILES FOR USE IN THE SPREADSHEET SIMULATION MODEL BY
' PERFORMING DATA MANAGEMENT TASKS.

' ***** THIS SECTION IS FOR COLORADO ************************

   OPEN "CO-C.CSV" FOR INPUT AS #11

   OPEN "COC-RUN.CSV" FOR OUTPUT AS #21

  FOR K = 1 TO 2
    FOR J = 1 TO 12
      SEASON!(J, K) = 0        ' THIS SECTION RESETS THE ARRAYS
    NEXT J
  NEXT K
```

```
   FOR K = 1 TO 2              ' ARRAY FOR MONTHLY DUMMY VARIABLES
     FOR J = 1 TO 12           ' STEERS=1 HEIFERS=2
         READ SEASON!(J, K)
     NEXT J
   NEXT K

   DATA    0, -1.684280, 1.370576, .646721, 3.066931, 1.146939, 2.584500, 2.568871,
       7.776883, 9.485522, 5.644719, 3.661339
   DATA    0, -.123321, 1.216764, 3.229676, 2.792758, 2.576075, 1.947269, 2.586711,
       8.434088, 8.674568, 7.512469, .124391

DO WHILE (NOT EOF(11))


     ' THIS SECTION READS IN THE INDIVIDUAL STATE
     ' LEVEL DATA AND ASSIGNS VARIABLES.
     ' ONLY ONE LINE FROM A FILE IS USED PER LOOP.

INPUT #11, IDYARD!, SEX, YEARCLS, MONTHCLS, CLSDAY, HEADIN!, HEADOUT!,
   PAYWTOUT!, TOTDOL!, YARDAGE!, LBGAIN!, HEADDAY!, LBFEED!, INWT!,
   CLSDATE!, PLCDATE!, PLCYEAR!, PLCMONTH!, PLCDAY!, UNITDAY1!

   IF SEX = 1 THEN
     SELECT CASE IDYARD!
     CASE 112075
     FEEDLOT! = 0
     CASE 112093
     FEEDLOT! = -18.08046
     CASE 112103
     FEEDLOT! = -2.36587
     CASE 112112
     FEEDLOT! = -6.600598
     CASE 112129
     FEEDLOT! = 5.835146
     CASE 112134
     FEEDLOT! = 13.814365#
     CASE 731182
     FEEDLOT! = -.519773
     CASE 731195
     FEEDLOT! = 3.24032
     CASE 731205
     FEEDLOT! = -5.918014
     CASE 731221
     FEEDLOT! = -16.678443#
     CASE 731236
     FEEDLOT! = -15.088714#
     CASE 731249
     FEEDLOT! = -6.644792
     CASE 731269
```

```
        FEEDLOT! = 7.747813
        CASE 731276
        FEEDLOT! = 29.831134#
        CASE ELSE
        FEEDLOT! = -.82
    END SELECT

    ELSE
        SELECT CASE IDYARD!
        CASE 112075
        FEEDLOT! = 0
        CASE 112093
        FEEDLOT! = -17.948807#
        CASE 112103
        FEEDLOT! = -.835582
        CASE 112112
        FEEDLOT! = -4.249648
        CASE 112129
        FEEDLOT! = -3.930255
        CASE 112134
        FEEDLOT! = -.071894
        CASE 731182
        FEEDLOT! = -3.764798
        CASE 731195
        FEEDLOT! = -4.975036
        CASE 731205
        FEEDLOT! = 1.928683
        CASE 731221
        FEEDLOT! = -9.406969
        CASE 731236
        FEEDLOT! = -13.511836#
        CASE 731249
        FEEDLOT! = -6.950973
        CASE 731269
        FEEDLOT! = -6.847313
        CASE 731276
        FEEDLOT! = -27.90073
        CASE ELSE
        FEEDLOT! = -3.58
    END SELECT
  END IF

' This Section corrects for death loss

        IF SEX = 1 THEN
            INTERCEPT! = 529.053451#
            UNITINWT! = -.835607#
            WTSQ! = .000404#
```

```
        TIME! = .32305#
        TIMESQ! = -.00269
        K = 1
        DEATHINT! = .966983

IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN SEABAR! = 0
IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN SEABAR! =
.000277
IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN SEABAR! =
-.000297
IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN SEABAR! =
-.003571

        IF INWT! <= 550 THEN WTBAR! = 0
        IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .015715
        IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .025529
        IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .028254
        IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .026414
        IF INWT! > 950 THEN WTBAR! = .026309

  ELSE

      K = 2
      INTERCEPT! = 545.217517#
      UNITINWT! = -.958423#
      WTSQ! = .000499#
      TIME! = .334712#
      TIMESQ! = -.002001#
      DEATHINT! = .970688

IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2
   THEN SEABAR! = 0
IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5
   THEN SEABAR! = .009756
IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8
   THEN SEABAR! = .004538
IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11
   THEN SEABAR! = -.001982

        IF INWT! <= 550 THEN WTBAR! = 0
        IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .013366
        IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .015932
        IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .017719
        IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .013231
        IF INWT! > 950 THEN WTBAR! = .019217

  END IF
                                    ' DAYS ON FEED AND PREDICTED SURVIVAL.
    FOR J = 1 TO 12               ' THIS INFORMATION IS THE WRITTEN TO AN
    IF J = PLCMONTH! THEN          ' OUTPUT FILE *-RUN.TXT WHERE
```

```
                ' *=STATE ABBREVIATION.
      DUMMY! = SEASON!(J, K)
      TREND = (PLCYEAR! - 1986) * 12 + PLCMONTH!
      TREND1! = TREND * TIME!
      TREND2! = (TREND * TREND) * TIMESQ!
      INWTSQ! = INWT! * INWT!
      WT1! = UNITINWT! * INWT!
      WT2! = INWTSQ! * WTSQ!
      PREDICT! = INTERCEPT! + WT1! + WT2! + TREND1! + TREND2! + DUMMY!
     + FEEDLOT!
      PREDICT = INT(PREDICT! + .5)
      HEADSOLD = INT((HEADIN! * (DEATHINT! + SEABAR! + WTBAR!)) + .5)
      WRITE #21, SEX, PLCMONTH!, PLCDAY!, PLCYEAR!, HEADSOLD,
     PREDICT, PLCDATE!, HEADOUT!, UNITDAY1!

    END IF
  NEXT J

LOOP     ' THIS STATEMENT CAUSES THE PROGRAM TO RETURN TO THE
         ' BEGINNING OF THIS MODULE TO EVALUATE THE NEXT LINE OF
         ' DATA.

CLOSE #11, #21

' ****END COLORADO *********************************************



' ***** BEGIN IOWA ***********************************************

   OPEN "IA-C.CSV" FOR INPUT AS #12

   OPEN "IAC-RUN.CSV" FOR OUTPUT AS #22

  FOR K = 1 TO 2
    FOR J = 1 TO 12
      SEASON!(J, K) = 0
    NEXT J
   NEXT K

   FOR K = 1 TO 2
     FOR J = 1 TO 12
         READ SEASON!(J, K)
     NEXT J
   NEXT K

   DATA     0, 10.502394, -1.537810, 8.858436, 7.397138, 10.968607, -1.228328, 5.171655,
       1.961956, 1.876592, 10.502664, 8.472412
   DATA     0, -4.552854, -20.293558, -10.888050, -11.457789, -8.704221, -8.276929,
       2.746394, 7.725724, 9.650843, -.619128, 1.136581
```

```
DO WHILE (NOT EOF(12))

   INPUT #12, IDYARD!, SEX, YEARCLS, MONTHCLS, CLSDAY, HEADIN!,
    HEADOUT!, PAYWTOUT!, TOTDOL!, YARDAGE!, LBGAIN!, HEADDAY!,
    LBFEED!, INWT!, CLSDATE!, PLCDATE!, PLCYEAR!, PLCMONTH!, PLCDAY!,
    UNITDAY1!

      IF SEX = 1 THEN
         SELECT CASE IDYARD!
         CASE 231088
         FEEDLOT! = 0
         CASE 231110
         FEEDLOT! = -27.575928#
         CASE 231127
         FEEDLOT! = -34.650551#
         CASE ELSE
         FEEDLOT! = -20.74
      END SELECT

      ELSE
         SELECT CASE IDYARD!
         CASE 231088
         FEEDLOT! = 0
         CASE 231110
         FEEDLOT! = -43.783678#
         CASE 231127
         FEEDLOT! = -81.751921#
         CASE ELSE
         FEEDLOT! = -41.78
      END SELECT
   END IF

   INWT! = (PAYWTOUT! - LBGAIN!) / HEADOUT!

