Determining Optimum Marketing Endpoints for Feedlot Cattle

Joseph. P. McMeniman, M.S. Ph.D.
Consulting Nutritionist
Nutrition Service Associates

The objective of this paper is to review methods available to determine the optimum days on feed for individual groups of cattle entering the feedlot. Days on feed, is simply a descriptor of the time an animal is in the feedlot and fails to describe a specified carcass endpoint and profit/loss potential. Numerous environmental, animal, dietary, economic, and management factors interact to determine ultimate days on feed an animal remains in the feedlot (Figure 1).

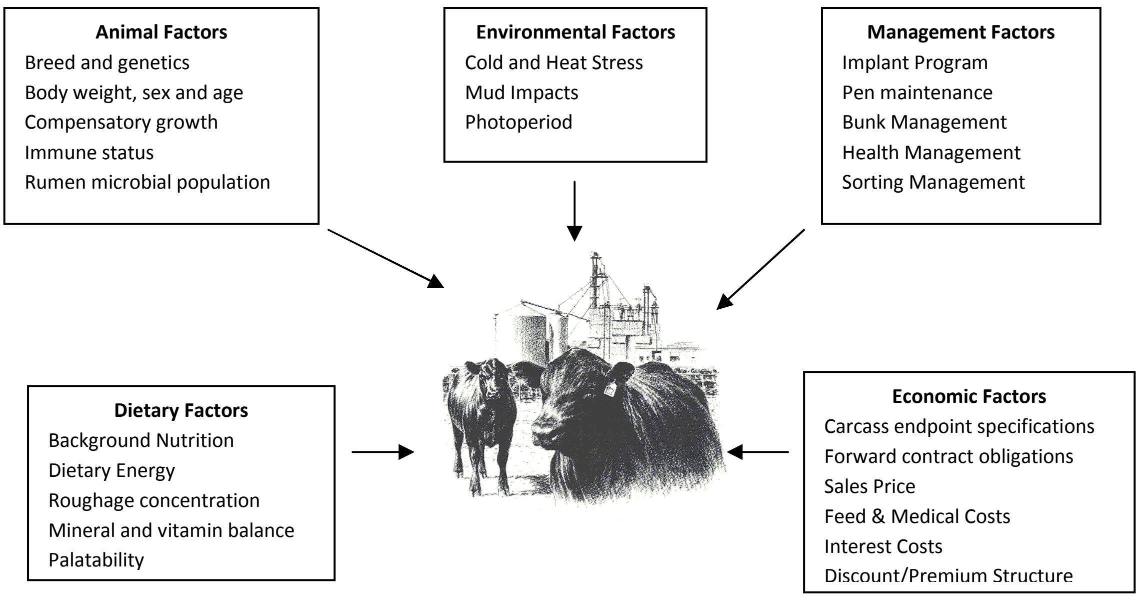

Figure 1. Factors that interact to determine days on feed of cattle in the feedlot

What is the Optimal Endpoint for Feedlot Cattle?

Individual cattle management systems are based on the concept that individual cattle should be slaughtered when their incremental carcass cost of gain exceeds their sales price, within the range of acceptable carcass characteristics specified by the target market. Put simply, when the cost to put an extra kilogram of hot carcass weight exceeds the price you will get for that kilogram, the animal or pen should be sold, maximising profit.

Cattle can be sorted at feedlot entry, re-implant (may occur in cattle fed > 120 DOF), or prior to exit from the feedlot. Key goals of any sorting program include:

1. Maximising pen space utilisation
2. Maximising saleable weight gain from a lot of cattle
3. Minimising any potential discounts
4. Meeting forward contract obligations on a weekly basis
5. Compliance with drug withholding periods
6. Compliance with minimum DOF requirements for GF or GFYG accreditation

Sorting systems in Australia are relatively basic. At the simplest level, sorting of cattle involves weighing cattle 1-14 DOF prior to scheduled exit date. Based on body weight and an estimated historical dressing percentage, cattle are sorted into marketing groups. Some companies managing cattle as groups may sort on weight or biological type at induction and send the entire group to slaughter on one date.

