DEVELOPING A BOVINE KETOSIS RISK INDICATOR USING SPECTRAL ANALYSIS AND ANIMAL PHENOTYPE DATA

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Outline

- Introduction
- Materials and methods
- Results
  - Split sample cross validation
  - Four way cross validation
- Reporting
  - On national spectra
  - Alongside energy traits
- Conclusions

Introduction

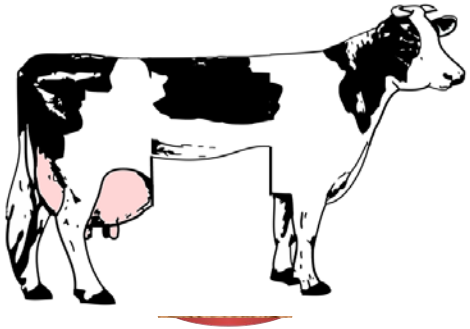
What is ketosis?

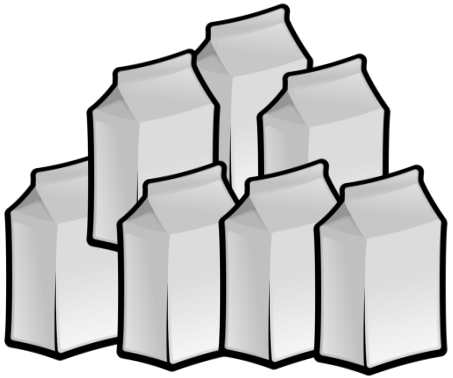
SRUC

Energy balance (MJ/ day)

Positive

Negative





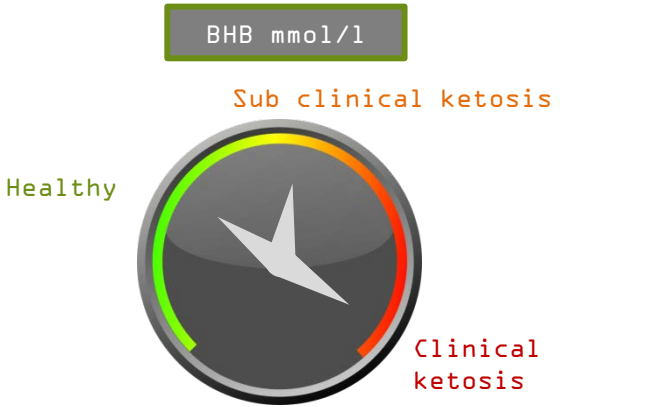
Introduction

What is ketosis?

Ketosis is a metabolic disorder in which the body has to derive energy from ketone bodies

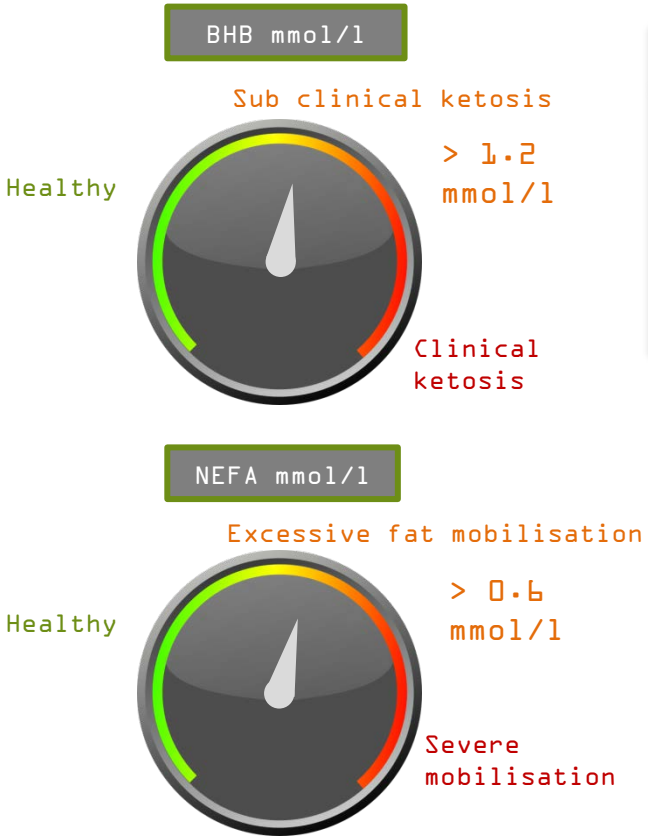
BHB = ’-hydroxybutyrate and is a very stable ‘ketone body’

NEFA = Non-esterified fatty acids and a measure of fat mobilisation



Introduction

What is ketosis?



Sub clinical ketosis

Can impact milk production, cow health and fertility

Introduction

What is ketosis?

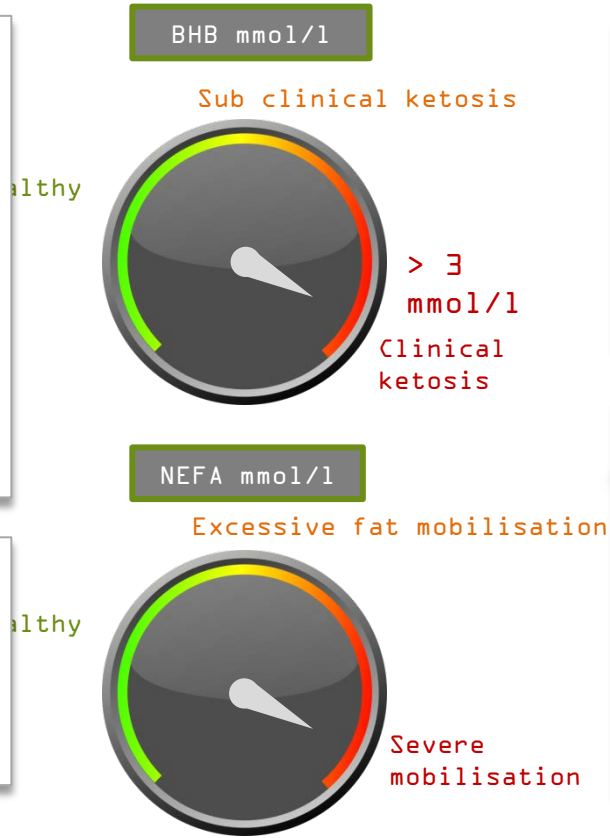
Heritability

Both BHB and NEFA are heritable

Estimates of 0.06 - 0.40 for BHB and 0.08 - 0.35 for NEFA (Koeck et al. 2014, Oikonomou et al., 2008, Jamrozik et al., 2016).

