Measuring a Milk Response Lactation Models Add Power

J.L. Ehrlich, *DVM*[1]; **J.B. Cole**, *PhD*[2]; **D. Null**[2]
[1]*Dairy Veterinarians Group*
[2]*USDA Animal Improvement Programs Laboratory, Beltsville, MD*

Introduction:
Milk production is often the most important outcome variable in both field investigations and research involving dairy herds. Nutrition, health, and environment all have strong and rapid effects on milk production, but precise and unbiased quantification of such effects usually requires either matching of and controls by lactation stage and parity, or use of a lactation model to minimize the confounding effects lactation stage. Use of a model is often the only practical option, but little attention has been paid to measuring the precision and bias of lactation models, especially for individual lactations. An estimate expected performance is essential in choosing among competing lactation models for maximum sensitivity and specificity in detecting changes from normal milk production, and in power calculations.

Materials and Methods:
The MilkBot lactation model was compared to the current ICAR approved Best Prediction methodology the older DHIA Test Interval method, for accuracy in projecting future milk production in individual lactations. An additional "Null Model" was also included, which simulates the assumption that lactation stage does influence milk production. Up to a hundred thousand complete lactations were selected randomly from large DHIA data set for each of 2 parity groups in each of 5 breeds. Sequential projections for the following test day were made at 50day intervals through the lactation, and compared to measured milk production. That is, a prediction was made using the 1 or 2 test days before 50 DIM for milk at the next test day. Prediction error was tabulated, then a new prediction made for the next test after 100 DIM based on before 100 DIM, and so on. This enabled calculation of mean prediction error (model bias) and standard error of prediction (SEP) by lactation stage, for each breed parity group using each model. Finally, daily milk weights from a single herd were used to compare M305 from summed daily weights to M305 calculated from monthly test day data using each model.

Results:
MilkBot consistently displayed least bias of the models tested, generally of less than half a kg. The Null Model is expected to be biased with respect to DIM, because of the normal lactation curve, but Test methodology sometimes showed greater bias than the Null Model. SEP was similar between models, decreasing in late lactation as more data points became available for the prediction, and approaching approximately 5 kg, which likely reflects normal variation in daily milk production. MilkBot also performed slightly better than Best Prediction in calculating M305, in the single herd where that was tested.

Significance:
Best Prediction methodology was developed for genetic evaluations at the USDA-AIPL labs, where it has been used with great success. The Fortran-based software is freely available at http://aipl.arsusda.gov/software/bestpred/. Implementing Best Prediction software on PC computers, and especially using it for generating lactation curves, provides significant technical challenges.

The MilkBot model is freely available also, but projecting future milk requires nonlinear curve-fitting, which is also technically challenging, especially for the sparse and noisy data of individual lactations with monthly tests. The MilkBot fitting engine used in this study is commercially available over the Internet, at http://MilkBot.com. After fitting, daily projections are easily calculated from MilkBot parameter values.