In the United States, a survey of 29 Consulting Nutritionists conducted by Vasconcelos and Galyean (2007) indicated approximately 41.4% of respondent's clients sorted cattle into outcome groups. Sorting on body weight at induction and re-implant was the predominant method. A shift to grid marketing of carcasses in the US in recent years has raised interest in ultrasound and carcass composition prediction systems. The aim of this paper is to review current technologies available to optimise profit endpoints of groups of cattle. These include:

1. Modelling of performance based on historical closeout data
2. Cornell/TAMU Cattle Value Discovery System
3. Ultrasound prediction systems

<u>Composition of Body Weight and Carcass Gain</u>

As an animal matures, fat deposited in body weight gain increases in comparison to protein deposition (NRC, 1996). Protein is deposited with water which increases rate of gain early in the feeding period. As fat is hydrophobic and repels water, rate of body weight gain decreases as the animal approaches maturity. Despite the fact that body weight gain appears to decrease with increasing days on feed, carcass weight gain remains constant due to deposition of subcutaneous and intramuscular fat in the carcass (MacDonald et al. 2007). Dressing percent thus increases with days cattle are in the feedlot (Bruns et al. 2004). The practical limits of dressing percent are dictated by higher cost of gain and increased discounts that can be achieved as cattle exceed their specified carcass endpoint, primarily from over-fat or over-weight carcasses (Bruns and Pritchard, 2010). Feedlots should develop historical datasets to model the effect of dressing percent with over a range of hot carcass weights.

<u>Historical Closeout Data</u>

Prior to purchasing cattle, feedlot managers should have an accurate prediction and understanding of the effects that market category, breed, initial weight and seasonal effects may have on the potential closeout results. Purchase breakeven and Profit/Loss projection should be conducted on all feedlot cattle entering yards. Below in Figure 2, seasonal relationships by entry month in feedlot performance are examined for bullocks (100 to 120 DOF) from a feedlot in Northern Australia. It can be noted that entry weight and season of entry has a significant effect on performance.

Entry weights are highest in cattle entering the feedlot in autumn. These cattle are typically forward in body condition after coming off a high plane of nutrition over summer, with increased body weights and maintenance energy requirements. These cattle typically have lower dry matter intake, average daily gain and feed efficiency. The effects of heat stress events, autumn health challenges and decreasing photoperiod length are also possible reasons for the slide in performance from January to June.

Dry matter intake of cattle is typically stimulated in the second half of the year leading to increased ADG of cattle. Expanding photoperiod and favourable environmental conditions favour this response. Cattle entering the feedlot in later winter and spring are typically of lighter initial body weight and are in backward store condition, and typically have some degree of compensatory gain.

The effect of initial weight on feed efficiency for this feedlot is modelled by simple linear regression in Figure 3. It is obvious that initial body weight has a significant effect on feed efficiency. It should be noted that data presented in Figure 3, is unadjusted for effects of year of entry and breed. Entry of these factors into the regression model would be expected to improve the strength of this relationship considerably. The effects of entry weight on feed efficiency can be related to higher dry matter intake for maintenance requirements of heavy entry weight cattle, and a composition of gain which favours fat vs. protein deposition in animals that are approaching their mature body weight.

