FEEDLOT DATA ANALYSIS: REPEATABILITY OF ESTIMATION OF THE VALUE OF VENDORS.

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SUMMARY

An index of traits was used to calculate the financial performance of steers fed at Rangers Valley Cattle Station. This performance was calculated relative to the average for steers fed between 1991 and 1994. From this the most probable financial performance was calculated for the vendors that supplied steers. The variance components of the vendor and vendor by entry year interaction were used to calculate the repeatability (42%) of the most probable financial performance and its component traits for vendors supplying steers. Repeatabilities for the component traits ranged from 12% to 43%. From the repeatability it was calculated that 6 years data (observations of annual vendor financial performance) are required to predict the most probable financial performance of vendors' (predicted producing ability) with 90% accuracy. This accuracy means that 80% of the potential gain from discriminating between vendors can be achieved with 6 years data compared to knowing the 'true' financial performance of vendors. The number of years data required to predict vendor most probable performance depends on the feedlot management's attitude to risk.
Keywords: Feedlot, repeatability, selection index, producing ability

INTRODUCTION

The feedlot industry has developed in Australia over the last 30 years and presently has the capacity to feed over 800,000 cattle. The medium to long term viability of feedlots is determined by grain and cattle prices. However once cattle are on feed, the performance of individual animals determines the actual profitability of the feedlot (McDonald 1993). Significant variation in steer performance has been found between vendors supplying a feedlot (Baud 1991; McDonald 1993; Baud *et al.* 1996). Feedlots have realised this and have compared vendors but, until recently, only in individual trials (AMH 1994; Baud *et al.* 1996). Some feedlots have begun statistically analysing their complete cattle data base to identify superior sources of feeder cattle for their production systems. We reported significant differences between vendor's most probable financial performance for Rangers Valley Cattle Station. Vendor most probable financial performances (least squares means) were distributed normally, with a mean $0, relative to all other vendors, and a standard deviation $60. The difference between the best and worst vendors supplying steers was $307 per steer supplied, averaged over at least 55 steers. The difference between the best and worst steers was $1490. However, a highly significant interaction between vendor performance and year was found. This paper addresses the question: how many years of data are required to predict a vendor's most probable performance?

MATERIALS AND METHODS

The records from 43,047 steers fed from 1991 to 1994 at Rangers Valley Cattle Station, Glen Innes, N.S.W. were examined. These cattle were supplied by 1030 vendors, were either Angus or Murray Grey or their crosses with Hereford or Shorthorn and ranged in age from 0 to 8 teeth when slaughtered.

The data set was restricted to 160 vendors who each supplied greater than 55 steers over the 4 year period. On average vendors supplied 63 steers per year excluding years when they supplied none. In total vendors supplied 25,117 steers for which financial performance could be calculated. Financial performance of each steer was calculated relative to the mean of all steers using a simple index.

$$\text{Financial Performance} = \sum_{i=1}^{n} a_i * (x_i - \bar{x}_i)$$

where a_i is the economic weight, x_i is the phenotype of a steer and $\bar{x}_i$ is the mean phenotype of all steers for trait i. The 6 traits used to value steers were dressing percent (%), carcass P8 fat depth (mm), eye muscle area (cm^2), marble score, daily gain (kg/day) and time on feed (days). The specific economic weights for each trait were estimated by the feedlot management and are confidential.

Vendor and vendor by entry year variance components were calculated for financial performance and each of the component traits. This was done using Restricted Maximum Likelihood with Proc Mixed (SAS Institute Inc. 1992). The model used for this analysis included breed, dentition (age at slaughter), entry season (Summer, Autumn, Winter, Spring) and entry year as fixed effects; entry weight as a covariate; and vendor and the interaction between vendor and entry year as random effects.

The repeatabilities (intra-class correlations) and standard errors for the financial performance and its component traits were calculated from the variance components (Becker 1985). In this study the vendor and vendor by year interaction variance components were treated as the between and within individuals variance components, respectively. The standard error of the repeatability was calculated using the arithmetic mean number of years per vendor (2.5). Given the repeatability, the accuracy can be calculated for a set number of years of data. Likewise the number of years of data required to calculate repeatability with a desired accuracy can be determined.

$$\text{Accuracy of Most Probable Performance} = \sqrt{\frac{n\,t}{1 + (n-1)\,t}}$$

where t is the repeatability and n is the number of years of data (Van Vleck *et al.* 1987).

RESULTS

The repeatability and accuracy of most probable performance for the traits are presented in Table 1. These range from moderate, for financial performance, dressing percent and carcass P8 fat depth, to low for eye muscle area, marble score, daily gain and time on feed.