   IF SEX = 1 THEN
      INTERCEPT! = 342.435687#
      UNITINWT! = -.323869#
      WTSQ! = 8.958000000000001D-05
      TIME! = -.701619#
      TIMESQ! = .018271
      K = 1
      DEATHINT! = .986297

         IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2
        THEN SEABAR! = 0
         IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5
       THEN SEABAR! = .007156
         IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8
       THEN SEABAR! = .006708
```

```
    IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11
   THEN SEABAR! = .0026911

    IF INWT! <= 550 THEN WTBAR! = 0
    IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = -.003313
    IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .002711
    IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .004587
    IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .002164
    IF INWT! > 950 THEN WTBAR! = .002742

ELSE

  K = 2
  INTERCEPT! = 261.602831#
  UNITINWT! = -.186246#
  WTSQ! = -7.747999999999999D-06
  TIME! = 2.487876#
  TIMESQ! = -.01656#
  DEATHINT! = .986297

    IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2
   THEN SEABAR! = 0
    IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5
   THEN SEABAR! = .007156
    IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8
   THEN SEABAR! = .006708
    IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11
   THEN SEABAR! = .0026911

    IF INWT! <= 550 THEN WTBAR! = 0
    IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = -.003313
    IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .002711
    IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .004587
    IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .002164
    IF INWT! > 950 THEN WTBAR! = .002742

END IF


  FOR J = 1 TO 12
  IF J = PLCMONTH! THEN
    DUMMY! = SEASON!(J, K)
    TREND = (PLCYEAR! - 1986) * 12 + PLCMONTH!
    TREND1! = TREND * TIME!
    TREND2! = (TREND * TREND) * TIMESQ!
    INWTSQ! = INWT! * INWT!
    WT1! = UNITINWT! * INWT!
    WT2! = INWTSQ! * WTSQ!
    PREDICT! = INTERCEPT! + WT1! + WT2! + TREND1! + TREND2! + DUMMY!
   + FEEDLOT!
```

```
        PREDICT = INT(PREDICT! + .5)
        HEADSOLD = INT((HEADIN! * (DEATHINT! + SEABAR! + WTBAR!)) + .5)
        WRITE #22, SEX, PLCMONTH!, PLCDAY!, PLCYEAR!, HEADSOLD,
       PREDICT, PLCDATE!, HEADOUT!, UNITDAY1!

      END IF
    NEXT J
LOOP

CLOSE #12, #22

' **** END IOWA *****************************

' ***** BEGIN KANSAS *********************

OPEN "KS-C.CSV" FOR INPUT AS #13

   OPEN "KSC-RUN.CSV" FOR OUTPUT AS #23

  FOR K = 1 TO 2
    FOR J = 1 TO 12
      SEASON!(J, K) = 0
    NEXT J
   NEXT K

   FOR K = 1 TO 2
     FOR J = 1 TO 12
         READ SEASON!(J, K)
     NEXT J
   NEXT K

   DATA     0, .331795, 1.976727, 3.664981, 4.428908, 4.033537, 1.3499, 3.026413,
         4.893527, 4.852363, 4.283387, .458817
   DATA     0, -.333569, -.029028, .480736, .311325, -.553146, -2.364457, -.551585,
       2.739696, 4.361652, 4.886412, 2.198445


DO WHILE (NOT EOF(13))

   INPUT #13, IDYARD!, SEX, YEARCLS, MONTHCLS, CLSDAY, HEADIN!,
    HEADOUT!, PAYWTOUT!, TOTDOL!, YARDAGE!, LBGAIN!, HEADDAY!,
    LBFEED!, INWT!, CLSDATE!, PLCDATE!, PLCYEAR!, PLCMONTH!, PLCDAY!,
    UNITDAY1!

   IF SEX = 1 THEN
     SELECT CASE IDYARD!
     CASE 121040
     FEEDLOT! = 0
     CASE 121149
     FEEDLOT! = 12.993814#
```

CASE 121176
FEEDLOT! = 8.164034
CASE 121194
FEEDLOT! = 14.887509#
CASE 121259
FEEDLOT! = 13.923934#
CASE 122029
FEEDLOT! = 9.05399
CASE 122034
FEEDLOT! = .490476
CASE 122092
FEEDLOT! = -3.360039
CASE 122111
FEEDLOT! = -9.591145
CASE 122166
FEEDLOT! = -.233018
CASE 122191
FEEDLOT! = 4.901666
CASE 122201
FEEDLOT! = 3.350277
CASE 122210
FEEDLOT! = 1.846293
CASE 122227
FEEDLOT! = -.656473
CASE 122256
FEEDLOT! = 1.150135
CASE 122265
FEEDLOT! = 9.101509
CASE 122326
FEEDLOT! = 11.446124#
CASE 122344
FEEDLOT! = 4.599496
CASE 122409
FEEDLOT! = -1.222037
CASE 122418
FEEDLOT! = 3.292101
CASE 122425
FEEDLOT! = -6.376426
CASE 122454
FEEDLOT! = 7.32298
CASE 122470
FEEDLOT! = 4.314772
CASE 122498
FEEDLOT! = 5.54613
CASE 122517
FEEDLOT! = 26.0230292#
CASE 122524
FEEDLOT! = 4.669489
CASE 122539
FEEDLOT! = 13.866525#

```
  CASE 122542
  FEEDLOT! = 4.881213
  CASE 122553
  FEEDLOT! = .619006
  CASE 122579
  FEEDLOT! = 14.422472#
  CASE 122584
  FEEDLOT! = 2.933237
  CASE 122597
  FEEDLOT! = 6.183754
  CASE ELSE
  FEEDLOT! = 3.5
END SELECT

ELSE
  SELECT CASE IDYARD!
  CASE 121040
  FEEDLOT! = 0
  CASE 121149
  FEEDLOT! = 19.314304#
  CASE 121176
  FEEDLOT! = 9.067497
  CASE 121194
  FEEDLOT! = 11.67158
  CASE 121259
  FEEDLOT! = 12.124312#
  CASE 122029
  FEEDLOT! = 8.185551
  CASE 122034
  FEEDLOT! = 7.217119
  CASE 122092
  FEEDLOT! = 6.861933
  CASE 122111
  FEEDLOT! = -8.293414
  CASE 122166
  FEEDLOT! = 2.607732
  CASE 122191
  FEEDLOT! = 4.455888
  CASE 122201
  FEEDLOT! = 1.401121
  CASE 122210
  FEEDLOT! = -2.44204
  CASE 122227
  FEEDLOT! = -2.212528
  CASE 122256
  FEEDLOT! = -4.529857
  CASE 122265
  FEEDLOT! = 14.325819#
  CASE 122326
  FEEDLOT! = 8.787653
```

```
    CASE 122344
    FEEDLOT! = -2.963194
    CASE 122409
    FEEDLOT! = -.843877
    CASE 122418
    FEEDLOT! = 5.238373
    CASE 122425
    FEEDLOT! = -4.785257
    CASE 122454
    FEEDLOT! = 9.341131
    CASE 122470
    FEEDLOT! = 4.542321
    CASE 122498
    FEEDLOT! = 8.599828
    CASE 122517
    FEEDLOT! = 7.958294
    CASE 122524
    FEEDLOT! = 2.8095
    CASE 122539
    FEEDLOT! = 12.83617
    CASE 122542
    FEEDLOT! = .873223
    CASE 122553
    FEEDLOT! = 1.317551
    CASE 122579
    FEEDLOT! = 8.317572
    CASE 122584
    FEEDLOT! = 4.571204
    CASE 122597
    FEEDLOT! = 4.374867
    CASE ELSE
    FEEDLOT! = 5.23
  END SELECT
END IF

INWT! = (PAYWTOUT! - LBGAIN!) / HEADOUT!

 IF SEX = 1 THEN
    INTERCEPT! = 548.364504#
    UNITINWT! = -.968607#
    WTSQ! = .000521#
    TIME! = .287712#
    TIMESQ! = -.000749#
    K = 1
    DEATHINT! = .979625

       IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2
      THEN SEABAR! = 0
       IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5
      THEN SEABAR! = .004201
```

```
    IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8
   THEN SEABAR! = .0024
    IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11
   THEN SEABAR! = -.001467

    IF INWT! <= 550 THEN WTBAR! = 0
    IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .003621
    IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .011037
    IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .014405
    IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .011351
    IF INWT! > 950 THEN WTBAR! = .007402

ELSE

  K = 2
  INTERCEPT! = 592.2330899999999#
  UNITINWT! = -1.171955
  WTSQ! = .000685#
  TIME! = .322476#
  TIMESQ! = -.001038#
  DEATHINT! = .9715394

    IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2
   THEN SEABAR! = 0
    IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5
   THEN SEABAR! = .01046
    IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8
   THEN SEABAR! = .005858
    IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11
   THEN SEABAR! = .00548

    IF INWT! <= 550 THEN WTBAR! = 0
    IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .011218
    IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .006492
    IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .007789
    IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .002281
    IF INWT! > 950 THEN WTBAR! = -.005424