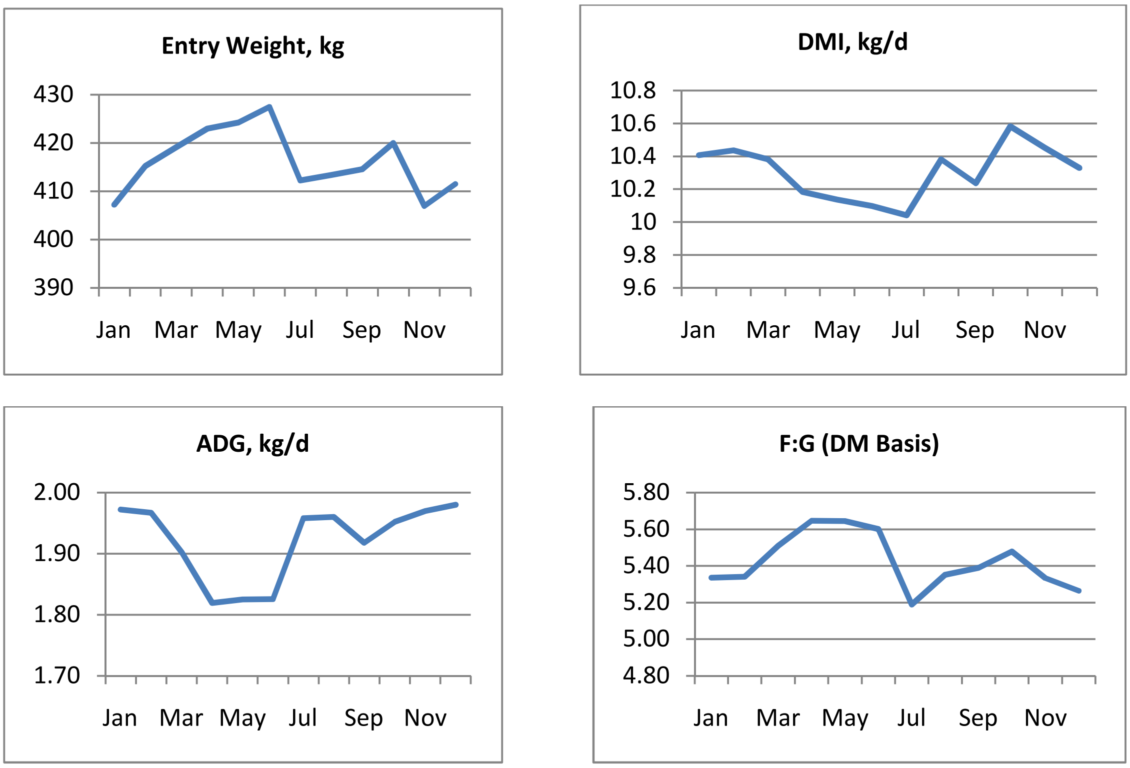

Figure 2. Mean closeout performance of short-fed bullocks by month of entry in the feedlot

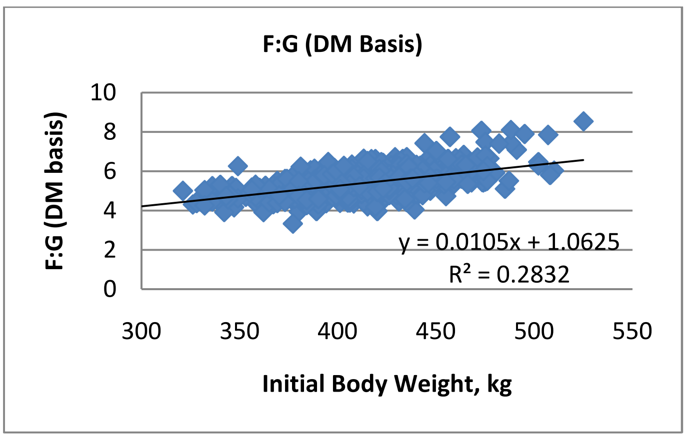

Figure 3. Effect of initial body weight on feed efficiency of short-fed bullocks

A question you may have is how do you as a feedlot manager integrate all these seasonal relationships for cattle at your location over a range of initial body weights? For feedlots that collect historical closeout data, it is possible to model performance through General Linear and Mixed Model Regression analysis. This enables simple performance calculators to be generated for individual feedlots. Incorporation of genetic data into such models in future years is likely to greatly improve the accuracy and precision of model predictions. This enables feedlot managers to have some confidence in break-even and profit loss calculations.