Dressing percent, financial performance and carcass P8 fat depth are the most repeatable traits of vendors for this feedlot. Two years of data would predict vendor most probable financial performance with an accuracy of 77%. With 2 years of data the most probable financial performance of a vendor will be calculated with a weighting of 0.50. Consequently gain from discrimination against vendors using their most probable financial performance, calculated from 2 years of data, would be 50% of the potential gain if 'true' vendor financial performance was known.

The number of estimates of a vendor's performance (years data) have been calculated, given the appropriate repeatability, to enable the most probable vendor performance to be calculated for each trait with 90% accuracy. These are also presented in Table 1. To achieve 90% accuracy when calculating the most probable vendor financial performance requires 6 years of data for this feedlot.

Table 1. Repeatability, accuracy with 2 years data and number of years data required to predict most probable vendor performance with 90% accuracy for traits

Vendor trait	Repeatability (%)	Accuracy with 2 years of data (%)	Number of years of data to produce 90% accuracy
Dressing percent (%)	43 ± 5	78	6
Financial Performance ($)	42 ± 5	77	6
Carcass P8 fat depth (mm)	42 ± 5	77	6
Eye muscle area (cm^2)	28 ± 6	66	12
Marble score	24 ± 6	62	14
Daily gain (kg/day)	18 ± 6	55	20
Time on feed (days)	12 ± 6	46	32

DISCUSSION

The repeatability of the vendor most probable financial performance and its component traits vary from moderate for dressing percent to low for time on feed. The repeatability for each trait is a function of the proportion of temporary environmental effects compared to other effects on the trait, excluding effects that have been accounted for by the model. A trait with a low repeatability is influenced more by these temporary effects than a moderately or highly repeatable trait.

Dressing percent and carcass P8 fat depth, both moderately repeatable for vendors, can be measured consistently both within and between abattoirs. Temporary influences on these traits would include fat removal when the hide is stripped from the body and variation in visual assessment when deciding to send steers to slaughter.

Eye muscle area is a function of both the size and muscularity of a steer. Rangers Valley Cattle Station purchases steers of very similar type and ignores muscularity. They perceive muscularity as a measure of the hindquarter of a carcass and so place little value in visual measures of muscularity

(M. Foster, general manager, pers. comm.). Steers are slaughtered at an average 678 kg live weight, however this was found to vary from 500 kg to 900 kg. Such variation in turn off weight could produce variation in eye muscle area and so affect repeatability. It could be expected that although slaughter weight is controlled to some extent it could vary in response to market forces affecting time steers are kept on feed.

Marble score was 4 times more important than any other component trait for this feedlot and had one of the lowest repeatabilities. However, financial performance was moderately repeatable. This seems surprising given the importance of marble score. Temporary influences on marble score could be, at the vendor (breeding and nutrition), feedlot (feeding management) and at the abattoir (slaughter and chilling regime management). The latter, which can vary between abattoirs and within abattoirs, on weekly cycles, could be the major cause of these effects. This low repeatability seems to reflect the inability to measure and control marbling at all stages of beef production.

Daily gain and time on feed are influenced by weight, condition and backgrounding of the steers when they enter the feedlot, a function of the environment prior to feedlot entry. Temporary effects during lot feeding would also influence these traits. Within a group, variations in temporary effects during lot feeding would probably be small due to nutritional management. As mentioned, time on feed may vary to some degree as a result of market fluctuations.

The accuracy of prediction of most probable performance reduces as the repeatability itself falls. Whether 70%, 80%, 90% or some other level of accuracy is desirable must be determined by the person using the data and will reflect their attitude to risk and risk management. Thus the use of extra data when predicting vendor most probable financial performance is a trade off between risk and the cost of collecting and analysing the extra data.

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REFERENCES

Baud, S. (1991) *Proc. Aust. Assoc. Anim. Breed Genet.* 9:216.

Baud, S., Goddard, M. and Hygate, L. (1996) A sire evaluation system to improve the commercial competitiveness of Australian grain-fed beef. A summary of the Meat Research Corporation Project M.112. Meat Research Corporation.

Becker, W.A. (1985) "Manual of quantitative genetics." 4th Ed. Academic Enterprises, Pullman, WA.

McDonald, M.D.S. (1993) Undergraduate Dissertation, Department of Agricultural Economics, University of New England.

SAS Institute Inc. (1992) "SAS® technical report P-229, SAS/STAT® Software: Changes and Enhancements, Release 6.07." Cary, NC.

Van Vleck, L.D., Pollack, E.J. and Branford Oltenacu, E.A. (1987) "Genetics for the Animal Sciences." W.H. Freeman and Company, New York.