END IF

  FOR J = 1 TO 12
  IF J = PLCMONTH! THEN
    DUMMY! = SEASON!(J, K)
    TREND = (PLCYEAR! - 1986) * 12 + PLCMONTH!
    TREND1! = TREND * TIME!
    TREND2! = (TREND * TREND) * TIMESQ!
    INWTSQ! = INWT! * INWT!
    WT1! = UNITINWT! * INWT!
    WT2! = INWTSQ! * WTSQ!
    PREDICT! = INTERCEPT! + WT1! + WT2! + TREND1! + TREND2! + DUMMY!
```

```
        + FEEDLOT!
         PREDICT = INT(PREDICT! + .5)
         HEADSOLD = INT((HEADIN! * (DEATHINT! + SEABAR! + WTBAR!)) + .5)
         WRITE #23, SEX, PLCMONTH!, PLCDAY!, PLCYEAR!, HEADSOLD,
        PREDICT, PLCDATE!, HEADOUT!, UNITDAY1!
      END IF
    NEXT J
LOOP

CLOSE #13, #23

' ***** END KANSAS *************************************

' ***** BEGIN NEBRASKA *******************************

OPEN "NE-C.CSV" FOR INPUT AS #14

  OPEN "NEC-RUN.CSV" FOR OUTPUT AS #24

  FOR K = 1 TO 2
    FOR J = 1 TO 12
      SEASON!(J, K) = 0        ' THIS SECTION RESETS THE ARRAYS
    NEXT J
   NEXT K


   FOR K = 1 TO 2              ' ARRAY FOR IDENTIFYING MONTHLY DUMMY
VARIABLES
     FOR J = 1 TO 12           ' STEERS=1 HEIFERS=2
        READ SEASON!(J, K)
     NEXT J
   NEXT K

   DATA 0, 2.613430, 3.528728, 4.184060, 5.165327, 1.284279, -.016902, -1.367099,
3.399371, 9.481914, 6.991029, 3.730858
   DATA 0, -3.416429, -3.185076, 3.576005, -4.013093, -3.740733, -6.545298, -4.9988,
-.978835, 5.177869, 4.615889, .696598


DO WHILE (NOT EOF(14))

  INPUT #14, IDYARD!, SEX, YEARCLS, MONTHCLS, CLSDAY, HEADIN!,
HEADOUT!, PAYWTOUT!, TOTDOL!, YARDAGE!, LBGAIN!, HEADDAY!, LBFEED!,
INWT!, CLSDATE!, PLCDATE!, PLCYEAR!, PLCMONTH!, PLCDAY!, UNITDAY1!


'   IF HEADIN! = 0 THEN LOOP

  IF SEX = 1 THEN
     SELECT CASE IDYARD!
```

```
    CASE 121060
    FEEDLOT! = 0
    CASE 121181
    FEEDLOT! = -8.047109
    CASE 121220
    FEEDLOT! = -19.275321#
    CASE 121268
    FEEDLOT! = -6.916078
    CASE 121275
    FEEDLOT! = -32.377467#
    CASE 121280
    FEEDLOT! = -19.521171#
    CASE 121293
    FEEDLOT! = -16.503102#
    CASE 121303
    FEEDLOT! = -20.864312#
    CASE 121329
    FEEDLOT! = -15.76623#
    CASE 262082
    FEEDLOT! = -19.575066#
    CASE 262105
    FEEDLOT! = -26.47345#
    CASE 262114
    FEEDLOT! = -9.65516
    CASE 262136
    FEEDLOT! = -6.72478
    CASE 262149
    FEEDLOT! = -16.964181#
    CASE 262169
    FEEDLOT! = -19.346004#
    CASE 711025
    FEEDLOT! = -8.264129
    CASE 711054
    FEEDLOT! = -6.188862
    CASE 711070
    FEEDLOT! = -13.702193#
    CASE 711085
    FEEDLOT! = -16.502382#
    CASE 711098
    FEEDLOT! = -14.895024#
    CASE ELSE
    FEEDLOT! = -14.2
END SELECT

ELSE
    SELECT CASE IDYARD!
    CASE 121060
    FEEDLOT! = 0
    CASE 121181
    FEEDLOT! = -19.182345#
```

```
    CASE 121220
    FEEDLOT! = -26.976324#
    CASE 121268
    FEEDLOT! = -23.113778#
    CASE 121275
    FEEDLOT! = -28.775504#
    CASE 121280
    FEEDLOT! = -33.102152#
    CASE 121293
    FEEDLOT! = -24.238031#
    CASE 121303
    FEEDLOT! = -29.781792#
    CASE 121329
    FEEDLOT! = -16.430103#
    CASE 262082
    FEEDLOT! = -22.06105#
    CASE 262105
    FEEDLOT! = -34.004144#
    CASE 262114
    FEEDLOT! = -22.910271#
    CASE 262136
    FEEDLOT! = -15.439715#
    CASE 262149
    FEEDLOT! = -26.280534#
    CASE 262169
    FEEDLOT! = -32.254649#
    CASE 711025
    FEEDLOT! = -14.435796#
    CASE 711054
    FEEDLOT! = -17.272827#
    CASE 711070
    FEEDLOT! = -28.677482#
    CASE 711085
    FEEDLOT! = -17.671201#
    CASE 711098
    FEEDLOT! = -17.588531#
    CASE ELSE
    FEEDLOT! = -21.95
  END SELECT
END IF

  INWT! = (PAYWTOUT! - LBGAIN!) / HEADOUT!

  IF SEX = 1 THEN
    INTERCEPT! = 579.871863#
    UNITINWT! = -.9343#
    WTSQ! = .000458#
    TIME! = .294677#
    TIMESQ! = .001047#
    K = 1
```

```
    DEATHINT! = .97815

        IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
        IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .000995
        IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = -.00055
        IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = -.0006126

        IF INWT! <= 550 THEN WTBAR! = 0
        IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .008231
        IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .013952
        IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .018715
        IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .017144
        IF INWT! > 950 THEN WTBAR! = .018365

  ELSE

    K = 2
    INTERCEPT! = 511.225692#
    UNITINWT! = -.79005#
    WTSQ! = .000382#
    TIME! = .177122#
    TIMESQ! = .001901#
    DEATHINT! = .97818

        IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
        IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .000436
        IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = .001739
        IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = -.003972

        IF INWT! <= 550 THEN WTBAR! = 0
        IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .008338
        IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .014918
        IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .016526
        IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .016788
        IF INWT! > 950 THEN WTBAR! = .016166

  END IF
                                   ' DAYS ON FEED AND PREDICTED SURVIVAL.
   FOR J = 1 TO 12                      ' THIS INFORMATION IS THE WRITTEN TO
AN
    IF J = PLCMONTH! THEN                    ' OUTPUT FILE *-RUN.TXT WHERE
*=STATE ABBREVIATION.
```

```
        DUMMY! = SEASON!(J, K)
        TREND = (PLCYEAR! - 1986) * 12 + PLCMONTH!
        TREND1! = TREND * TIME!
        TREND2! = (TREND * TREND) * TIMESQ!
        INWTSQ! = INWT! * INWT!
        WT1! = UNITINWT! * INWT!
        WT2! = INWTSQ! * WTSQ!
        PREDICT! = INTERCEPT! + WT1! + WT2! + TREND1! + TREND2! + DUMMY!
+ FEEDLOT!
        PREDICT = INT(PREDICT! + .5)
        HEADSOLD = INT((HEADIN! * (DEATHINT! + SEABAR! + WTBAR!)) + .5)
        WRITE #24, SEX, PLCMONTH!, PLCDAY!, PLCYEAR!, HEADSOLD,
PREDICT, PLCDATE!, HEADOUT!, UNITDAY1!
      END IF
    NEXT J
LOOP          ' THIS STATEMENT CAUSES THE PROGRAM TO RETURN TO THE
BEGINNING
          ' OF THIS MODULE TO EVALUATE THE NEXT LINE OF DATA.

CLOSE #14, #24

' ***** END NEBRASKA*********************************************************

' ***** BEGIN NEW MEXICO******************************************************

OPEN "NM-C.CSV" FOR INPUT AS #15

   OPEN "NMC-RUN.CSV" FOR OUTPUT AS #25

  FOR K = 1 TO 2
    FOR J = 1 TO 12
      SEASON!(J, K) = 0       ' THIS SECTION RESETS THE ARRAYS
    NEXT J
   NEXT K

   FOR K = 1 TO 2             ' ARRAY FOR IDENTIFYING MONTHLY DUMMY
VARIABLES
     FOR J = 1 TO 12          ' STEERS=1 HEIFERS=2
         READ SEASON!(J, K)
     NEXT J
   NEXT K

   DATA 0, .471276, -8.377378, -6.11610, -3.615604, -6.659967, 7.236173, 12.602009,
12.998945, 7.179442, 3.186779, -1.764605
   DATA 0, -1.756579, -6.617481, -2.483873, .119879, -3.100318, 3.017507, 11.145868,
11.604647, 12.494608, 14.082333, 7.607464


DO WHILE (NOT EOF(15))
```

```
   INPUT #15, IDYARD!, SEX, YEARCLS, MONTHCLS, CLSDAY, HEADIN!,
HEADOUT!, PAYWTOUT!, TOTDOL!, YARDAGE!, LBGAIN!, HEADDAY!, LBFEED!,
INWT!, CLSDATE!, PLCDATE!, PLCYEAR!, PLCMONTH!, PLCDAY!, UNITDAY1!

