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Abstract Submission Form

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Preferred presentation Oral

Preferred session Joint ICAR/INTERBULL Session: Data collection for Beef on Dairy

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Title of your paper Analysis of Factors Affecting Daily Milk Yields: An Initial Case Study in an Automatic Thrice-Milking Farm

Insert ABSTRACT text

The methodologies and parameters used for estimating day milk yields (DMY) in the United States were predominantly developed from the 1960s through the 1990s. A recent initiative by the Council on Dairy Cattle Breeding, USDA-AGIL, and the National DHIA aims to update these methods and parameters for estimating DMY by collecting and analyzing milking data from dairy farms. This study first utilized a non-parametric method, generalized additive models (GAM), to explore the determinants impacting DMY estimation at a specific site, Farm 1 in New York state, serving as a preliminary case study amid ongoing or planned data collection across other locations. In total, 63,562 milking data were extracted from approximately 2,200 cows that were milked thrice daily at Farm 1. These data were sourced from BouMatic parlor software. After data cleaning that eliminated incomplete or missing records, 48,456 valid entries from 1,886 cows were used for subsequent data analyses. The average contributions (95% confidence interval) of three milkings to total DMY are 32.6% (24.3-39.5%), 36.7% (29.4-45.0%), and 30.7% (24.0-38.3%) of DMY, with the average milking interval (95% confidence interval) being 7.88 (7.06-8.81),

8.79 (7.84-9.75) hours, and 7.25 (6.39-8.07) hours, respectively. Analysis of variance showed significant non-linear effects of lactation numbers, days in milk, and milking intervals on proportional DMY and significant non-linearity of these three variables and partial yields on DMY. Furthermore, the analysis highlighted significant non-linear interactions between partial yields and milking interval times on DMY. These insights motivated us to use a global, polynomial with interactions regression (PIR) model, modifying the DeLorenzo-Wiggans (D-W; 1986) model that fits separate linear regression for various milking interval classes. A general expression of PIR is y=(b_0+b_1 t+b_2 t^2)x+…+ϵ, where y is a test-day yield, x is a single yield, t is milking interval time for the single yield, b_0, b_1, and b_2 are coefficients for the polynomial function, "…" stands for additional covariates or factors when applicable, and ϵ is the error term. In the present study, we considered months in milk and lactation numbers as additional categorical model effects. The accuracy of estimated DMY was evaluated by R2 accuracy and the correction between estimated and actual DMY. GAM had the highest correlations (0.912 for 1st milking, 0.915 for 2nd milking, and 0.899 for 3rd milking) and R2 accuracies (0.856 for 1st milking, 0.860 for 2nd milking, and 0.839 for 1st milking). The two PIR models had similar yet slightly lower correlations (0.905-0.906, 0.909, and 0.827) and R2 accuracy (0.847-0.848, 0.853, and 0.827) for the three milkings. In contrast, the D-W and GW models exhibited noticeably lower correlations (0.820-0.879, 0.902-0903, and 0.865-0.875). Concerning the relative predictability of the three milkings, the 1st or 2nd milkings alone gave more accurate DMY estimates than the 3rd milking because the latter had the shortest milking interval time. All these methods, except the GW model, had a smaller variance of estimated DMY than the actual DMY variance. Nevertheless, the variance shrinkage was more drastic with the D-W model than PIR and GAM. In contrast, the GW model had a substantially enlarged variance of estimated DMY. Hence, rescaling the variance of estimated DMY is necessary when estimated test-day yields are used for genetic evaluation. Calculated MCFs in Farm 1 were slightly higher increases for the 2nd and 3rd milkings but slightly smaller for the 1st milking compared to the Wiggans (1986) assessment, suggesting only minor changes in daily yield correction factors over the past decades. Deriving population-wise multiplicative correction factors based on GAM is not computationally trivial. Instead, the PIR model, having approximately equivalent accuracies as GAM, provides a computationally efficient alternative to conventional methods.

Enter keywords

dairy cattle, non-linear model, interactions, polynomial regression, test-day