



BY THE NUMBERS

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Predicting Heifer Pregnancy Performance

Updates to heifer pregnancy contemporary groups enhance genetic evaluation.

The heifer pregnancy expected progeny difference (HP EPD) predicts the probability of a sire's daughters becoming pregnant as first-calf heifers compared to other sires in the population. The information used for the prediction includes pedigrees, genotypes and HP phenotypes, which are a binary record indicating if a heifer was pregnant or open in that breeding season. Other information such as age at breeding, service sire and contemporary group are also used to account for nongenetic effects in the genetic evaluation.



Motivation

The HP EPD has been an important genetic selection tool for Angus breeders and their customers to improve heifer reproductive performance. Even with its success, as more phenotypic data becomes available, it is important to revisit each genetic evaluation model to ensure the most accurate EPD prediction possible.

Recently, the Angus Genetics Inc. (AGI) team conducted research on the HP evaluation model which led to a revision in the contemporary group definition.

This revised definition results in more accurate EPD predictions, and this update will be implemented with the next sire evaluation report

in summer 2024. Before diving into the details of these updates, it is important to understand well-structured contemporary groups are crucial for accounting for nongenetic effects in the HP genetic evaluation such as the breeding herd, year, season, technician and management conditions.

Contemporary group deep dive

When considering the HP contemporary group, it's essential to account for various factors. Factors such as the birth herd, year and season along with the management differences these heifers are bred to prior to the breeding season, have significant effects.

Other factors affect the heifers at the time of breeding, including the herd year and season those heifers are being exposed in. In addition, we also need to consider if those heifers were synchronized or not, as well as any other management grouping that might be taking place at that stage. It's important to note heifers could have multiple reproductive events, for instance multiple artificial insemination (AI) services, within a breeding season, but remain in the same contemporary group.

Let's look at an example. Imagine a group of heifers from the same herd were born in the winter of 2022. These heifers were raised under the same conditions and exposed to AI

for the first time in Spring 2024, which puts them in the same HP contemporary group.

As you can imagine, some of these heifers didn't get pregnant in their first AI, and the bulls were turned into the pasture after that. In this example, even though some heifers could become pregnant later in the season, they are still in the same HP contemporary group.

Within the same management conditions and the same breeding season (i.e., same contemporary group), some heifers will be pregnant while others will be open. This variability in the data is crucial, as it informs the prediction of the EPD.

Research leads to better definition

The complete data set in this investigation included more than 156,000 heifer pregnancy records, and more than 2.1 million animals in the pedigree, of which 1.4 million were genotyped. The goal was to investigate age differences among heifers in the same contemporary group. Although the heifer breeding age is accounted for in the model, if the age differences within a contemporary group are too large, it may indicate that heifers were born or bred in different seasons and should not be in the same contemporary group.

The season component of the contemporary group definition accounts for differences in the weather patterns and environmental conditions in a given herd and year. For example, heifers born in the fall will experience different environmental conditions as those born in the spring, which could affect their breeding outcomes.

The research showed adding heifer birth seasons alongside their

subsequent breeding seasons led to a better model fit. With that, it resolved a small number of contemporary group issues in which heifers with large age differences were showing up in the same group.

This update addresses both of these issues, ensuring the heifer birth and breeding seasons are being adequately accounted for, thus minimizing the age differences between heifers in the same contemporary group.

As a result of this update, some contemporary groups will change and some heifers will be moved to a new contemporary group. In some instances, this will result in a single animal contemporary group, and a small number of records will be removed from the evaluation as part of this quality control step, as single animal contemporary groups are not informative.

Model validation and EPD changes

To confirm whether the changes are improving the prediction of the EPD, it is common practice to do a validation analysis. Through this validation, we calculated both the prediction accuracy (P_ACC) and the bias (Table 1), which are indicators of the model's effectiveness in predicting the EPD.

It is important to note that prediction accuracy is not the same as the individual EPD accuracy. Both prediction accuracy and bias from a validation study are properties of the statistical model. For prediction accuracy, a higher value indicates better predictability, and for bias, a value close to 0 means unbiased predictions. Therefore, higher prediction accuracy and lower bias are preferred.

Although the current contemporary group definition


TABLE 1: Prediction Accuracy (P_ACC) and bias of the models, assuming the current and the new contemporary group.

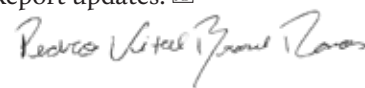
Model	P_ACC	BIAS
Current cg	0.30	0.10
New cg	0.34	0.06

does a good job in providing accurate and unbiased predictions, the new contemporary group definition adds value by providing both more accurate and less-biased EPDs. This brings a significant improvement in the HP evaluation and an overall enhancement in EPD predictions.

The correlation between the current EPDs and the EPDs from the new contemporary group was high (0.98). No substantial reranking in EPDs occurred, although individual changes in EPDs and accuracy will occur as some heifers may have changed contemporary group or their data is now being excluded as part of data quality control. Changes may also indirectly affect sires whose daughters have changed contemporary group.

Take-home message

The update in HP contemporary groups has enhanced the HP genetic evaluation. The correlation between the EPDs derived from the original and the new contemporary groups is high, indicating no substantial overall EPD reranking; even though individual animals may experience EPD and accuracy changes. Ongoing work on models is necessary to ensure the most accurate information is being delivered to the membership. The new contemporary group update is slated to go live in Summer 2024 with the American Angus Association Sire Evaluation Report updates. 


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