MANAGEMENT FACTORS THAT CAUSE VARIATION IN FEEDLOT CATTLE

Robbi H. Pritchard, Ph.D.
Department of Animal and Range Sciences
South Dakota State University, Brookings

INTRODUCTION

The theme of this session is variation, which we can think about as variation in outcomes or as variation in inputs. To be relevant to production, we eventually will need to connect the two and determine whether variation in inputs contributes to variation in outcomes. Cattle feeders are acutely aware of the importance of variation in inputs. Variable weather and genetics of incoming cattle are generally recognized as primary contributors to unintended outcomes. Feedlot management can work to temper the impact of weather and genetics but has no true control over those inputs.

The conventional wisdom regarding inputs over which feedlot management has control is to be consistent. Being consistent means minimizing variation. We know that a singular change can alter outcomes in a favorable or unfavorable fashion. A diet change may boost intake. An overfeeding mistake can, at a minimum, cause intake depression or go as far as resulting in mortalities. We operate under the presumption that a singular change does not appreciably contribute to variation in outcomes but that repeated changes result in adverse outcomes.

We are oriented toward looking at averages. We usually give little thought to how variation may be involved. When the percentage of Choice carcasses from a pen is above or below the feedlot average it is atypical to evaluate whether a change in distribution of carcass grades had occurred. Instead, we fall back to making presumptions about a singular change event that may have altered the outcome. The objective of this essay is to reiterate the importance of the conventional wisdom of cattle feeding to be consistent and strengthen the connection that has with managing variation.

IMPACT OF VARIATION

The short section on feeding corn to cattle in Henry and Morrison's Feeds and Feeding (1928) is a must read. Without using the term variation, it is the underlying principle for everything they saw need to address. While the mechanics of cattle feeding has changed since that writing, the underlying principles remain the same. The following sections basically follow the Henry and Morrison template of important considerations.

Feed Schedules. The simplest variable for management to evaluate is the time when cattle are fed. Mumford (1908) writes, *"Cattle should be fed at certain hours and in the same way. This cannot be varied 15 minutes without some detriment to the cattle. The extent of injury will depend upon the frequency and extent of irregularity..."*. We looked at this by acquiring actual feeding times from a farmer feeder, then mimicking those times when feeding yearling heifers. The control treatment was fed on the routine feed schedule for the research feedlot. In this small pen (8 hd/pen; 4 pens/TRT) environment where bunk space was not limiting, inconsistent feeding times over 137 d reduced ($P = 0.07$) ADG (4.15 v. 3.98 lb) without affecting DMI (23.08 v. 22.84 lb) or feed/gain (5.56 v. 5.74). During the last 40 days on feed, the ADG of variable time feeding was 9% lower than for controls ($P = 0.08$). Morning feeding times (military time ± St. Dev.) in this study were similar at 0828 ± 0.58 and 0808 ± 0.47. The disparity in feeding times as indicated by the standard deviation really only occurred with afternoon deliveries of 1619 ± 0.26 and 1653 ± 0.71. In large commercial pens where < 50% of cattle can be accommodated at the bunks at once, one would expect behavioral problems associated with aggressiveness that would exacerbate performance depression and increase the potential for other problems related to aggressive behaviors.

Feed Quantities. We know a little more about managing the quantity of feed deliveries. This aspect of bunk management has been evaluated in several ways. Prescriptive feeding that by design limits day to day fluctuations, results in improved feed efficiency (Sainz, 1997; Plegge, 1986). When day to day fluctuations are imposed on cattle, feed efficiency worsens (Galyean, et al., 1992). We (Bierman and Pritchard, 1996) observed that using measured study responses rather than managing deliveries to match appetite also improved efficiency. The feed deliveries and cattle performance in this study are depicted in Figure 1. The percentages of pen days with no feed present in the bunks at 0700 were 69% and 40% for the steady and appetite driven deliveries.