'   IF HEADIN! = 0 THEN LOOP



    IF SEX = 1 THEN
      SELECT CASE IDYARD!
      CASE 130015
      FEEDLOT! = 0
      CASE 130037
      FEEDLOT! = -9.937807
      CASE 132011
      FEEDLOT! = -6.274429
      CASE ELSE
      FEEDLOT! = -5.33
    END SELECT

    ELSE SEX = 2
      SELECT CASE IDYARD!
      CASE 130015
      FEEDLOT! = 0
      CASE 130037
      FEEDLOT! = -15.840705#
      CASE 132011
      FEEDLOT! = -15.840705#
      CASE ELSE
      FEEDLOT! = -5.33
    END SELECT
  END IF

   INWT! = (PAYWTOUT! - LBGAIN!) / HEADOUT!

   IF SEX = 1 THEN
      INTERCEPT! = 574.4627410000001#
      UNITINWT! = -.921709#
      WTSQ! = .000451#
      TIME! = .334165#
      TIMESQ! = -.001781#
      K = 1
      DEATHINT! = .975814

         IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
         IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .005953
         IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = .003745
```

```
        IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = -.008256

        IF INWT! <= 550 THEN WTBAR! = 0
        IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = -.002892
        IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .009912
        IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .013913
        IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .008158
        IF INWT! > 950 THEN WTBAR! = .019336

  ELSE

      K = 2
      INTERCEPT! = 551.507026#
      UNITINWT! = -.942702#
      WTSQ! = .000478#
      TIME! = .683069#
      TIMESQ! = .009019
      DEATHINT! = .969926

        IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
        IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .014358
        IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = .012199
        IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = .003154

        IF INWT! <= 550 THEN WTBAR! = 0
        IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .001542
        IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .007087
        IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .003478
        IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = -.005683
        IF INWT! > 950 THEN WTBAR! = 0

  END IF
                                   ' DAYS ON FEED AND PREDICTED SURVIVAL.
    FOR J = 1 TO 12                     ' THIS INFORMATION IS THE WRITTEN TO
AN
      IF J = PLCMONTH! THEN                  ' OUTPUT FILE *-RUN.TXT WHERE
*=STATE ABBREVIATION.
        DUMMY! = SEASON!(J, K)
        TREND = (PLCYEAR! - 1986) * 12 + PLCMONTH!
        TREND1! = TREND * TIME!
        TREND2! = (TREND * TREND) * TIMESQ!
        INWTSQ! = INWT! * INWT!
        WT1! = UNITINWT! * INWT!
        WT2! = INWTSQ! * WTSQ!
        PREDICT! = INTERCEPT! + WT1! + WT2! + TREND1! + TREND2! + DUMMY!
```

```
+ FEEDLOT!
        PREDICT = INT(PREDICT! + .5)
        HEADSOLD = INT((HEADIN! * (DEATHINT! + SEABAR! + WTBAR!)) + .5)
        WRITE #25, SEX, PLCMONTH!, PLCDAY!, PLCYEAR!, HEADSOLD,
PREDICT, PLCDATE!, HEADOUT!, UNITDAY1!
      END IF
    NEXT J

LOOP          ' THIS STATEMENT CAUSES THE PROGRAM TO RETURN TO THE
BEGINNING
              ' OF THIS MODULE TO EVALUATE THE NEXT LINE OF DATA.
CLOSE #15, #25

' ***** END NEW MEXICO*****************************************************


' *****START OF OKLAHOMA***************************************************

  OPEN "OK-C.CSV" FOR INPUT AS #16

  OPEN "OKC-RUN.CSV" FOR OUTPUT AS #26

  FOR K = 1 TO 2
    FOR J = 1 TO 12
      SEASON!(J, K) = 0       ' THIS SECTION RESETS THE ARRAYS
    NEXT J
   NEXT K


   FOR K = 1 TO 2             ' ARRAY FOR IDENTIFYING MONTHLY DUMMY
VARIABLES
     FOR J = 1 TO 12          ' STEERS=1 HEIFERS=2
         READ SEASON!(J, K)
     NEXT J
   NEXT K

   DATA 0, -.171604, 2.683789, 3.356538, 4.721836, 2.857239, 3.480695, 3.209149,
3.700927, 4.471864, 4.459219, 3.700214
   DATA 0, -1.397581, .0170228, 1.170364, .0885841, -.0597416, -1.946234, .638144,
3.848190, 4.965563, 7.821435, 3.638082


DO WHILE (NOT EOF(16))

   INPUT #16, IDYARD!, SEX, YEARCLS, MONTHCLS, CLSDAY, HEADIN!,
HEADOUT!, PAYWTOUT!, TOTDOL!, YARDAGE!, LBGAIN!, HEADDAY!, LBFEED!,
INWT!, CLSDATE!, PLCDATE!, PLCYEAR!, PLCMONTH!, PLCDAY!, UNITDAY1!

'   IF HEADIN! = 0 THEN LOOP
```

```
  IF SEX = 1 THEN
    SELECT CASE IDYARD!
    CASE 141035
    FEEDLOT! = 0
    CASE 141048
    FEEDLOT! = -5.338955
    CASE 141059
    FEEDLOT! = -12.849175#
    CASE 141068
    FEEDLOT! = -2.737335
    CASE 141075
    FEEDLOT! = -14.581152#
    CASE 141112
    FEEDLOT! = -9.360104
    CASE 141167
    FEEDLOT! = 6.078019
    CASE 141174
    FEEDLOT! = -7.382197
    CASE ELSE
    FEEDLOT! = -5.75
  END SELECT

 ELSE
    SELECT CASE IDYARD!
    CASE 141035
    FEEDLOT! = 0
    CASE 141048
    FEEDLOT! = -5.728671
    CASE 141059
    FEEDLOT! = -5.546597
    CASE 141068
    FEEDLOT! = -5.230761
    CASE 141075
    FEEDLOT! = -11.751572#
    CASE 141112
    FEEDLOT! = -4.605663
    CASE 141167
    FEEDLOT! = 13.084895#
    CASE 141174
    FEEDLOT! = -18.709403#
    CASE ELSE
    FEEDLOT! = -4.1
  END SELECT
END IF

INWT! = (PAYWTOUT! - LBGAIN!) / HEADOUT!

 IF SEX = 1 THEN
```

```
    INTERCEPT! = 570.295155#
    UNITINWT! = -.967299#
    WTSQ! = .000504#
    TIME! = .266138#
    TIMESQ! = -.003067#
    K = 1
    DEATHINT! = .98388

       IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
       IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .001303
       IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = 8.649600000000001D-05
       IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = -.002511

       IF INWT! <= 550 THEN WTBAR! = 0
       IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .004904
       IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .008833
       IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .010491
       IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .010681
       IF INWT! > 950 THEN WTBAR! = .011873

  ELSE

    K = 2
    INTERCEPT! = 565.069543#
    UNITINWT! = -1.052212#
    WTSQ! = .000587#
    TIME! = .357055#
    TIMESQ! = -.003937#
    DEATHINT! = .9870774

       IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
       IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .007895
       IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = .00498
       IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = -.002544

       IF INWT! <= 550 THEN WTBAR! = 0
       IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .006707
       IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .009035
       IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .008171
       IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .004911
       IF INWT! > 950 THEN WTBAR! = -.00401
```

```
  END IF
                                       ' DAYS ON FEED AND PREDICTED SURVIVAL.
    FOR J = 1 TO 12                        ' THIS INFORMATION IS THE WRITTEN TO
AN
      IF J = PLCMONTH! THEN                      ' OUTPUT FILE *-RUN.TXT WHERE
*=STATE ABBREVIATION.
        DUMMY! = SEASON!(J, K)
        TREND = (PLCYEAR! - 1986) * 12 + PLCMONTH!
        TREND1! = TREND * TIME!
        TREND2! = (TREND * TREND) * TIMESQ!
        INWTSQ! = INWT! * INWT!
        WT1! = UNITINWT! * INWT!
        WT2! = INWTSQ! * WTSQ!
        PREDICT! = INTERCEPT! + WT1! + WT2! + TREND1! + TREND2! + DUMMY!
+ FEEDLOT!
        PREDICT = INT(PREDICT! + .5)
        HEADSOLD = INT((HEADIN! * (DEATHINT! + SEABAR! + WTBAR!)) + .5)
        WRITE #26, SEX, PLCMONTH!, PLCDAY!, PLCYEAR!, HEADSOLD,
PREDICT, PLCDATE!, HEADOUT!, UNITDAY1!
      END IF
    NEXT J

