Profitability and performance – a critical perspective

When producers or researchers are trying to compare treatments or products, it is common to compare only physical production metrics such as average finished animal weight, average growth rates, feed conversion and comparative mortality, as examples.

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It is widely assumed that the trial or group achieving the superior physical production metrics will automatically be the winner in profitability.

A new look at production

We are urging a new look at these assumptions based on an understanding of how cost of production is affected by disease and how animals are valued in modern packer pricing schemes.

For simplicity and because in most cases it is not possible to measure things like individual animal feed consumption or daily growth rates, almost all production metrics are reported as an average for the entire group after the production process is closed and the animals are sold.

Because of this, the distribution of outcomes which make up the average are essentially hidden from the analysis. We know at the time of sale for finished animals, the range in weights within the group often approaches as much as 45kg. For those producers who can receive individual animal weights (usually carcase weights) at slaughter from the buyer, it is clear with a 45kg range, that the average sale weight is not a very good estimate of any single animal's weight in the group.

Regardless of strategies to market loads of animals from a single building on different dates to achieve a more uniform and profitable outcome, the effect of the underlying variation results in large variations in individual animal profitability.

Profitability is determined by gross revenue minus the cost of production. When we remind ourselves that each animal generates a profit outcome which taken together provides the total, we begin to realise that groups of animals, even with the same average weight, for instance, may produce very different revenue and cost outcomes.

On the revenue side, this is because most pricing schemes at slaughter plants offer premiums and discounts for heavy or light pigs. These net prices (base price plus or minus the premium/discount) are not symmetric about a mean weight. In some cases penalties for heavier than ideal animals are far more than the discounts for correspondingly light weight animals, in other cases it is the opposite.

So even if the distribution of animals marketed is normal or perfectly symmetric around a mean weight (which is extremely rare), it cannot be assumed that the heavier than average animal's revenue will offset the lighter than average weight animal's revenue. Because of this, taking an average weight and multiplying it by the average price offered that day will rarely equal the actual revenue received.

The effect of disease on individual animals in a group creates a similar problem on the cost side with relying only on average metrics like growth rates. When disease affects a group of animals, one typical outcome is loss of appetite and therefore slower growth rates.

However, most diseases affect individual animals in the group differently. Some will have more natural immunity or are located within the barn relative to where the disease entered so that they are less affected. Others will be severely affected and may die.

This range affect results in the distribution of growth rate, feed efficiency and other cost metrics to become more variable and often skewed so that the lighter weight tail of the distribution of weights elongates and is mirrored in the distribution of average daily gains and feed efficiencies etc.

The consequence of this is that the time frame required to achieve profit optimal market weights becomes much wider. Less affected animals finish faster, and the building must remain open longer to allow the slower growing animals time to gain value. If the farm is short on space, the building may need to be emptied at a certain date with the consequence of selling large numbers of lighter than ideal animals.

Trial results

We can demonstrate an example with a trial which was done comparing the efficacy of FLEXcombo (one dose of freshly mixed combination of Ingelvac CircoFLEX and Ingelvac MycoFLEX) and Circumvent PCV-M G2 (two doses).

It is common in trials comparing products or pharmaceuticals for all the animals to be sold at once either on a single predetermined date or at the attainment of a predetermined average group weight (the off-test date). While this type of protocol assures fair comparative production metrics it does not match the way US producers market animals and does not always accurately measure comparative profitability differences.

We illustrate why it is important to consider profit differences and employ

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typical producer marketing strategies even when common physical production metrics in comparative groups are essentially equal, as they were in this trial.

Data from 704 pigs, which had been randomly assigned to two treatment groups, FLEXcombo (hereafter T1) = 331 pigs; Circumvent PCV-M G2 (hereafter T2) = 333 pigs and a non-vaccinated control group of 40 pigs were examined. Animals were weaned at 21 days of age and placed in a 1,200-head wean-to-finish barn under similar conditions.

On trial day 1, group T1 and T2 were administered vaccine and on trial day 22, T2 received its second dose. All pigs were weighed on trial day 71 and trial day 154 at which time they were taken off test.

In the original published research, the authors report essentially equal average growth and equal average finished weight outcomes for both T1 and T2 treatment protocol groups. In addition, the same number of animals died in each treatment group by the completion of the study (17 head) and the culls differed by one animal resulting in statistically indistinguishable cull rates.

We create a stochastic, bio-economic profit optimisation model to test for profitability differences in the trial groups by simulating the typical marketing patterns of US producers and optimising the sale dates for three marketing groups to maximise profits and a common fixed cost per head. We determine the optimal marketing day for a topping load (first marketing; heaviest 16.67% of total group), a closeout load (middle group; next heaviest 66.67%) and a tail-end load, final 16.67%, the lightest weight animals.

Using actual individual animal weights from the trial, we fit weight distributions for T1 and T2 at day 71 and day 154 along with estimating four (polynomial) average growth curves (T1 Barrows, T1 Gilts, T2 Barrows, T2 Gilts) between days 71 and passing through day 154 weights.

From these average growth curves, we fit unique individual animal growth curves and forced their collective daily gains between day 71 and the optimal marketing day to be in correlation with the actual trial data.

The diet feed ingredients and finishing diet cost supported an average daily feed intake consistent with an average daily gain of 730.3g and average feed conversion ratio of 2.51 from 5.9 to 131.5kg. Feed ingredient prices were randomly selected from distributions fit to recent historical data with means: corn $123.38/MT; soybean meal/MT $344.93; and DDGS/MT $126.32 (dried distillers grains).

The animals were priced using a base price randomly selected from a distribution fit to recent historical hog prices with mean $64.03/cwt ($1.41/kg) in the carcase.

Premiums to base were determined using an actual US pricing grid (Schedule 111) anonymised and made publicly available through USDA Packers and Stockyards division.

Results

To avoid calculating the difference associated with different turn lengths, we forced the sale of both marketing groups when the first one reached optimal weight and assume finishing space was not competed for under 175 days.

The optimal marketing days were day 141 (tops), day 157 (closeout), day 175 tail enders. Profit was net -$0.16/head for T1 vs T2 for the topping load, net $0.59/head for T1 vs T2 for the closeout loads, and net $2.70/head for T1 vs T2 in the closeout. Weighted by animals sold per load, total advantage was net $0.814/head for T1 vs T2.

We did not increase mortalities beyond marketing day 154 as they were identical up to day 154 for each group in the original data. Differences in standard deviation of marketing weights which are influenced by disease and other factors can result in very different profit outcomes even when average weight outcomes are identical. ■

References are available

Fig. 1. Profit comparisons (blue is T1 and red is T2).