Retention pay-off prediction using machine learning algorithms.

S. Shahinfar*, A. S. Kalantari, V. Cabrera, and K. Weigel, *Department of Dairy Science, University of Wisconsin-Madison, Madison.*

Culling decisions have a major effect on dairy farm profitability. Dynamic programming (DP) has been widely used for finding the optimal replacement policies in dairy cattle. However, DP models are computationally intensive and might not be practical for daily decision making. Hence, the ability of machine learning to provide fast and accurate predictions of non-linear and inter-correlated variables makes it an ideal methodology. Milk class (1–5), lactation number (1–9), month in milk (1–20), and pregnancy status (0–9) were used to describe a cow in the DP model. Twenty-seven scenarios based on all combinations of 3 levels of milk production, milk price, and replacement cost were solved with the DP model, resulting in a data set of 122,716 records, each with a calculated retention pay-off. Then, a machine learning model tree algorithm was used to mimic the evaluated RPO in DP. The correlation coefficient factor was used to observe the concordance of RPO evaluated by DP and RPO predicted by the model tree. The obtained correlation coefficient was 0.991 with corresponding value of 0.11 relative absolute error. At least 100 instances were required per model constraint, and resulting in 204 total models. When these model s were used for binary classifications of positive and negative RPOs, error rate were %1 false negatives and %9 false positives. Applying this trained model from simulated data for prediction of retention pay-off for 102 actual culling records from UW-Madison dairy herd resulted in a 0.994 correlation with 0.10 relative absolute error rate.

Key Words: machine learning, retention pay-off, prediction