Incidence

Nationally SCK of c. 30% (Macrae et al. 2012)



Sub clinical ketosis

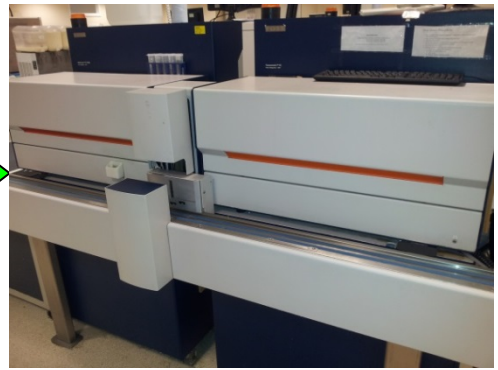
Can impact milk production, cow health and fertility

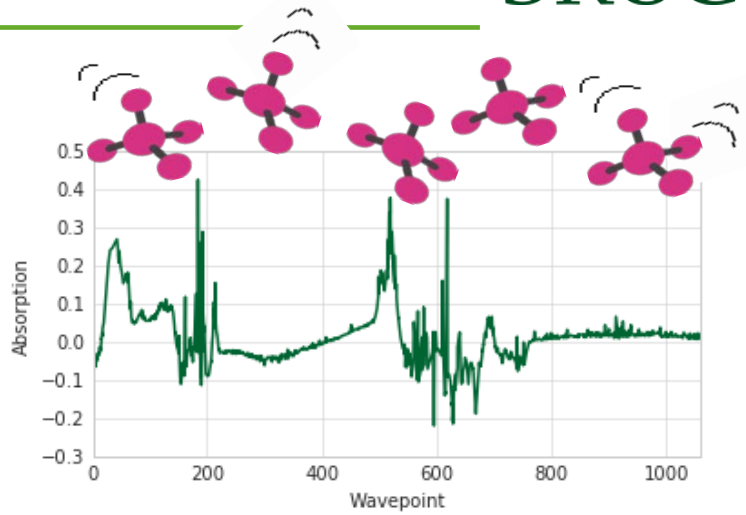
Clinical ketosis

Loss of appetite, reduced milk yield, can induce hypoglycaemia, hyperketonaemia, immunosuppression

Introduction

Mid-infrared (MIR) technology

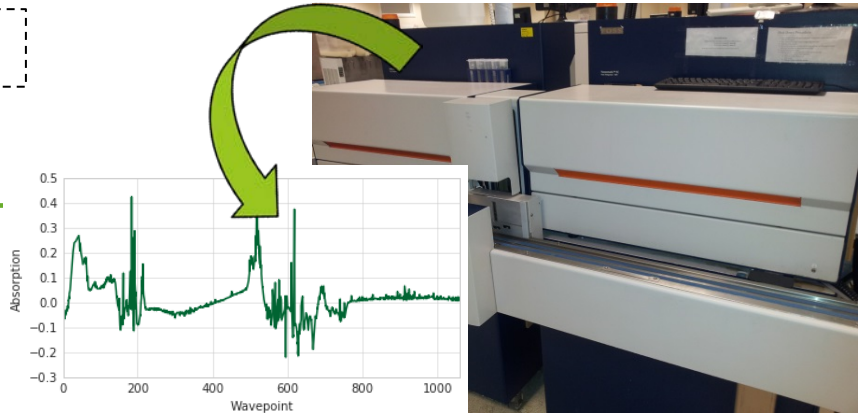




Objective : Can we detect levels of BHB and NEFA from milk MIR spectra?

Materials & Methods

Alignment & calibration



Partial Least Squares Analysis

Predicted *NEFA*

Validation

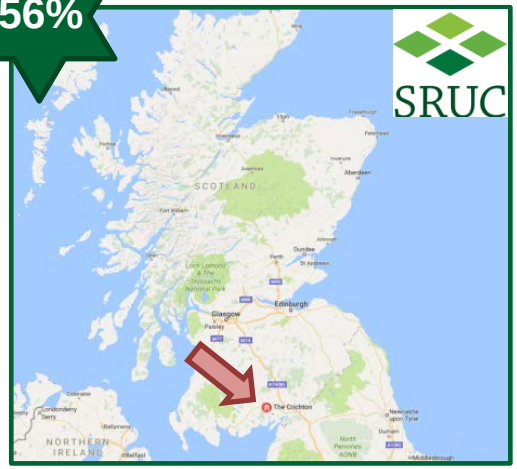
Fatty acids (Soyeurt et al., 2011)