Cattle Value Discovery System

The Cornell/TAMU Cattle Value Discovery System as outlined by Tedeschi and Fox (2010) is the most current individual cattle management model utilised in the United States to predict carcass growth, composition and incremental cost of gain. The model is based on adaptations of the NRC (1996) Beef Cattle Growth Model. Micro Beef Technologies - ACCU-TRAC® Electronic Cattle Management System and Performance Cattle Companies - Cattle Classification and Sorting System™ utilize the CVDS model as a key component of their sorting systems.

With these sorting systems, cattle are commonly sorted either at induction or re-implant (50 – 80 days) into common marketing endpoint groups (typically 2 – 8 groups). For the model to work effectively a number of events need to occur:

1. *Accurate measurements :* accurate and consistent recording of body weight and/or frame size dimensions is essential. Animals should be quietly handled, scales should be clean, accurate and calibrated on a routine basis. Animals should also be weighed at a consistent time each day else digestive tract fill has the potential to bias calculations. Accurate and consistent diet composition and feed delivery are needed.

2. *Dry matter intake:* accurate prediction is essential to predict gain in feedlot cattle. DMI can either be predicted by the NRC (1996) model or equations developed from historical closeout databases. Research by McMeniman et al. (2009, 2010) indicates that DMI prediction equations developed from commercial feedlot databases may contain less mean and linear prediction bias than NRC (1996) equations. Daily dry matter deliveries and medical costs can also be inputted into these models to give daily updates of projected incremental cost of gain of feedlot pens, to determine when profit endpoints have been optimised. One of the biggest problems the US feedlot industry faced when implementing these models was billing of feed accurately with mixed lot pens of cattle, so as to obtain accurate closeout data. Whilst in Australia it is commonly accepted to use a weighted average to apply feed to individuals in sorted lots, the CVDS model takes a different approach. The CVDS model uses final body composition and weight to iteratively calculate dry matter intake. Guiroy et al. (2001) and Bourg et al. (2006) reported that the CVDS accurately allocated the feed to commercial feedlot cattle with bias of less than 1 and 2.43%, respectively.

3. *Final body weight at target body composition:* the NRC (1996) shrunk weight gain equation relies on the specification of a final shrunk body weight at a target compositional endpoint. Much of the hard work in developing these models revolves around developing prediction equations based on frame size, body dimensions, implant programs, and ultrasound measurements to predict this body weight. Once accurate estimates of final SBW and ADG are obtained, days to

reach a specified target endpoint can be projected. Cattle can then be sorted in potential marketing groups e.g. early, medium and late maturing groups.

4. *Diet Net Energy for Maintenance (NEm) and Gain (NEg)*: accurate dietary energy values are needed for accurate prediction of shrunk weight gain and dry matter intake. Some commercial systems, back generate dietary NEm and NEg values from recent closeout data, to re-calibrate the model on an ongoing basis and update performance calculations.

5. *Adjustments to maintenance energy requirements:* adjustments to maintenance energy requirements are applied due to different breeds, cold and heat stress.

6. *Carcass Composition Changes over the feeding period:* initial carcass composition needs to be predicted along with the accretion of subcutaneous and intramuscular fat. Changes in dressing percent, empty body fat (EBF) content and USDA Quality and Yield Grade are modelled. The CVDS model relies on a defined relationship between USDA Quality grade and EBF content with cattle reaching low Choice grade at approximately 28% EBF (Guiroy et al. 2001).

The CVDS model has been evaluated under commercial feedlot conditions. Evaluation of the CVDS by Tedeschi et al. (2004) indicated the model explained 83% of the variation in observed body weight at actual days fed with a bias of -1.0%. Garcia et al. (2005) reported the evaluation of the Cattle Classification and Sorting System (CCSS) which utilises aspects of CVDS. The study involved 12,874 steers at a commercial Texas Panhandle feedlot that were either sorted at reimplant via the CCSS into early, medium and late finishing pens or returned to their pens unsorted. Sorted pens returned $9.03 more per head, due heavier final (8 lb) and carcass (5 lb) weights, compared to controls. Discounts were decreased as overweight carcasses (>950 lb) were reduced by 42%, and yield grade 4 and 5 carcasses were by 23%. Investigation of sorting cattle on weight at reimplant vs. the systems based on CVDS is needed to determine its true value, as sorting on body weight may be just as effective as sorting on days to finish at a lesser cost.

