Derivation and interpretation of the MilkBot® lactation model in monitoring health of dairy cattle

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Introduction

The MilkBot® model is a nonlinear lactation model that has been shown to perform well both in summarizing differences in lactation-curve shape and in projecting future milk production for individual lactations. An understanding of the derivation and assumptions behind the model aids in interpretation of model parameters, which constitute a concise language for summarizing the distribution of milk production within a lactation.

Materials and Methods

Derivation of the MilkBot® model is essentially a thought experiment leading to the equation MBMilk = *scale**EXP(-*decay**DIM)*(1 - EXP((*offset* - DIM)/*ramp*)/2) where MBMilk is daily milk yield, and the parameter *scale* controls magnitude while *ramp, offset*, and *decay* control the shape of the lactation curve.

Results

The effect of individual parameters on curve shape are best shown graphically. The *ramp* parameter controls the steepness of the post-parturient rise in production. The *decay* parameter controls the decline, most visible in late lactation. The *offset* parameter has minor effect, reflecting the offset between calving and the start of milk production. Fitting a data set to the MilkBot model requires nonlinear fitting methods, for which several strategies are available, depending on the type of input data.

Significance

The MilkBot® model is the first successful attempt to summarize the distribution of milk production within individual or aggregate lactations as a set of parameters related to observable aspects of lactation-curve shape. Fitted parameter values may be used in statistical studies as independent variables or used to project future milk production in incomplete lactations.