Energy traits (McParland et al., 2011

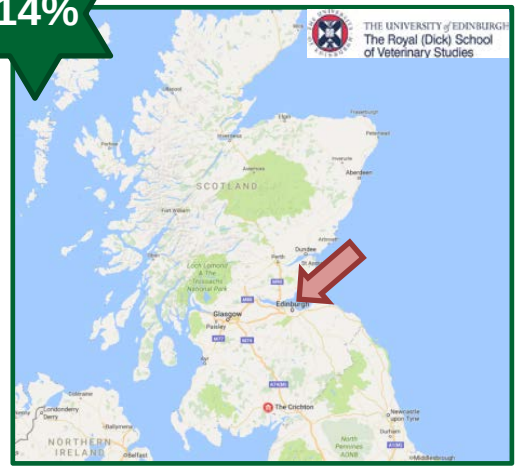
Materials & Methods

Sourcing reference data: Location

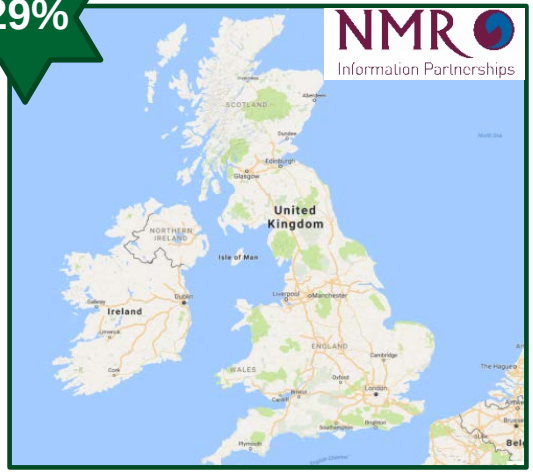
56%



14%



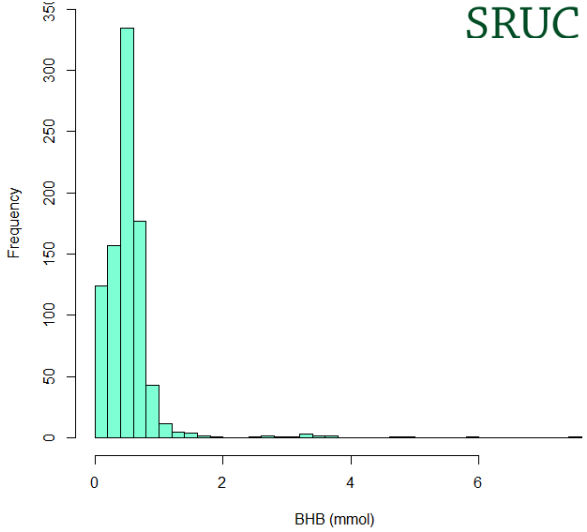
29%



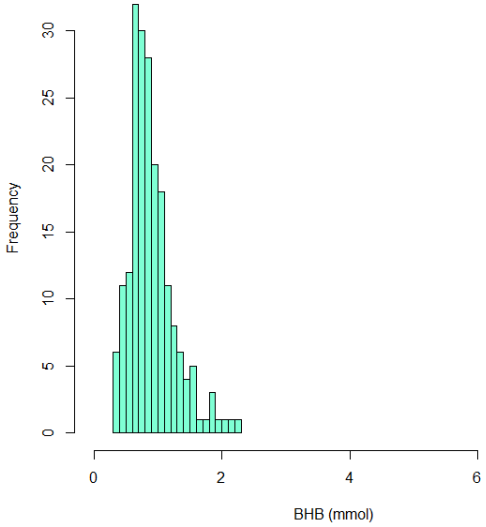
Materials & Methods

Sourcing reference data: distributions

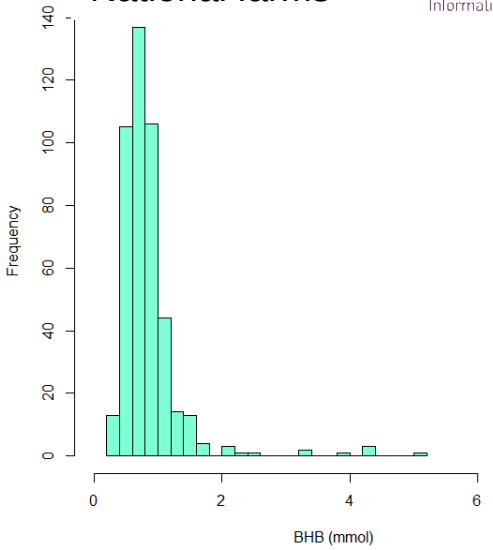
Crichton Farm



Langhill Farm



National farms



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Sourcing reference data: distributions

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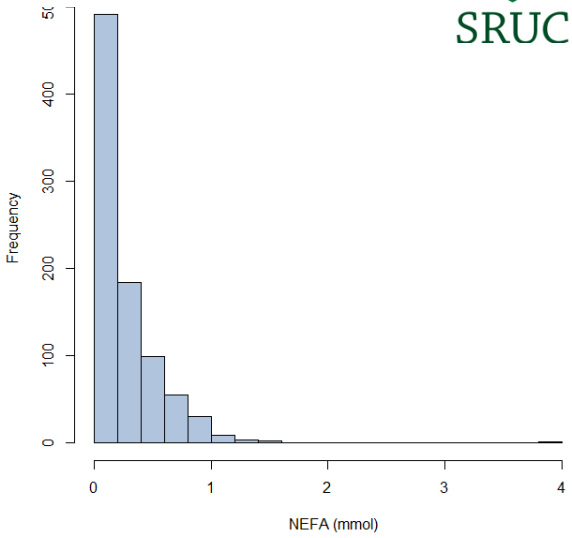

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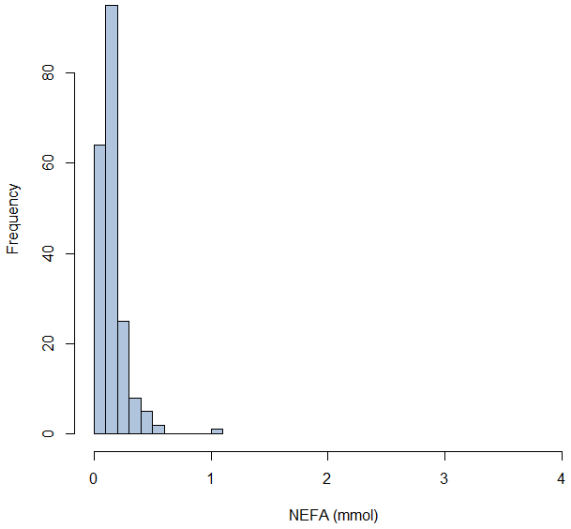