In the case of feed deliveries, variation is not a simple parameter. Cooper, et al. (1998) reported that fluctuating feed deliveries was not deleterious to cattle performance. In one of two studies, they observed an increase ($P < 0.05$) in DMI when feed deliveries were intentionally adjusted up and down 3 $\text{lb}\cdot\text{hd}^{-1}\cdot\text{d}^{-1}$ relative to controls. However, there was substantial variation in deliveries to controls in that study (Figure 2). Study average day to day fluctuation in control feed delivery was 1 $lb \cdot hd^{-1} \cdot d^{-1.}$ This may have led to a completely different dynamic of feeding behavior in the treatment with imposed fluctuations.

Too little variation can also be a challenge. We reviewed our data base and looked at the frequency of calendar weeks where bunks were slick all 7 days. We then compared those frequencies with Quality Grades and found that very low variation brought on by managing feed deliveries too tightly was negatively correlated ($r^2 = 0.56$) to percent Choice.

Mix Integrity. I am not familiar with any mixer evaluations where faulty mixing was knowingly allowed to continue throughout finishing pens of cattle. Intuitively, we can deduce that deviations in roughage levels or ionophore concentrations from the beginning to the end of a load would affect performance. In our research facility we off-load each batch of feed to the same sequence of pens at each feeding. It quickly becomes clear from the intake records when roughages are not uniformly delivered. Other characteristics are more difficult to differentiate. We have one case where daily monensin intake was erratic due to inconsistent feed mixing and delivery patterns. In that backgrounding study we also had a diet where we provided monensin at a fixed daily rate as a supplemental feed. Monensin effectively increased ADG and reduced coccidia oocyst shedding when fed at a constant mg/d rate. Monensin was ineffective when fed in the complete diet that was associated with a calculated, erratic daily intake of the ionohore. At the end of the study, the average daily dosage of monensin did not differ between management approaches, but the standard deviation of daily deliveries did differ. Inconsistency brought about by management negated the efficacy of an effective technology.

In Figure 3, I have depicted the mean intake data for 5 pens of steers all in the same finishing diet. Also shown are two pens within this data set that had noticeably different feed delivery patterns. It is not clear what caused those differences. It could have been brought on by a single or repeated mixing error, a bias in mix uniformity, a feed delivery error, or an error in feed calls. What is clear is that these two pens deviate substantially from the average.

When intake patterns deviate from the norm as shown in Figure 3, we tend to think on a pen basis. In reality, we must also consider individual animal responses. In the course of digestive disturbance challenge experiments, Brown, et al. (2000) reported that some steers developed acute inappetance following a digestive insult and that other steers were unaffected. When intake within a pen is reduced by 20%, and we think on a pen basis, we are assuming all steers are consuming 20% less feed. That may be the response to some challenges like heat stress or monensin overdose, but it probably does not apply to variation that results in digestive disturbances. It is more likely that part of the population is unaffected, while others are now exhibiting substantially lower intakes. This would in turn inflate feed/gain for the pen and lead to more lighter, leaner, lower Quality Grade carcasses than if the insult had not occurred.

Identifying and quantifying the impact of deviations in the management of a pen requires having multiple pens of homogenous cattle, fed the same diet, started on the same date. Commercial feedlots do not have that luxury. Adding to the challenge in identifying sources of variation in feed preparation is that logistics prevent many commercial yards from using the same batch-delivery patterns within a day, let alone doing so over time. This prompts one to reconsider some of the concerns about disparity between small pen research and commercial cattle feeding. Perhaps the impact of the source and degree of variations that exist in cattle management are more clearly expressed in small pens or under research protocols, or are inherent (specific) to pen size. Something for both sides of that argument to ponder.

Ingredient Composition. The physical characteristics of feeds being mixed are not the only factors that create variation in batched feeds. Many commodities are loaded into mixers with payloaders. The first bias to emerge in these systems is to invariably miss by going over the targeted commodity weight. The second bias to emerge comes about because some ingredients are much more prone to coming out in large chunks than are other ingredients. The final bias I encounter is a high frequency of situations where the loader operator has not been provided with criteria to decide if errors are sufficient to cause a load to be out of spec.