LOOP        ' THIS STATEMENT CAUSES THE PROGRAM TO RETURN TO THE
BEGINNING
            ' OF THIS MODULE TO EVALUATE THE NEXT LINE OF DATA.
CLOSE #16, #26

' ***** END OKLAHOMA**************************************************************


' ***** BEGIN SOUTH DAKOTA*********************************************************

OPEN "SD-C.CSV" FOR INPUT AS #17

   OPEN "SDC-RUN.CSV" FOR OUTPUT AS #27

  FOR K = 1 TO 2
    FOR J = 1 TO 12
      SEASON!(J, K) = 0       ' THIS SECTION RESETS THE ARRAYS
    NEXT J
   NEXT K


   FOR K = 1 TO 2             ' ARRAY FOR IDENTIFYING MONTHLY DUMMY
VARIABLES
      FOR J = 1 TO 12         ' STEERS=1 HEIFERS=2
         READ SEASON!(J, K)
      NEXT J
   NEXT K
```

```
    DATA  0, -.47449, 6.336378, 8.499240, 8.088594, 1.542578, -.056989, 2.418863,
6.677163, 7.012230, 4.343870, 1.180761
    DATA  0,  2.922336, 1.358614, 4.434923, 7.20597, -.605582, -4.000521, -5.652796,
-3.235285, -.305363, -.230772, -2.306624

DO WHILE (NOT EOF(17))

   INPUT #17, IDYARD!, SEX, YEARCLS, MONTHCLS, CLSDAY, HEADIN!,
HEADOUT!, PAYWTOUT!, TOTDOL!, YARDAGE!, LBGAIN!, HEADDAY!, LBFEED!,
INWT!, CLSDATE!, PLCDATE!, PLCYEAR!, PLCMONTH!, PLCDAY!, UNITDAY1!

'   IF HEADIN! = 0 THEN LOOP



   IF SEX = 1 THEN
     SELECT CASE IDYARD!
     CASE 281038
     FEEDLOT! = 0
     CASE 281041
     FEEDLOT! = -21.290059#
     CASE 721017
     FEEDLOT! = -10.674616#
     CASE ELSE
     FEEDLOT! = -11
   END SELECT

   ELSE
     SELECT CASE IDYARD!
     CASE 281038
     FEEDLOT! = 0
     CASE 281041
     FEEDLOT! = -22.258613#
     CASE 721017
     FEEDLOT! = -16.217315#
     CASE ELSE
     FEEDLOT! = -12
   END SELECT
  END IF

   INWT! = (PAYWTOUT! - LBGAIN!) / HEADOUT!

   IF SEX = 1 THEN
      INTERCEPT! = 394.350441#
      UNITINWT! = -.429786#
      WTSQ! = .000141#
      TIME! = -.70029#
      TIMESQ! = .013498#
      K = 1
      DEATHINT! = .98562
```

```
        IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
        IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .003985
        IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = .003395
        IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = -.004529

        IF INWT! <= 550 THEN WTBAR! = 0
        IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .00804
        IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .003082
        IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .007696
        IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .007439
        IF INWT! > 950 THEN WTBAR! = .007242

  ELSE

      K = 2
      INTERCEPT! = 459.432623#
      UNITINWT! = -.6359#
      WTSQ! = .000275#
      TIME! = -.422317
      TIMESQ! = .010485#
      DEATHINT! = .9794274

        IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
        IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .007049
        IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = .008019
        IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = -.005064

        IF INWT! <= 550 THEN WTBAR! = 0
        IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .003356
        IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .008656
        IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .008505
        IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .007104
        IF INWT! > 950 THEN WTBAR! = .009954

  END IF
                                   ' THE FOLLOWING NESTED ARRAY
                                   ' IS USED TO CALCULATE PREDICTED
                                   ' DAYS ON FEED AND PREDICTED SURVIVAL.

     FOR J = 1 TO 12                     ' THIS INFORMATION IS THE WRITTEN
TO AN
```

```
      IF J = PLCMONTH! THEN                        ' OUTPUT FILE *-RUN.TXT WHERE
*=STATE ABBREVIATION.
         DUMMY! = SEASON!(J, K)
         TREND = (PLCYEAR! - 1986) * 12 + PLCMONTH!
         TREND1! = TREND * TIME!
         TREND2! = (TREND * TREND) * TIMESQ!
         INWTSQ! = INWT! * INWT!
         WT1! = UNITINWT! * INWT!
         WT2! = INWTSQ! * WTSQ!
         PREDICT! = INTERCEPT! + WT1! + WT2! + TREND1! + TREND2! + DUMMY!
+ FEEDLOT!
         PREDICT = INT(PREDICT! + .5)
         HEADSOLD = INT((HEADIN! * (DEATHINT! + SEABAR! + WTBAR!)) + .5)
         WRITE #27, SEX, PLCMONTH!, PLCDAY!, PLCYEAR!, HEADSOLD,
PREDICT, PLCDATE!, HEADOUT!, UNITDAY1!
      END IF
    NEXT J
LOOP          ' THIS STATEMENT CAUSES THE PROGRAM TO RETURN TO THE
BEGINNING
              ' OF THIS MODULE TO EVALUATE THE NEXT LINE OF DATA.

CLOSE #17, #27

' ***** END SOUTH DAKOTA*****************************************************


' ***** BEGIN TEXAS*********************************************************

OPEN "TX-C.CSV" FOR INPUT AS #18

   OPEN "TXC-RUN.CSV" FOR OUTPUT AS #28

  FOR K = 1 TO 2
    FOR J = 1 TO 12
      SEASON!(J, K) = 0       ' THIS SECTION RESETS THE ARRAYS
    NEXT J
   NEXT K


   FOR K = 1 TO 2            ' ARRAY FOR IDENTIFYING MONTHLY DUMMY
VARIABLES
     FOR J = 1 TO 12         ' STEERS=1 HEIFERS=2
        READ SEASON!(J, K)
     NEXT J
   NEXT K

   DATA  0, -.751518, -1.57464, 1.524746, 3.104273, 1.427966, .781276, 5.00215,
6.456665, 6.693970, 7.729220, 3.4433473
   DATA  0, -3.193573, -6.860499, -5.760175, -5.391952, -5.857264, -6.096851, .013063,
5.822381, 6.195470, 7.202386, 3.907755
```

```
DO WHILE (NOT EOF(18))

   INPUT #18, IDYARD!, SEX, YEARCLS, MONTHCLS, CLSDAY, HEADIN!,
HEADOUT!, PAYWTOUT!, TOTDOL!, YARDAGE!, LBGAIN!, HEADDAY!, LBFEED!,
INWT!, CLSDATE!, PLCDATE!, PLCYEAR!, PLCMONTH!, PLCDAY!, UNITDAY1!

'   IF HEADIN! = 0 THEN LOOP


    IF SEX = 1 THEN
      SELECT CASE IDYARD!
      CASE 150013
      FEEDLOT! = 0
      CASE 150035
      FEEDLOT! = -.587904
      CASE 150048
      FEEDLOT! = -1.362041
      CASE 150080
      FEEDLOT! = -2.387901
      CASE 150103
      FEEDLOT! = -4.535696
      CASE 150129
      FEEDLOT! = -.923541
      CASE 150147
      FEEDLOT! = -.241691
      CASE 150167
      FEEDLOT! = -3.924152
      CASE 150174
      FEEDLOT! = -15.230326#
      CASE 150189
      FEEDLOT! = -4.330902
      CASE 150192
      FEEDLOT! = 1.175778
      CASE 151089
      FEEDLOT! = .08108
      CASE 151128
      FEEDLOT! = 4.138491
      CASE 151146
      FEEDLOT! = 17.661391#
      CASE 151157
      FEEDLOT! = -.42591
      CASE 151166
      FEEDLOT! = 8.096594
      CASE 151173
      FEEDLOT! = 1.644205
      CASE 151210
      FEEDLOT! = 9.370442
      CASE 151227
      FEEDLOT! = 1.290295
```

```
  CASE 151245
  FEEDLOT! = -3.938321
  CASE 151256
  FEEDLOT! = -.668556
  CASE 151287
  FEEDLOT! = -.811667
  CASE 151319
  FEEDLOT! = -.946873
  CASE 151331
  FEEDLOT! = 2.370496
  CASE 151364
  FEEDLOT! = 2.937239
  CASE 151399
  FEEDLOT! = 6.904268
  CASE 151409
  FEEDLOT! = -1.7267
  CASE 151418
  FEEDLOT! = -1.720501
  CASE 151425
  FEEDLOT! = -2.450838
  CASE 152044
  FEEDLOT! = 4.139378
  CASE 152055
  FEEDLOT! = 3.62942
  CASE 152064
  FEEDLOT! = 1.016822
  CASE 152071
  FEEDLOT! = -7.545379
  CASE 152099
  FEEDLOT! = 12.983195#
  CASE 152143
  FEEDLOT! = -10.499065#
  CASE 153076
  FEEDLOT! = -8.864697
  CASE 153104
  FEEDLOT! = -21.275168#
  CASE ELSE
  FEEDLOT! = -.41
END SELECT