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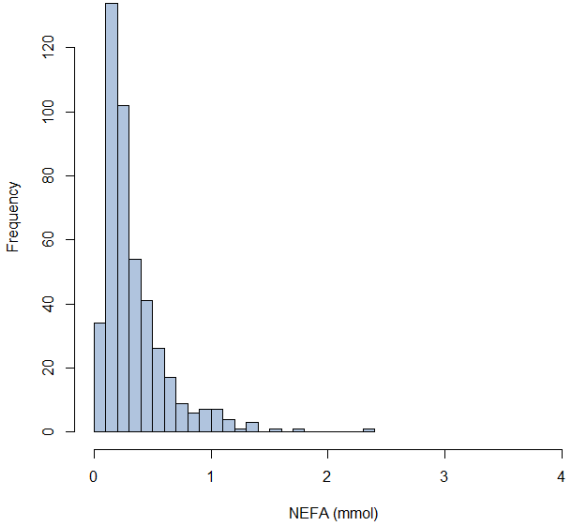
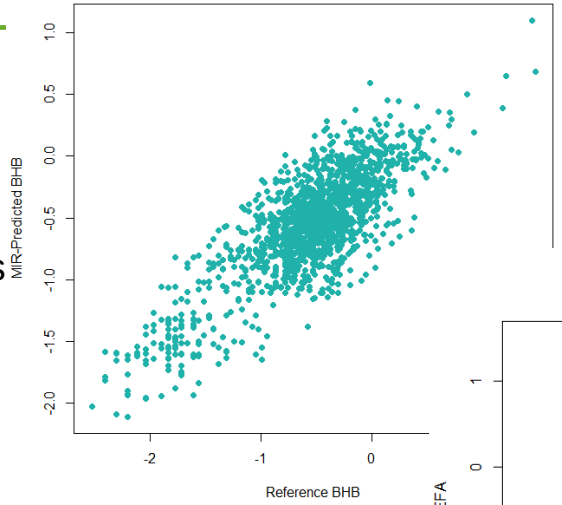


- Spectral data standardised in accordance with Grelet et al., 2016. as part of the Optimir project.
- Transformation of reference data
- Data thinning (similar to Grelet et al. 2016)
- Restrictions on residuals in defining outliers
- Feedback from receiver operating characteristic curves (sensitivity and specificity, area under the curve)
- Inclusion of various phenotypic traits alongside spectral data in the PLS
- Optimal number of factors to use in the model according to SAS

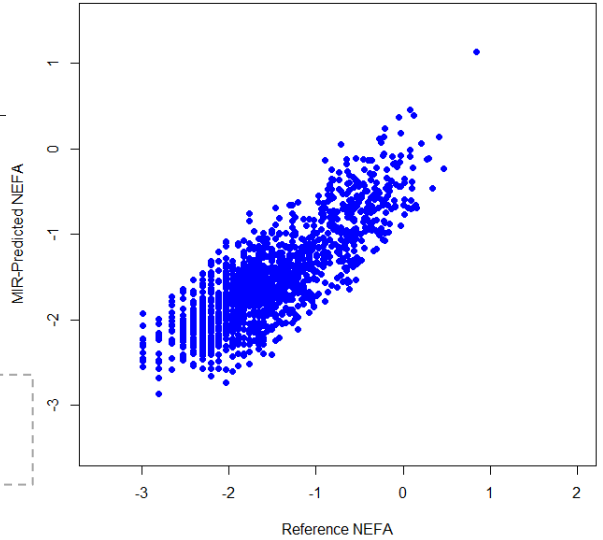
Results

Split sample validation

- Converged upon a tool
  - Using data from all sources
  - Residuals > 2 stdev of the global press considered outliers and removed
  - Both traits (natural) log transformed
- Split sample validation
- R = square root of the coefficient of determination