<u>Ultrasound Models</u>

Ultrasound can obtain estimates of Ribeye area, marbling score and backfat thickness. Extensive work on developing ultrasound models for sorting feedlot cattle has been conducted by John Brethour at Kansas State University (Brethour et al. 2000), and is now marketed commercially by Cattle Performance Enhancement Company (CPEC). Micro Beef Technologies - ACCU-TRAC® Electronic Cattle Management System also combines ultrasound to predict carcass accretion with aspects of the CVDS model to predict incremental cost of gain. The CPEC prediction model projects the most profitable, optimum outdate for each individual and automatically places them into a pre-set marketing group with cattle of similar carcass projections. A trained technician can sort up to 100 head per hour. The model is based on a series of accretion curves for backfat and intramuscular fat (See Figure 4). Ultrasound is typically conducted at reimplant or prior to harvest. The closer to harvest images are taken to slaughter, the more accurate indication they are of true carcass composition (Brethour, 2000; Williams, 2002). Correlations coefficients of greater than 0.82 have been detected for marbling and 0.90 for back-fat thickness (Brethour, 1990; 1992). Basarab et al. (1999) evaluated the CPEC sorting system in two Alberta, Canada, feedlots. The CPEC-sorted steers gained faster, had increased carcass quality grade, and a reduction in over-fat carcasses. Overall profitability was increased by $15.22 per steer in one feedlot and by $27.67 per steer in the other feedlot.

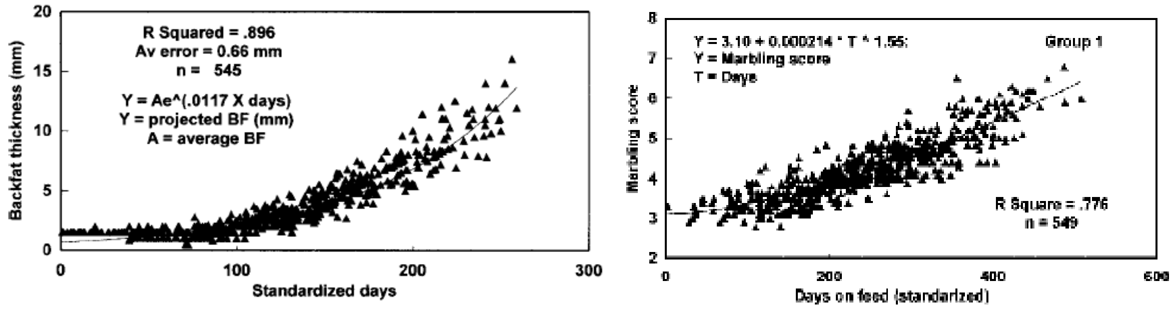

Figure 4. Exponential fit of backfat accretion and power fit function of marbling accretion of serial ultrasound measures as function of days on feed (Brethour, 2000)

Further examination of the utility of ultrasound in Australian feedlot systems is needed. To date no ultrasound systems have been designed to accurately determine marbling score in long-fed wagyu cattle.

Conclusions

A number of systems are available to predict feedlot cattle performance, carcass composition and incremental cost of gain to optimise profit endpoints for feedlot cattle. With any modelling technique or ultrasound technology it is important to realise that these technologies will never be 100% precise and accurate. Their usefulness lies in their ability to assimilate, integrate and process the large amount of information interacting to determine feedlot cattle performance and profitability. If they return value in excess of that provided by the human brain and eye when sorting cattle then they may be useful. With some abattoirs beginning to grade cattle on red meat yield, further effort will need to be placed in developing systems to predict and sort animals based on predicted red meat yield. Feasibility and return on investment of various sorting systems needs to be determined under Australian operating conditions.

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