Graphical applications of lactation model residuals for monitoring health in dairy cattle

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Introduction

The lactation curves which results from fitting observed data points from individual lactations to the MilkBot® lactation model represent estimates of what milk production would be in the absence of all factors that cause short-term changes in production. This means that aggregated residuals, the differences between observed milk and model predictions, measure the result of short-term changes that are common to the group (such as feeding, health, and environment), while filtering out the effect of lactation stage and changes in group composition. In the context of a large data set covering thousands of herds over several years, residuals would be expected to show mainly the effect of season on lactation. In the context of an individual herd, patterns in residuals (less the component attributable to season), show the effect of herd management and local environment. For an individual lactation, patterns in residuals may reflect health events.

Materials and Methods

For several million lactations in herds over a large part of the eastern US, MilkBot® residuals were calculated for each test day, then both total milk and the MilkBot residual averaged by date. Calving pattern, which also has a large effect on mean milk, was also calculated. Mean milk, mean number of calvings by parity group, and mean MilkBot residual were plotted by date between July 2005 and July 2008. For individual herds, similar calculations were plotted in a customized bidirectional bar-graph format developed specially for this purpose

Results

Calving pattern appears to be responsible for about three-quarters of the variability in mean daily milk production, on a regional basis. There is also a fairly consistent seasonal effect, with amplitude of about 5.5 lbs (2.5 kg) for the region. A few anomalies in mean residual may be related to short-term weather patterns, such as a hot or cold spell large enough to affect much of the region.

For individual herds, plotting mean MilkBot® residual over time appears to be capable of separating effects of management from the effects of herd composition and stage of lactation.

Significance

Seasonal calving patterns and the shape of the normal lactation curve provide significant confounding effects to mean milk production as a measure of herd health. By analyzing MilkBot® residuals rather than raw production data, it may be possible to neutralize these confounding effects. Analysis of MilkBot® residuals seems to be a powerful strategy for focusing on short-term factors influencing milk production and increasing our ability to detect effects of management and environment on milk production.