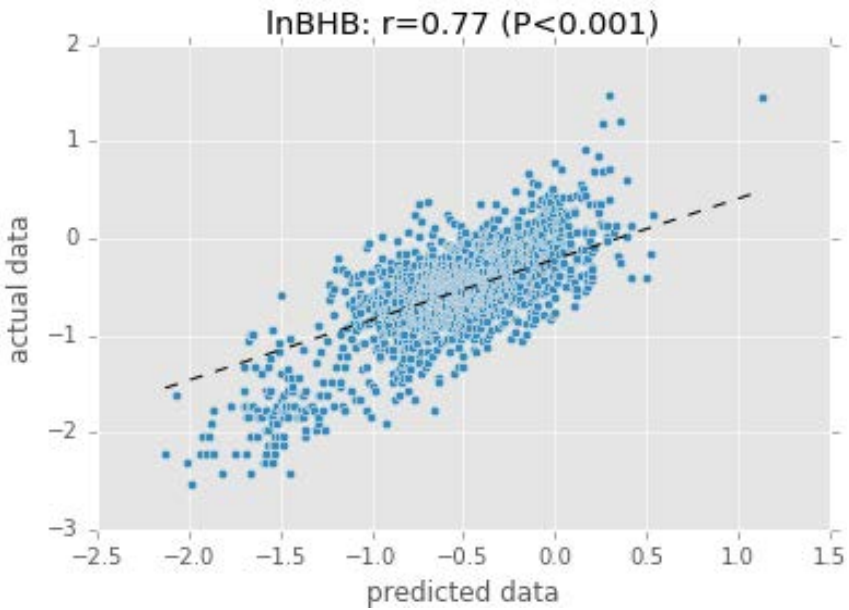
N = 1449
R = 0.81

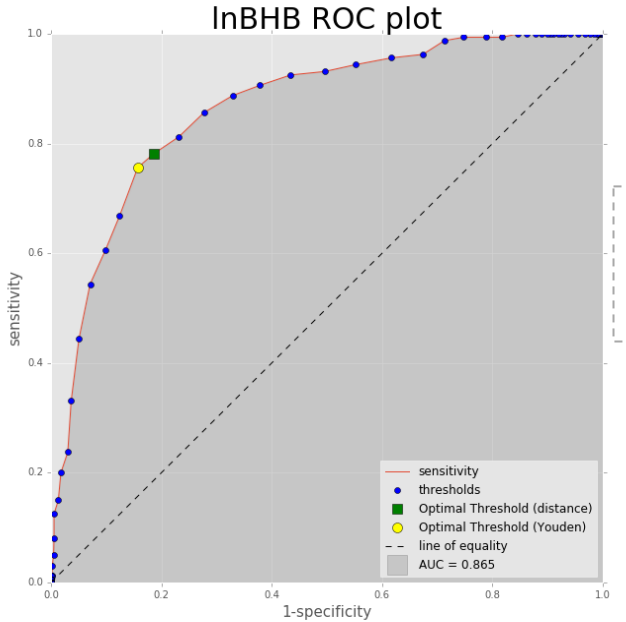


N = 1443
R = 0.84

Results

4 way cross validation



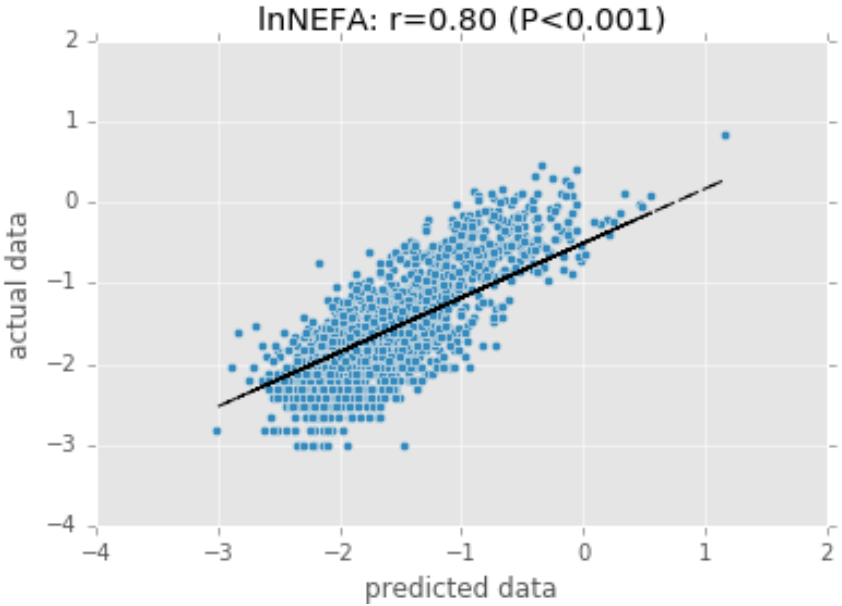


Area under the curve = 0.87

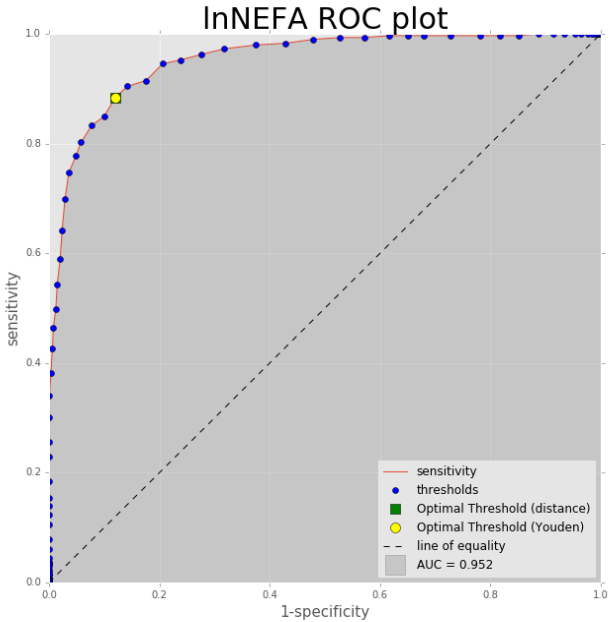
RPD = 1.27
SEC = 0.4
SDEP = 0.35

Results

4 way cross validation



RPD = 0.81
SEC = 0.48
SDEP = 0.71

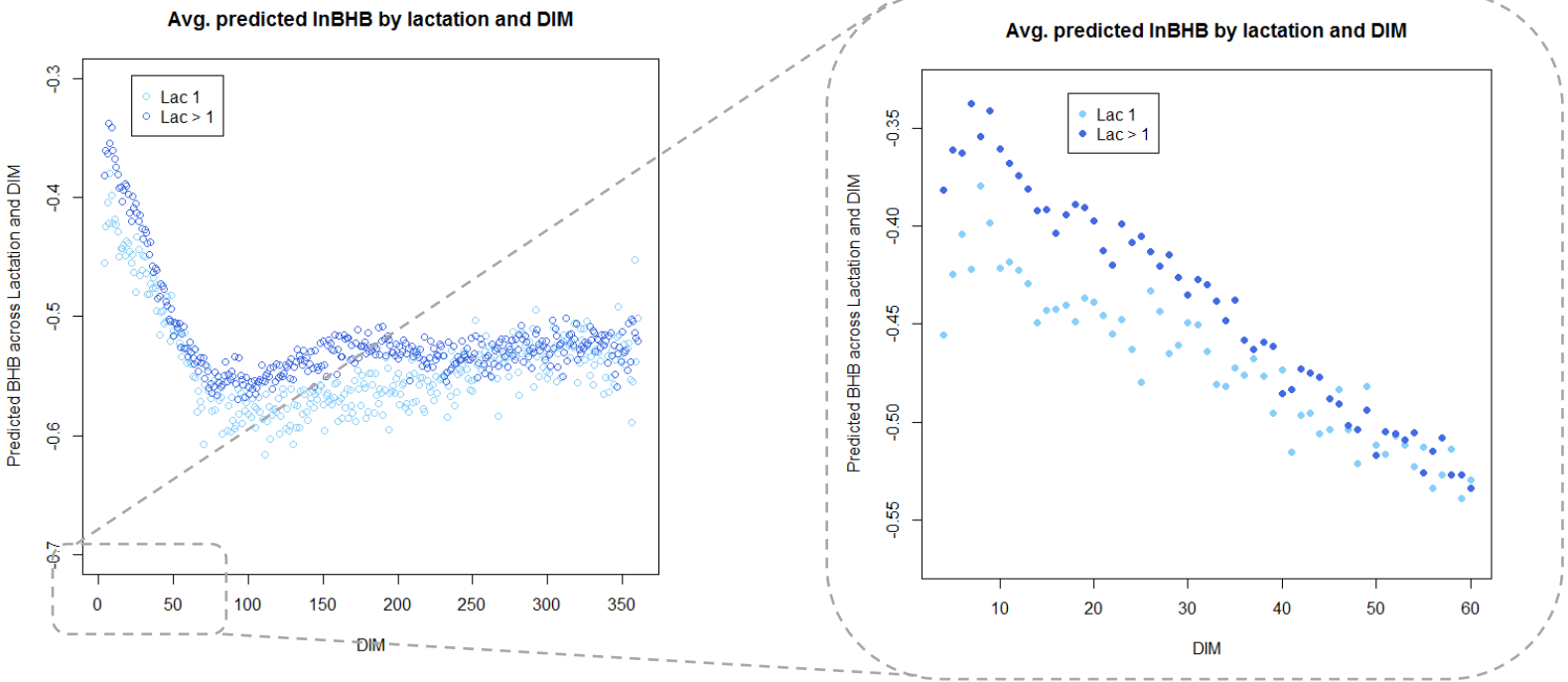