ELSE
  SELECT CASE IDYARD!
  CASE 150013
  FEEDLOT! = 0
  CASE 150035
  FEEDLOT! = 7.621061
  CASE 150048
  FEEDLOT! = -6.03065
  CASE 150080
```

FEEDLOT! = 4.601184
CASE 150103
FEEDLOT! = 1.689617
CASE 150129
FEEDLOT! = 5.799662
CASE 150147
FEEDLOT! = -2.272535
CASE 150167
FEEDLOT! = -.276889
CASE 150174
FEEDLOT! = -11.726664#
CASE 150189
FEEDLOT! = 1.034467
CASE 150192
FEEDLOT! = 2.198716
CASE 151089
FEEDLOT! = -5.739269
CASE 151128
FEEDLOT! = 5.336056
CASE 151146
FEEDLOT! = 16.596745#
CASE 151157
FEEDLOT! = -3.800182
CASE 151166
FEEDLOT! = 6.961307
CASE 151173
FEEDLOT! = 25.982379#
CASE 151210
FEEDLOT! = -4.00565
CASE 151227
FEEDLOT! = -1.479458
CASE 151245
FEEDLOT! = -.605614
CASE 151256
FEEDLOT! = -.454046
CASE 151287
FEEDLOT! = 1.131969
CASE 151319
FEEDLOT! = 2.647927
CASE 151331
FEEDLOT! = -1.096074
CASE 151364
FEEDLOT! = 13.162178#
CASE 151399
FEEDLOT! = 11.204992#
CASE 151409
FEEDLOT! = 11.327373#
CASE 151418
FEEDLOT! = 2.189886
CASE 151425

```
        FEEDLOT! = -11.422467#
        CASE 152044
        FEEDLOT! = 2.494563
        CASE 152055
        FEEDLOT! = 6.474861
        CASE 152064
        FEEDLOT! = -1.36377
        CASE 152071
        FEEDLOT! = -8.676299
        CASE 152099
        FEEDLOT! = 19.683988#
        CASE 152143
        FEEDLOT! = 10.424032#
        CASE 153076
        FEEDLOT! = -1.758469
        CASE 153104
        FEEDLOT! = -52.85669
        CASE ELSE
        FEEDLOT! = -2
     END SELECT
   END IF

    INWT! = (PAYWTOUT! - LBGAIN!) / HEADOUT!

    IF SEX = 1 THEN
        INTERCEPT! = 571.4719700000001#
        UNITINWT! = -.984199#
        WTSQ! = .00051#
        TIME! = .657738#
        TIMESQ! = -.006794#
        K = 1
        DEATHINT! = .977628

            IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
            IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .003776
            IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = -.000102
            IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = -.002416

            IF INWT! <= 550 THEN WTBAR! = 0
            IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .008324
            IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .013962
            IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .01584
            IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = .016408
            IF INWT! > 950 THEN WTBAR! = .01073

    ELSE
```

```
     K = 2
     INTERCEPT! = 585.627568#
     UNITINWT! = -1.080019#
     WTSQ! = .00059#
     TIME! = .542573#
     TIMESQ! = -.00682#
     DEATHINT! = .980133

        IF PLCMONTH! = 12 OR PLCMONTH! = 1 OR PLCMONTH! = 2 THEN
SEABAR! = 0
        IF PLCMONTH! = 3 OR PLCMONTH! = 4 OR PLCMONTH! = 5 THEN
SEABAR! = .003877
        IF PLCMONTH! = 6 OR PLCMONTH! = 7 OR PLCMONTH! = 8 THEN
SEABAR! = .0005144
        IF PLCMONTH! = 9 OR PLCMONTH! = 10 OR PLCMONTH! = 11 THEN
SEABAR! = .001392

        IF INWT! <= 550 THEN WTBAR! = 0
        IF INWT! > 550 AND INWT! <= 650 THEN WTBAR! = .0043355
        IF INWT! > 650 AND INWT! <= 750 THEN WTBAR! = .00752
        IF INWT! > 750 AND INWT! <= 850 THEN WTBAR! = .003129
        IF INWT! > 850 AND INWT! <= 950 THEN WTBAR! = -.00419
        IF INWT! > 950 THEN WTBAR! = .009537

   END IF

                                  ' DAYS ON FEED AND PREDICTED SURVIVAL.
    FOR J = 1 TO 12                   ' THIS INFORMATION IS THE WRITTEN TO

    IF J = PLCMONTH! THEN                 ' OUTPUT FILE *-RUN.TXT WHERE
                                          '*=STATE ABBREVIATION.
 DUMMY! = SEASON!(J, K)
        TREND = (PLCYEAR! - 1986) * 12 + PLCMONTH!
        TREND1! = TREND * TIME!
        TREND2! = (TREND * TREND) * TIMESQ!
        INWTSQ! = INWT! * INWT!
        WT1! = UNITINWT! * INWT!
        WT2! = INWTSQ! * WTSQ!
        PREDICT! = INTERCEPT! + WT1! + WT2! + TREND1! + TREND2! + DUMMY!
+ FEEDLOT!
        PREDICT = INT(PREDICT! + .5)
        HEADSOLD = INT((HEADIN! * (DEATHINT! + SEABAR! + WTBAR!)) + .5)
        WRITE #28, SEX, PLCMONTH!, PLCDAY!, PLCYEAR!, HEADSOLD,
PREDICT, PLCDATE!, HEADOUT!, UNITDAY1!
      END IF
    NEXT J
LOOP    '  THIS STATEMENT CAUSES THE PROGRAM TO RETURN TO
   '  THE BEGINNING OF THIS MODULE TO EVALUATE THE NEXT
'   LINE OF DATA.
```