At this level of quality control, moisture and CP content of feeds become contributors to variation as well as working to mask variation. Fluctuations in the moisture content of feeds impact the formulation and cost of the diet being fed on any given day. That cost difference in most situations appears only in inventory losses. Table 1 depicts the variation in an abbreviated list of samples collected weekly at our research feedlot July ’07 to June ’08.

The corn silage, sorghum silage, and high moisture corn were from one bunker each. Each assay for dry rolled corn and modified DGS represents a new delivery. Table 2 shows how the weekly drift in DM content of ingredients influences the diet formulation and price. Price variation was normally distributed for Diet B but not for Diet A. The CP content was not normally distributed for either diet. The variation depicted in these tables does not include variation originating from error associated with the actual amount of ingredients added to the mixer as each batch is prepared. We can anticipate that delivered feed had a larger CV and greater bias since problems associated with adding feeds to the mixer are not uniform across all ingredients.

Ingredient variation is likely one of the situations where small research pens and large commercial feedlots may differ. In our situation, a load of low crude protein content corn (Table 2) may be fed for a week. In a commercial feedlot it may affect only the morning feed delivery or be blended into inventory to where it becomes indiscernible. A second example from Table 2 relates to the mDGS. In controlled studies a single lot of the commodity may be acquired to complete a finishing cattle experiment. The potential influence of variable moisture content would not be a contributing factor in the outcome.

CONCLUSIONS

Our first challenge is to become familiar with capturing and evaluating variation from our data and records. When we do start down this line of quality control, the key sources of variation to target include ingredient composition, feed batching and mixing processes, feed calls-feed deliveries, and schedules. Circumstances differ such that the priority of these points is not common to all feedlots. In some instances we can identify relationships between inputs variation and adverse outcomes. In other instances providing such proof is problematic, but intuitively the relationships do make sense. We have virtually no good reference points that can help us identify a critical degree of variation for any aspect of cattle feeding management. As such, we can change management to yield a 50% decrease in variation, observe no response, and not know if it is because variation is still too great, or if variation was already adequately controlled. Besides not knowing critical levels of variation, we also do not know the characteristics of the response curves to improved or worsened degrees of variation. Combined, these limitations preclude having cost-benefit relationships, which are needed by management in order to justify changes in operations. This may be the single most important factor in affecting how management prioritizes dealing with variation in the feedlot.

TABLES

Table 1. Variation in FY08 feeds composition at SDSU research feedlot

n	Commodity		Mean	CV	Range
7	Corn Silage	DM	35.7	2.5	34.5 – 37.5
		CP	8.0	7.5	6.9 – 8.9
26	DRC	DM	85.6	1.0	84.4 – 87.4
		CP	8.2	4.3	7.7 – 9.0
19	mDGS	DM	50.1	6.7	44.5 – 61.2
		CP	29.1	4.2	25.4 – 31.4
22	Sorghum Silage	DM	39.9	8.4	32.2 – 45.3
		CP	8.9	7.6	7.6 – 10.3
18	HMC	DM	70.7	3.4	63.5 – 74.4
		CP	8.5	3.2	8.2 – 9.1

Table 2. Influence of compositional drift in ingredients on diets actually fed[a, b]

	Target	Mean	CV	Range
Diet A				
Sorghum silage, %	9.00	8.64	8.74	7.26 - 9.94
Whole shelled corn, %	36.00	37.08	1.65	36.26 – 38.19
High moisture corn, %	40.05	39.94	0.94	39.17 – 40.78
SBM, %	6.20	5.47	10.92	4.88 – 6.21
Corn germ, %	4.50	4.55	1.77	4.35 – 4.66
Supplement, %	4.25	4.32	1.21	4.25 – 4.44
DM, %	73	72.2	1.33	70.08 – 73.36
CP, %	12.7	13.05	4.74	12.47 – 15.08
Cost, $/T		227.29	0.67	224.54 – 229.29
Diet B				
Sorghum silage, %	9.00	8.39	9.93	7.17 – 9.88
Whole shelled corn, %	21.50	21.09	3.10	20.10 – 22.27
High moisture earcorn, %	42.75	43.69	3.35	42.20 – 46.23
Corn germ, %	4.50	4.42	3.74	4.18 – 4.72
DCGF, %	18.00	18.21	1.55	17.96 – 18.94
Supplement, %	4.25	4.20	3.50	3.98 – 4.45
DM, %	70	70.2	1.50	67.31 – 71.16
CP, %	12.5	12.25	1.05	12.08 – 12.51
Cost, $/T		195.83	0.66	194.31 – 198.77