Area under the curve = 0.95

Reporting

National

SRUC



Predictions from 366 herds, >150,000 animals and almost 2 million animal testdates

Reporting

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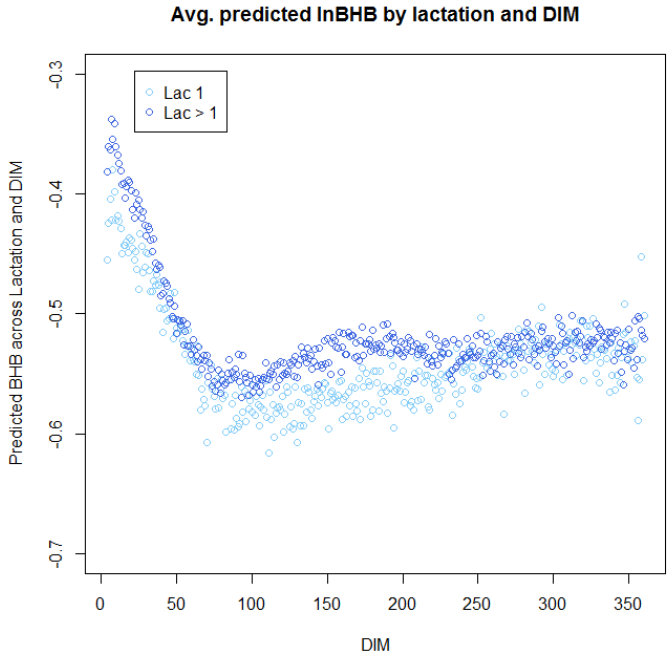
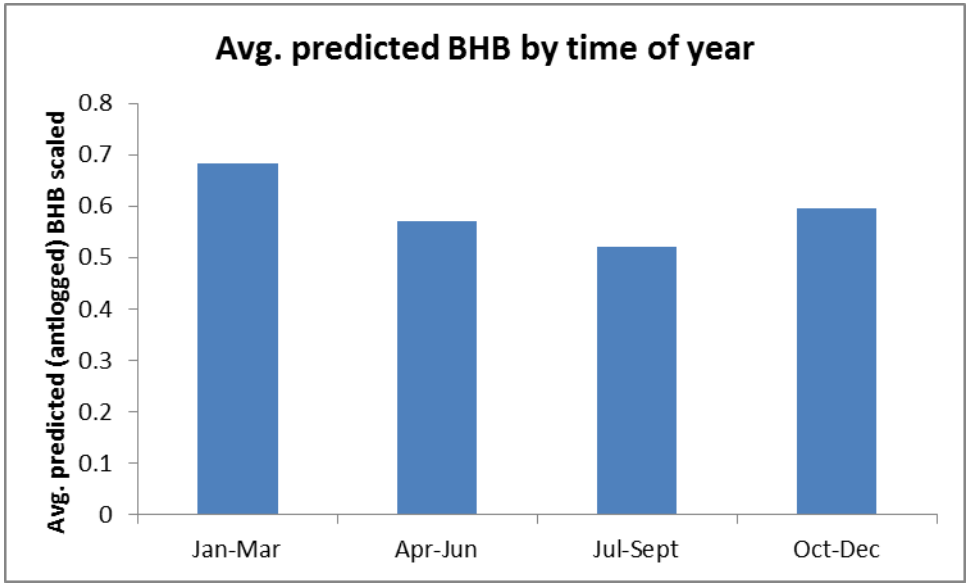
SRUC





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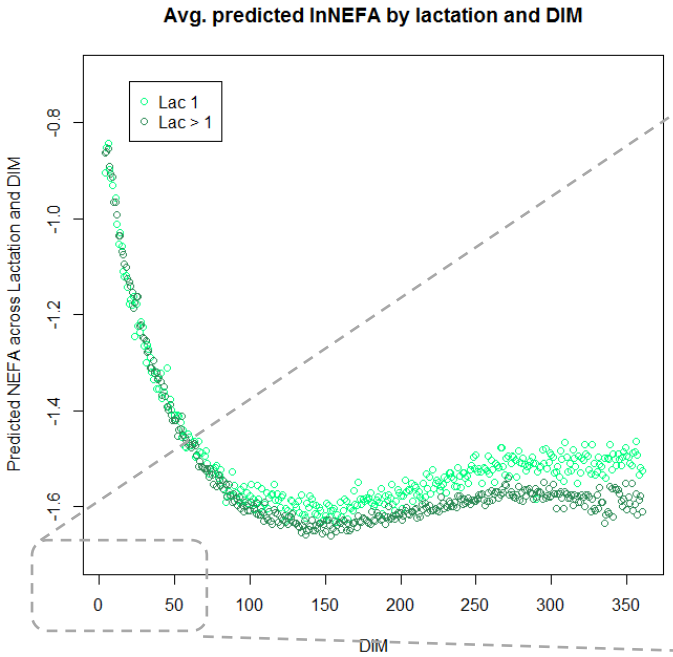

