UNIVERSITY of GUELPH

ONTARIO AGRICULTURAL COLLEGE

DEPARTMENT OF ANIMAL BIOSCIENCES

PhD Defence

Evaluating Individual Cow Adaptation of the NASEM (2021) Dairy Model Through Global Sensitivity Analysis, Parameter Calibration, and Economic Assessment

Patricia Kedzierski

Date: **Tuesday May 5, 2026 at 12:00 pm**

The PhD Defence for Patty Kedzierski has been scheduled for Tuesday May 5, 2026 at 12:00pm. The defence will be held **online via Teams and in room ANNU 141**: https://teams.microsoft.com/meet/252923582842372?p=mqPLCoSVmIJCfNjFX2

Examining Chair: Dr. Anna Kate Shoveller

Advisor: Dr. John Cant

Advisory Committee Member: Dr. Jennifer Ellis

Additional Committee Member: Dr. Vern Osborne

External Examiner: Dr. Heidi Rossow, University of California

Abstract:

Mechanistic nutrition models, such as the NASEM (2021) model (NASEM21) are widely used to predict nutrient requirements and performance of dairy cattle. Model parameters typically represent a mean within a population of cows from previous studies and may influence prediction performance. Few studies have evaluated the potential of applying NASEM21 at the individual dairy cow level. The objectives of this thesis were to 1) determine influential parameters within NASEM21 using global sensitivity analysis (GSA), 2) Calibrate influential parameters within the model at the individual cow level, and 3) perform an economic assessment by comparing income over feed cost (IOFC) using default NASEM21 parameters and individualized parameters. GSA was conducted using the Sobol-Saltelli method to determine the influence of 67 parameters on 6 selected NASEM21 outputs, which represented measurements able to be obtained on farm. Results from the GSA identified 7 parameters that explained the majority of variance in the outputs of interest. For chapters 2 and 3, experimental analyses were conducted on data collected from 29 Holstein cows ranging between 22 and 272 days in milk (DIM) over a 4-week (28-d) period. In chapter 2, the influential parameters were calibrated at the individual cow level to minimize differences between predicted and observed outputs. Calibrated parameters were obtained for all cow-week combinations, resulting in improved agreement between predicted and observed outputs. Calibrated parameters were consistently more variable between cows, compared to within cows, which supports the need for individual parameter calibration. Lastly, IOFC improved when using the NASEM21 with individually calibrated parameters in comparison to default model parameters. The findings from this work highlight the potential for the NASEM21 to be used at the individual cow level and potentially improve profits on farm by capturing individual variability in dairy cattle. Future work should focus on applying these changes on farms to determine if the model is capturing true biological variability, and determine how feed changes could be implemented at the individual level on farm.