[a] Weekly observations over a 14 week period.

[b] All values except DM are reported on a DM basis.

FIGURES

	ADG	DMI	FG
PI	3.84	23.57	6.15
Ad Lib	3.85	26.39	6.90

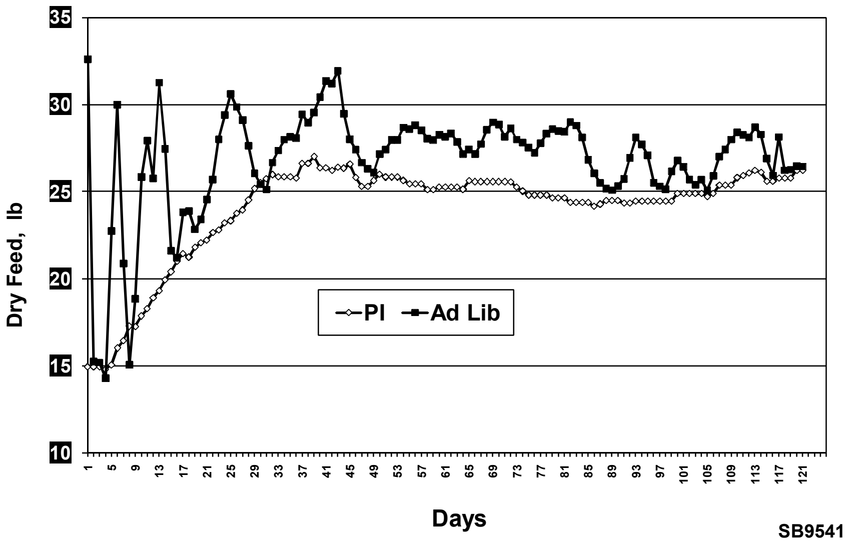

Figure 1. Daily feed deliveries (per head) for prescriptive (PI) and ad libitum (Ad Lib) approaches to bunk management. Bierman and Pritchard (1996)

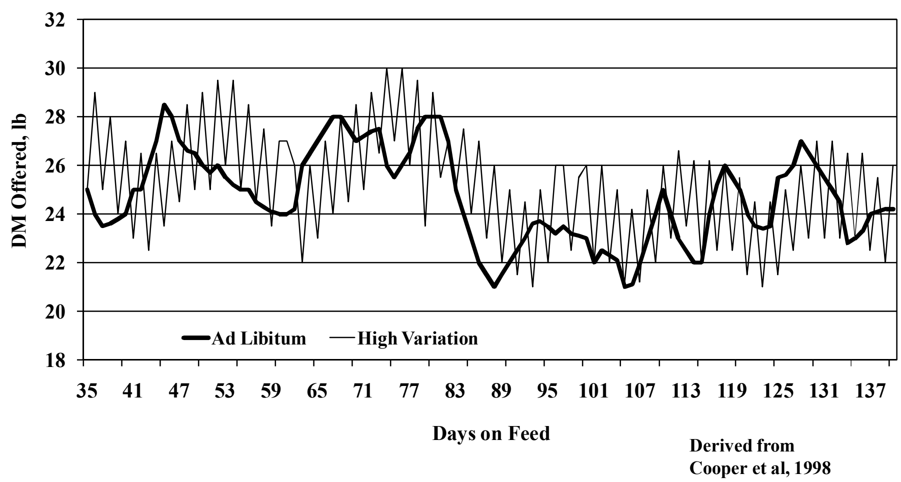

Figure 2. Daily feed delivery pattern for yearling steers and when deliveries were intentionally fluctuated ± 4 lb/head daily (High variation). Adapted from Cooper et al., (1998).