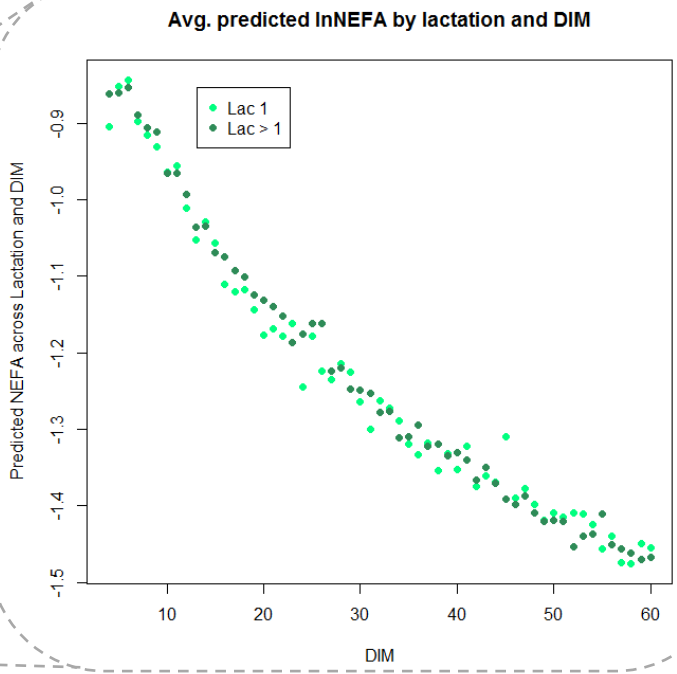

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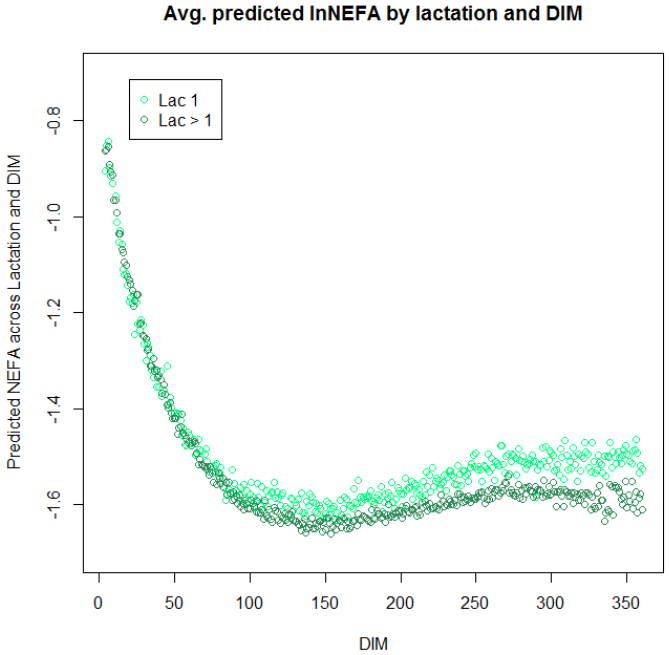

