UNIVERSITY of GUELPH

ONTARIO AGRICULTURAL COLLEGE

DEPARTMENT OF ANIMAL BIOSCIENCES

PhD Defence

Predicting Pellet Quality at the Mill Level Using Machine Learning and Statistical Models

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Date: February 23rd 2024 at 9:00am

The PhD Defence for Jihao You has been scheduled for February 23rd, 2024 at 9:00am. The defence will be held online via Teams and in room 141: https://teams.microsoft.com/l/meetup-join/19%3ameeting_NDQ0OTU3YTQtZDljOC00OGI0LWE4ZjQtYTk5YTViZjcxZDdi%40thread.v2/0?context=%7b%22Tid%22%3a%22be62a12b-2cad-49a1-a5fa-85f4f3156a7d%22%2c%22Oid%22%3a%22fbd28915-dda5-478f-8ecb-a3682dcf0c3a%22%7d

Examining Chair: Dr. Alexandra Harlander

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Abstract:

Feed mills face an ongoing challenge of controlling pellet quality of manufactured feeds, as many factors during formulation and manufacturing influence the physical properties and quality of the output. Many previous studies have been conducted to examine how single (or a few) isolated factors impact pellet quality under controlled research and experimental settings, but these studies have limitations when it comes to extrapolation to the commercial feed mill where a multitude of factors are changing simultaneously. Therefore, the objective of the current thesis was to develop predictive models for pellet quality from data collected (formulation, manufacturing conditions, environment) in the commercial mill setting. To achieve this goal, machine learning (ML) and statistical modelling approaches were applied to build models for predicting the pellet quality. Specifically, there were three objectives: (1) Twelve ML models were developed on a preliminary mill dataset with a small number of factors (N = 16); (2) After applying dimensional reduction methods on a mill dataset with a large number of factors (N = 75), four statistical models were developed; and (3) Feature engineering approaches including feature creation and feature selection were applied to a full dataset with a large number of factors (N = 75), and then the selected feature were used for constructing twelve ML models. The results showed that both ML models and statistical models developed in the current study could be used to predict the pellet quality, and ML models had potential to perform the task of prediction better than statistical models. Some factors, including expanding temperature, target species, starch content, wheat, soybean meal, etc., played an influential role in prediction of the pellet quality in both ML and statistical models. The models developed in this thesis, considering various dynamically changing factors across formulation, manufacturing conditions and the environment, can help commercial feed mills improve the manufacturing process as well as gain a better understanding of how various factors impact the pellet quality. The models developed can also be applied to optimize targeted parameters in the pelleted feed manufacturing process, leading to improvements in the efficiency and sustainability of the feed industry.