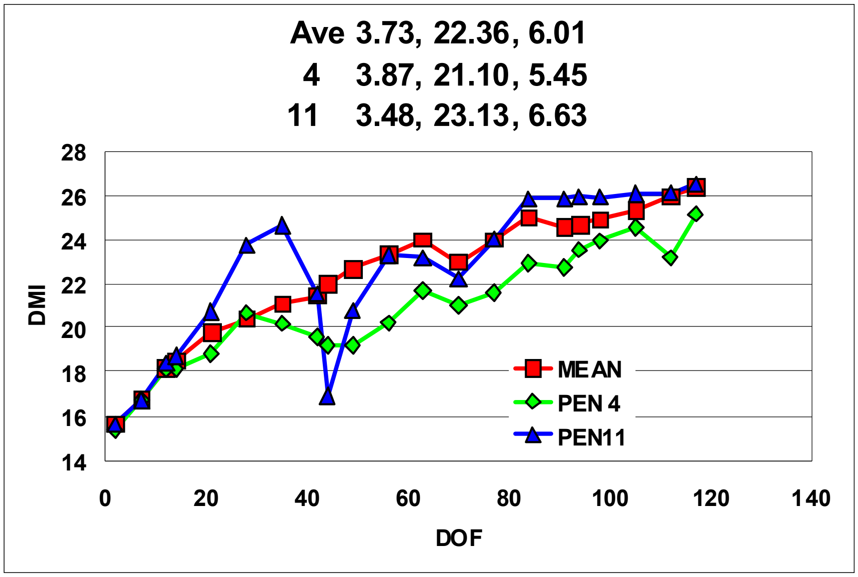

Figure 3. Daily feed delivery records for an average of 5 pens on a common treatment and for two outlier pens. Performance data are cumulative for the finishing period.

REFERENCES

Bierman, S. J. and R. H. Pritchard. 1996. Effect of feed delivery management on yearling steer performance. CATTLE 96-5. Pages 17-21 in SD Beef Rpt. SDAES, Brookings.

Brown, M. S., C. R. Krehbiel, M. L. Galyean, M. D. Remmenga, J. P. Peters, B. Hibbard, J. Robinson, and W. M. Moseley. 2000. Evaluation of models of acute and subacute acidosis on dry matter intake, rumial fermentation, blood chemistry, and endocrine profiles of beef steers. *J. Anim. Sci.* 78:3155-3168.

Cooper, R., T. Klopfenstein, R. Stock, C. Parrott, and D. Herold. 1998. Effects of feed intake variation on acidosis and performance of finishing steers. Pages 71-75 in Beef Cattle Rpt, Univ. NE, Lincoln.

Galyean, M. L., K. J. Malcolm-Callis, D. R. Garcia, and G. D. Pulsipher. 1992. Effects of varying the pattern of feed consumption on performance by programmed-fed beef steers. *Prog. Rpt No. 78*. Clayton Livestock Research Center, Clayton, NM.

Henry, W. A., and F. B. Morrison. 1928. Feeds and Feeding. Ithaca, NY: The Henry-Morrison Co.

Hicks, R. B., F. N. Owens, D. R. Gill, J. J. Martin, and C. A. Strasia. 1990. Effects of controlled feed intake on performance and carcass characteristics of feedlot steers and heifers. *J. Anim. Sci.* 68:233-244.

Mumford, H. W. 1908. Beef Production. Urbana, IL. Self-published.

Plegge, S. D. 1986. Restricting intake of feedlot cattle. Pages 297-301 in proceedings of 1986 Feed Intake Symposium, OK State Univ., Stillwater.

Sainz, R. D. 1995. Why does feed restriction improve efficiency? Pages 175-180 in proceedings of Symposium: Intake by Feedlot Cattle P-942. OK State Univ., Stillwater.