```
CLOSE #18, #28

END
```

APPENDIX D

USER'S GUIDE TO THE PREDICTION MODEL

The purpose of this guide is to provide sufficient information to successfully implement the COF report prediction model. This model is designed to utilize supply data form both Professional Cattle Consultants (PCC) and the USDA monthly COF report to predict cattle on feed, placements, and marketings. Background information on supporting principles is provided where appropriate. It is suggested that the user read this guide before attempting to use the model.

Start-up of the Prediction Model

This section covers the procedure to first install the model. Additional sections will contain more precise information on the internal workings of the model both in structural and economic terms.

The user should note that the original copy of the model has been saved on a write protected diskette. This is to ensure that the original copy will be secure from any accidental changes. It is highly advised that the user make a copy of the original, save the original, and use the copy. The model is designed to be backwards compatible with Lotus 123 through version 2.01 or with other fully compatible spreadsheets. In addition, the model is compatible with Excel 4.0 with the exception that the Cntrl key is used in place of the Alt key to activate macros. The model may be run either from a floppy disk or a hard drive.

To load the model, simply retrieve it as one would any other spreadsheet. However, since the model is designed as read-only, the first time that it is retrieved the user must designate a different name to the file before saving.

Overview of the Model

The objective of the this model is to project the monthly COF report using PCC data. The data requirements are PCC data by state for cattle on feed, marketings, placements, and capacity. The model will internally be able to carry up to a ten year history of this information. The location of this data in the model is in cell locations Q5..AZ125.

Additionally, the model requires full knowledge of the past history of the monthly COF report. The model is internally able to carry up to ten years of this information. The location of this information is to the right of the PCC data.

The heart of the model consists of three prediction equations found in cells B27..D27. There is a separate prediction equation for estimates of cattle on feed, marketings, and placements. These equations were developed using SHAZAM (a micro-computer statistical package). The parameters of these equations can be found in Table 1 (internal to the spreadsheet). For programming purposes Table

1. also contains variables at the bottom that are updated as needed. These equations will be discussed in greater detail in a later section.

The model accepts data input in three different locations. The first location is in cells A11..B11 (home screen). These cells tell the program the current month and year. Only change these cells when you are ready to change time periods. To the right of the date cells is a cell called checker. Do not change this cell. It is for programming purposes only.

The next area for data input is in the update tables. This area can be reached by using the ALT-T macro. This area consists of two separate tables. The first is a table for PCC numbers. Enter the input in actual head. Press tab once to find the USDA table. These entries are in thousands of head.

The third area that the user may enter data is in the edit table. Since USDA numbers are periodically updated and/or a mistake may happen when entering either USDA or PCC data it was necessary to allow the program to "backup". This part of the program requires special attention and will be discussed in its own section.

Model Operation

As eluded to in the previous section, the user has three choices when using this model. The first choice involves a "what if"scenario. The reason for including this option is to allow the user to utilize prior experience with the cattle industry to examine what would happen if either some (or all) of the USDA or

PCC numbers entered in the Update Table were varied. Only the prediction for that time period would change. To run this option,the date counter must remain constant, but the user must change at least one entry in the Update Table (If no item is changed then the program will not run.). The ALT-P macro will run this option.This option may be run as many times as desired.

The second option involves adding a new month's worth of data. The user should first run the ALT-T macro to move to the update tables and then enter the data in the appropriate places. Then press the HOME key. This will take the user to the screen with the date counter. The user should change the date to reflect the current month and year. The model can then be run by pressing the ALT-P macro. This option will take more time to run than option one because the model is physically adding the new data to the internal data set and updating all appropriate cells.

The third option allows the user to "correct" the internal data set after a USDA revision or upon the realization that there was a data entry mistake in an earlier projection. This option involves several steps. The first step is press the ALT-E macro. This will take the user a set of directions for editing. After reading the directions, page down one screen to find cell location A230. The number of months back to edit should be entered into this cell.Then, by activating the ALT-A macro, the program will create a temporary data set. The user may then key through this temporary data set making the necessary changes. After the user is satisfied that all the necessary changes have been made then the model can be updated by pressing the ALT-C macro. This macro operates in a very similar fashion as the macro in option two. It will take longer to operate since, in effect, it must complete the same steps in option two for every month back that the user chose to edit. One word of caution is that the edit routine should only be used when it is desired to go back more than one month. If only the last month needs to be changed, then press ALT-T to reach the update tables.Make the necessary changes then activate ALT-P to obtain the revised estimates.

There are numerous help statements inside the program designed to assist the user and to avoid mistakes. If an area says Don't then it does so with good reason. A general set of instructions can be reached from anywhere within the model by pressing ALT-I. For directions on how to edit the data set press ALT-E. Specific areas such as tables will also have important comments pertaining to that area of the program.

For the program to work in the manner that it is designed, the automatic recalculation option must be turned off. When operating in the Lotus environment, this task is automatically taken care of whenever the spreadsheet is accessed. Should the program be converted into any other environment, then the user is advised to take note of this requirement.

Graphs

To assist in interpreting the results, the program allows the user to view a number of graphs. To view the graphs, press Alt-G. This will activate a macro that arranges the data to be graphed. The macro will require the user to select the graph to be viewed. This is done by using the arrow key to highlight the appropriate choice. After viewing the graph press return. The user may then reactivate Alt-G to view another graph or the more experienced user can use the /GNU keystrokes to select their choice.

The graphs that are automatically updated are annual views of USDA Placements, USDA Marketings, USDA On-Feed and a comparison of current USDA On-Feed with a year ago USDA On-Feed. Other graphs available are these same graphs for the entire time span. These graphs were included to give a visual perspective of how the model performed within the data series. It should be noted that this last set of graphs do not automatically update. Further graphic enhancements are straight forwarded and can be added as the need arises.

When using the ALT-G macro, the user is strongly advised not to escape out of the macro before viewing a graph. Because of the necessary structure of the program, such an action could cause the macro to inappropriately place a "Q" in the current cell pointer location. Additionally, some units (on the Y axis) may have to be adjusted when using this program in some other environment than Lotus 2.01. This is due to software differences and is not a function of the program.

Saving the Results

After the user is through, the model must be saved if the results are to be retained for use in the next period. The user may or may not wish to save the results of option one, but the results of option two and three should always be saved. The user must use a different name than the very first original file. Any acceptable Lotus naming convention is acceptable, but the user should select names that are meaningful in terms of usage. If the program is to be used in a different environment than Lotus, it is advisable to save the file with the WK1 extension so that it is readable by Lotus.

Principles Behind the Model

The object of the model is to predict the monthly COF report for the current month using both PCC and USDA data. As an illustration, the necessary steps to predict the November report will be given. First, run the ALT-T macro and enter the most current information on PCC numbers. If closeout information is being used then this would be the closeout report generated at the end of October. If telephone survey information is used then it should be the report generated at the beginning of November.

The USDA report that should be used is the report released in October. Therefore November's forecast can not be completed until the October report is available. The most current information in the October report will consist of September data except for Cattle on Feed (which will be October's beginning inventory). The USDA data to be entered includes September Placements, Marketings, and Disappearances, and October Cattle On Feed.