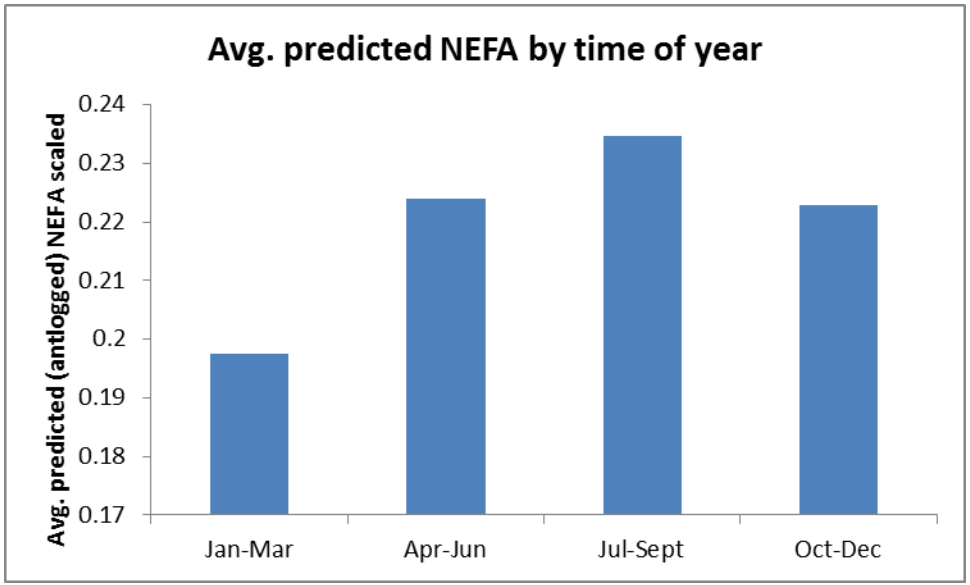

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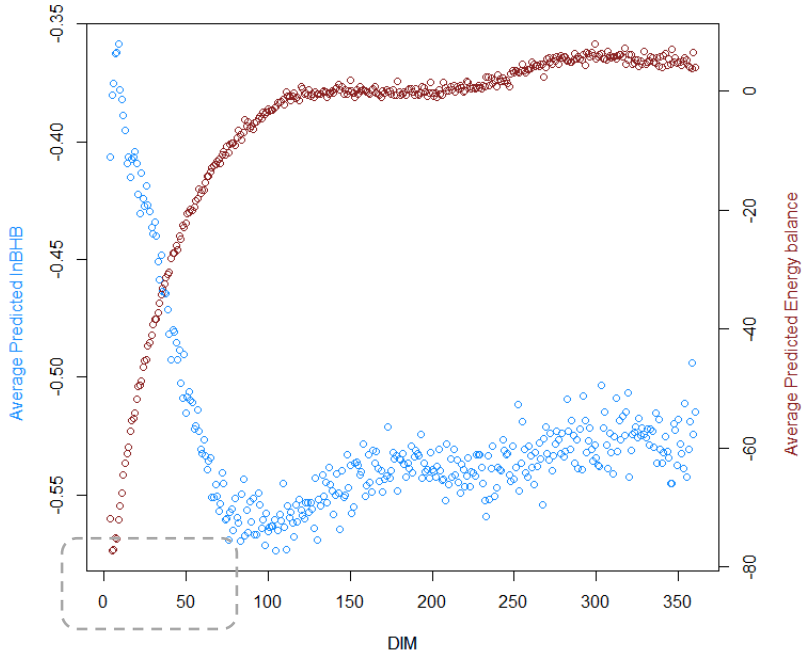

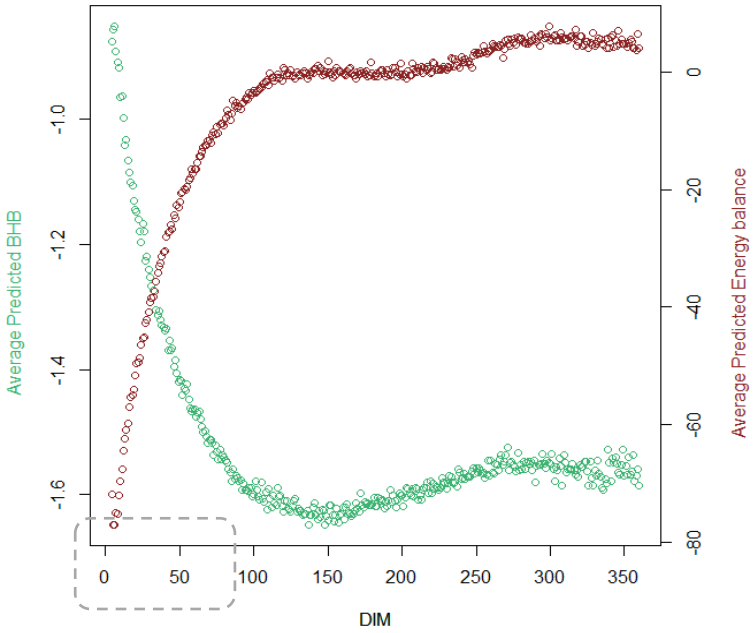

Predictions from 366 herds, >150,000 animals and almost 2 million animal testdates

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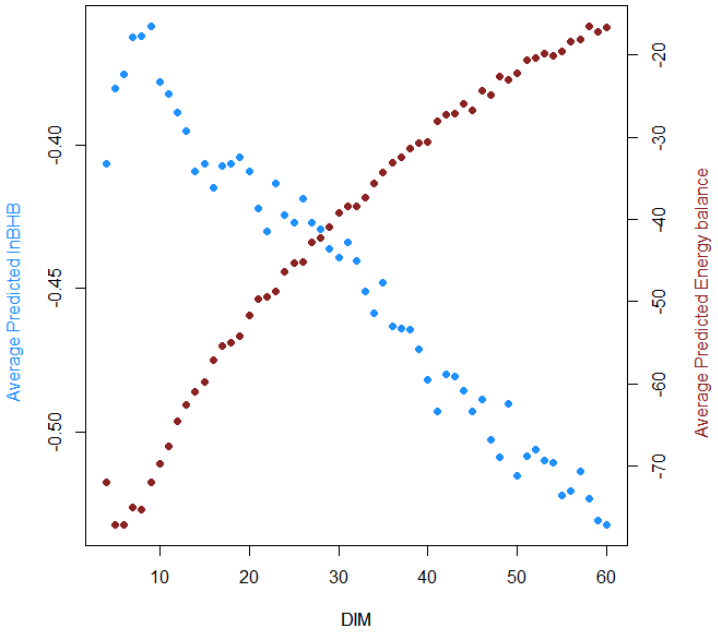

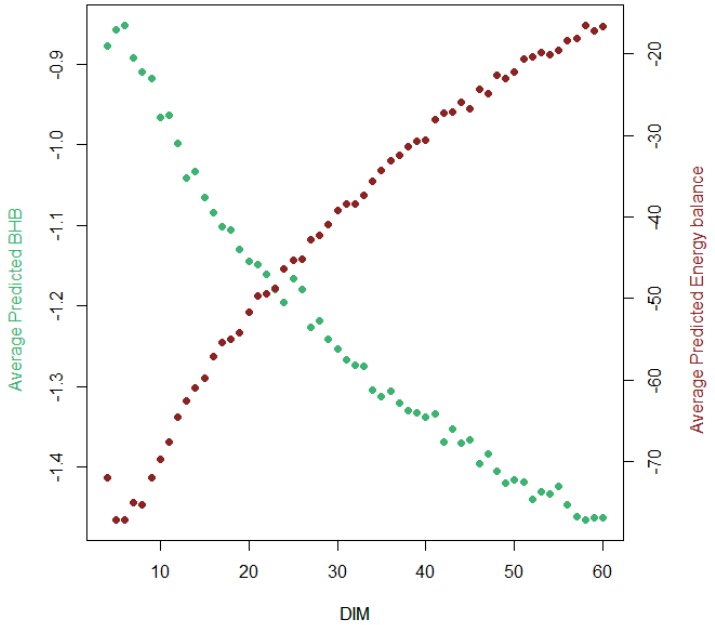

Predictions from 366 herds, >150,000 animals and almost 2 million animal testdates

Conclusions

- Demonstrated the ability to predict BHB and NEFA using MIR
- Could be used routinely as an early-indicator of potential health issues
- Energy balance predicted routinely from MIR at NMR; BHB and NEFA predictions due to accompany these

Acknowledgements

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