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Title of the presentation

Automated Anomaly Detection for Milk Components and Diagnostics in Dairy Herds

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ABSTRACT

Changes in the value of indicators such as bulk tank milk components (e.g., basic components, MUN and specific fatty acids) generally indicate some positive or negative effects in management and environmental factors such as feed quality, feeding behaviour, or ambient conditions. Generally, producers and their advisors detect abnormal trends by visual inspection of components on a report, which is tedious and requires skills, especially when simultaneously considering many complex variables such as fatty acids. However, it is possible to assist with interpretation and decision making and prevent abnormal situations using robust analytics for early anomaly detection.

This project aims to identify anomalies in bulk tank milk components using basic statistical techniques. Complementarily, the use of a rule-based artificial intelligence (AI) approach is explored to help diagnosing and recognizing potential issues with respect to herd or rumen health management.

There are two major steps in our anomaly detection method: (1) Calculating statistical measures for all components of all herds, and (2) Ranking the herds, each component separately, within the same predominant breed. The statistical measures are deviation, variation, and gradient. Deviation is the difference between the component value and population benchmarks, while variation and gradient indicate short-term (e.g., 4 days) and longer-term (e.g., 10 days) changes, respectively.

The diagnostic approach involves constructing a rule-based expert system where the calculated measures and ranks are used in its diagnostic rules list. Such system provides a confidence level for each rule.

A python package was developed for trend anomalies and diagnostic. Using the package, daily anomaly reports for advisors can be produced. One report consists of the statistical measure by component and the herd rank. We also create symbolic rank reports to highlight the herds with the lowest or highest percentile

scores, applying user-defined thresholds over the ranks. These results are intended to trigger alerts for producers and advisors in extreme cases.

With such reports, interpretation of ranks and herd anomalies remains the user's responsibility as defining an anomaly is challenging. However, if a rule-based diagnostic system can be used in complement, automatic recognition of high-risk anomalies will be possible. Currently, we are at the stage of extracting, implementing, and validating the diagnostic IF-THEN rules with the collaboration of domain experts and computer scientists.

Although this project is defined for bulk tank milk data, it can be adapted for milk recording data due to the intrinsic similarities.

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