After entering the USDA data, press the HOME key. Move the cell pointer to A11 to be sure that the correct year has been entered. Then move to B11 and enter the prediction month--for the above example 11. Then activate the ALT-P macro and wait for the results.

Summary of Instructions

GENERAL USE

1. ENTER CURRENT YEAR AND MONTH IN A11..B11.
2. PRESS ALT T TO GO TO UPDATE TABLES.
3. TYPE IN UPDATE INFORMATION.
4. PRESS ALT P TO RE-ESTIMATE THE MODEL.
5. TO RUN ALTERNATIVE SITUATIONS REPEAT STEPS 2-4
6. BE SURE ORIGINAL NUMBERS ARE IN A SAFE PLACE FIRST (SAVE NEW NAME BEFORE MODIFYING).
7. SAVE MODEL AFTER FINISHING ALL CHANGES.
8. KEEP ORIGINAL COPY SAFE !!!!!
9 RUN ALT O TO EXAMINE DATA OUTPUT SCREEN.

EDITING DATA

1. RUN ALT-E MACRO. THIS WILL TAKE YOU TO A SCREEN OF DIRECTIONS
2. REFER TO USER MANUAL FOR ADDITIONAL INFORMATION.
3. TO AVOID ERRORS, YOU MUST SELECT AT LEAST TO MONTHS TO EDIT. IF YOU ONLY WISH TO EDIT THE LAST MONTH, IT CAN MOST EASILY ACCOMPLISHED BY MAKING THE APPROPRIATE CHANGES IN THE UPDATE TABLES USING THE ALT-T MACRO.

GRAPHICS

1. PRESS ALT-G AND SELECT THE GRAPH YOU WISH TO VIEW. NOTE THAT CURRENT MONTH OF ACTUAL USDA NUMBERS WILL BE BLANK.
2. THE LABELING ON THE Y-AXIS MAY NEED CHANGED DEPENDING ON3. ESCAPING OUT OF THE GRAPH MACRO W/O VIEWING MAY CAUSE A " PRINTED---PLEASE AVOID!!!!

HARD COPY

ONCE THE PROGRAM IS SET FOR THE PRINTER, A HARD COPY OF THE OUTPUT CAN OBTAINED BY PRESSING ALT-H

MACRO IDENTIFICATIONS

NAME	FUNCTION
\I	INSTRUCTIONS
\O	OUTPUT SCREEN
\P	UPDATE PCC AND USDA
\T	UPDATE TABLES
\E	MONTHS TO EDIT
\A	EDIT MACRO
\C	COMPLETES EDIT
\K	COEFFICIENT UPDATING MACRO
\H	HARD COPY OF OUTPUT SCREEN
\G	RUN ALT-G AND CHOOSE GRAPH OF INTEREST
\E	EDIT TABLE
\Z	CREDITS

DIRECTIONS FOR EDIT

1. TO EDIT THE DATA SET FIRST PAGE DOWN ONE SCREEN.
2. IN CELL LOCATION A231 (PAGE DOWN) ENTER THE NUMBER OF MONTHS BACK TO EDIT. BE SURE TO COUNT THE CURRENT MONTH AS ONE.
3. PRESS THE ALT-A MACRO. THIS WILL PREPARE A WORKING DATA TABLE FOR YOU TO EDIT.
4. PRESS PAGE DOWN (TWICE) TO REACH THE EDIT TABLE.
5. MAKE CHANGES IN EDIT TABLE. TAB RIGHT TO SEE USDA NUMBERS.
6. AFTER ALL CHANGES ARE MADE, PRESS ALT-C.
7. *** WARNING *** THIS MACRO IS TO BE USED ONLY WHEN EDITING MORE THAN THE CURRENT MONTH. IF YOU ONLY WISH TO EDIT THE CURRENT MONTH, USE THE DATE UPDATE TABLE (ALT-T) WHILE LEAVING THE MONTH CONSTANT.

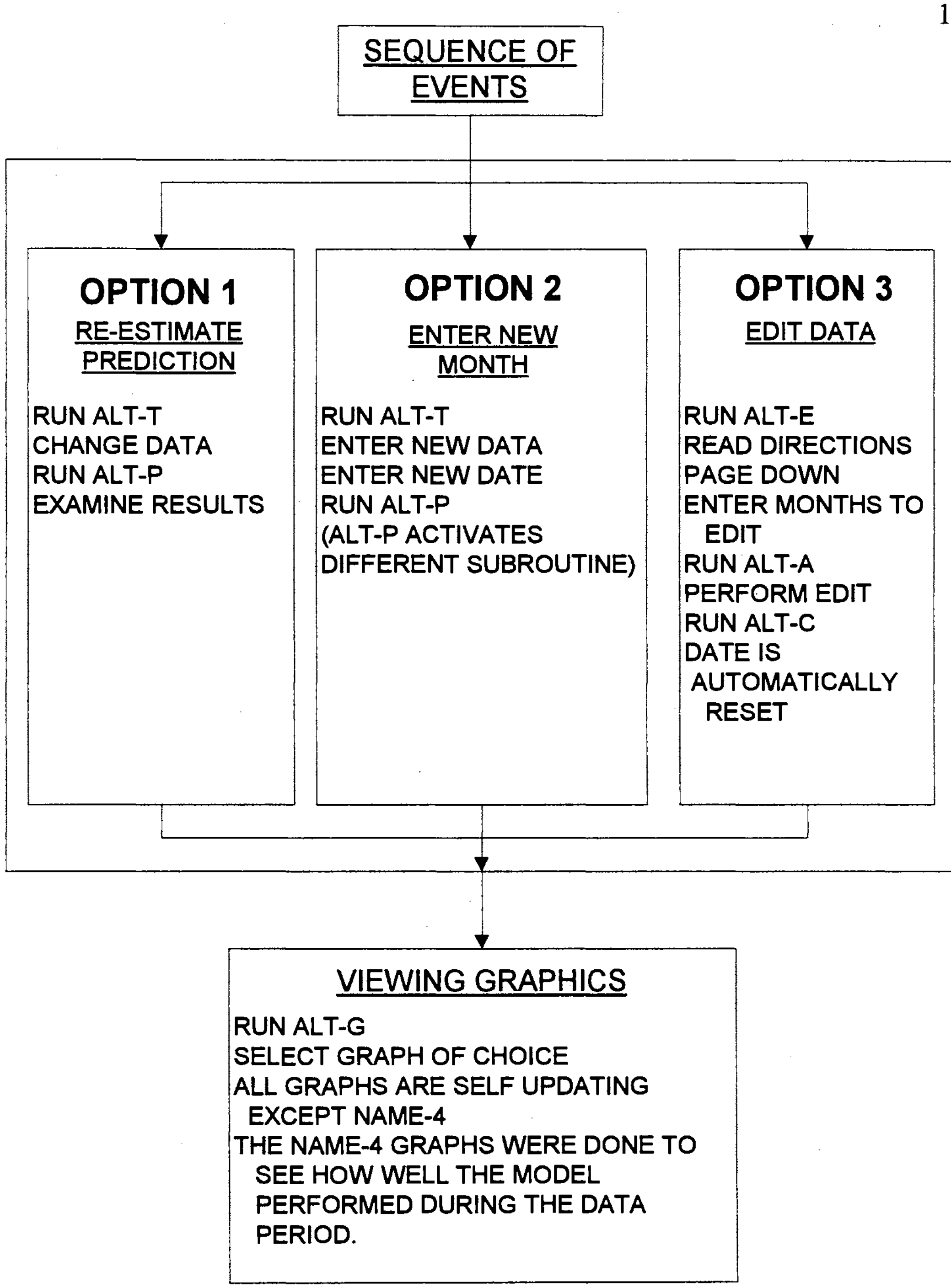

Figure 11. Sequence of Events

APPENDIX E

USER'S GUIDE TO THE SIMULATION MODEL

This appendix provides step by step instructions on how to prepare raw data from PCC's files into the feedlot simulation model. Also included is a description of the macros used in the simulation model along with the function of each macro. The appendix concludes with a discussion on interpreting the results. It is assumed the user has a working knowledge of spreadsheets along with an intermediate level of experience in macro development and interpretation.

System Requirements

The minimum suggested hardware requirements for the feedlot simulation model is a 486 DX-33 megahertz computer with at least 4 megabytes of ram. Additionally, it is advised that the system have at least 20 megabytes of hard drive space dedicated to the model and the results. Processing time will depend on how the data is organized (by states or merged after using the Quick Basic program), but generally performs about 700 observations (pens) per hour on a 386 25 megahertz machine. The speed on a 486 DX2-50 megahertz is approximately 5 times faster.

Data Preparation

Before data can be entered into the simulation model it must first be prepared by the Quick Basic program described in Appendix C. The Quick Basic program interprets the raw ASCII file developed by PCC's COBOL extraction program. Each line of the ASCII file is interpreted as a string variable. The purpose of the Quick Basic program is to convert the string variable into the appropriate alpha-numeric variables, perform the calculation for days on feed, and adjust for death loss. The results are then written out to individual state files. At this point, the state files can be merged if so desired, either through the disc operating system (DOS) or by editing the quick basic program to append each states output to the same output file. Otherwise, the result at this stage will be a comma delimited ASCII file for each state.

Importing Data to the Simulation Model

After preparing the data with the Quick Basic program, the next step is to import it into the feedlot simulation model. The simulation model should be fully compatible with Lotus 2.2 or newer, Quattro Pro 3.0 or newer, and/or Excel 4.0. The user is warned that the author has experienced substantial memory problems (accessing sufficient amounts of extended memory) using Lotus 2.2 and thus switched to the other spreadsheet packages.

To import data requires the use of the ALT-I macro (CNTRL-I in Excel 4.0). The macro may be either manually edited to identify the proper state to import or it may be edited by replacing the state abbreviation with "{}" which makes the macro interactive. An interactive version of the macro will simply require the user to input the file name to be imported after activating the macro.

The data must then be sorted. The advance macro programmer may wish to add this subroutine to the ALT-I macro. It was not done in the research phase because the author chose to manually review certain aspects of the data before proceeding. Namely neither the predicted days on feed nor the actual days on feed can exceed 365 days. A feeding length beyond this time horizon is unrealistic in terms of feedlot management and is most likely the result of a keypunch error in entering the raw data. In addition, the feedlot arrays in the simulation model are not designed to extend beyond 365 days.

Before the data is sorted, it is necessary to "tag" each month with a footer entry that occurs on the last day of the month. This is essentially an empty record. Its purpose is for internal data recognition to ensure proper posting in the monthly marketing results. The user is advised to keep this in mind when deciding whether to automate the sort procedure. After the data is "tagged", it must be sorted in ascending order by placement date.

Initializing the Feedlot Simulation Model

The user is advised to save the feedlot simulation model after the desired data set has been successfully imported. Before activating the model, it is necessary to reset three counters. The first is a numerical day counter. Its initial value should be set to -1. The second counter is a pen counter. The purpose of this counter is to keep a running total of the number of pens simulated. Thus, by knowing the number of rows of data imported, one can immediately determine the progress of the model. The pen counter is also required internally by the simulation macros. The pen counter should be reset to zero. The third counter requires the user to enter the date of the first placement by month, day, and the last two digits of the year in three separate cells.

If this is a continuation of a data set, the feedlot arrays should already contain the volume of future expected marketings by sex and total. By examining the depth of an individual observation in the array, one can immediately denote the number of days before the expected marketing date and thus have a fluid inventory of the volume of cattle on feed. In addition, if this is a continuation of a data set, the marketings output arrays will allow one to see the prior history of marketings.

If this is a new trial, both the feedlot array and the marketings array should be erased. In addition, the monthly summaries of expected marketings should be erased (numerical values only--do not erase the header!).

Activating the Feedlot Simulation Model

After all the counters have been reset, the model is ready to be activated. If using PCC Section C data, the user will have two options; simulating predicted marketing or simulating actual marketings. The purpose of simulating the actual marketings is that this was found to be the most cost effective method of studying the true historical flow of cattle throughout the feedlot process.

To simulate predicted marketings, the user should activate the ALT-Z macro. The ALT-S macro activates the simulation of actual marketings. The user should note that both macros make use of the same holding cells or reference cells for the incremental addition to the feedlot array. This is not a conflict in that both macros can not operate simultaneously.

If the user first simulates predicted marketings and the actual marketings, then the pen counter and the day counter must be reset before activating the second macro. However, there is a conflict with the feedlot arrays. Theses arrays are not designed to accommodate both predicted and actual feeding horizons. Modest program enhancement could overcome this limitation by adding another set of columns (3 in total) and by updating the appropriate reference cells. To avoid this complication, the user may prefer to either keep a separate set of files for predicted and actual days on feed (or extractions of the appropriate sections).

Interpreting the Results

After the simulation model is finished, the user should first save the file. If the user chose to model each state separately, then the output (the feedlot arrays, the future expected marketings, and the marketings output) should be combined. The future expected marketings can then be utilized with the private data forecasting model for the marketings component of the COF report. Both the feedlot array and the expected marketings can then be utilized to develop historical patterns of expected marketings versus actual marketings along with the expected future pattern of marketings. In addition, after correcting for the data issue discussed in Appendix A, this information can be aggregated to provide showlist information.

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