Validation of national methane mid-infrared prediction equation

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### Objective

<table>
<thead>
<tr>
<th></th>
<th>Number of records</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>1715</td>
</tr>
<tr>
<td>Train</td>
<td>3047</td>
</tr>
</tbody>
</table>

The diagram shows the comparison between the number of records in Test and Train datasets. The Train dataset has a significantly higher number of records (3047) compared to the Test dataset (1715).
Predicting methane emissions of individual grazing dairy cows from spectral analyses of their milk samples

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Data

- 93,888 individual methane spot measures (>2 minutes)
  - 384 lactations from 277 dairy cows

**Methane**

- n\(\geq\)20
  - n\(\geq\)10
  - 0
  - n\(\geq\)10
  - +6

**AM & PM Milk sample**
- Yield & composition
- Spectrum
- Days post calving

**AM only**
- PM only
- AM+PM
- AM&PM
Approach

Four fold cross-validation

Partial least squares or neural networks

Methane = \int (\text{spectrum, days in milk, yield, fat\%, protein \%})

One farm out

Partial least squares or neural networks
Results

• $\mu = 323.4$ g/d
• $\sigma = 75.2$ g/d
• Average of 30 spot measures to $\pm 6$ days
  • 111 minutes
• Repeatability = 28%

• Little difference
  • AM v PM, neural networks v partial least squares
• Flanking 6 days > previous 6 days > subsequent 6 days
## Results

<table>
<thead>
<tr>
<th>Model</th>
<th>No spectra</th>
<th>With spectra</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectra</td>
<td>0.55 (0.07)</td>
<td>0.55 (0.06)</td>
</tr>
<tr>
<td>DIM</td>
<td>0.32 (0.13)</td>
<td>0.55 (0.06)</td>
</tr>
<tr>
<td>Yield</td>
<td>0.10 (0.18)</td>
<td><strong>0.64 (0.05)</strong></td>
</tr>
<tr>
<td>Composition</td>
<td>0.32 (0.13)</td>
<td>0.57 (0.06)</td>
</tr>
<tr>
<td>DIM + yield</td>
<td>0.52 (0.10)</td>
<td>0.64 (0.06)</td>
</tr>
<tr>
<td>DIM + composition</td>
<td>0.41 (0.10)</td>
<td>0.55 (0.06)</td>
</tr>
<tr>
<td>Yield + composition</td>
<td>0.32 (0.07)</td>
<td>0.62 (0.05)</td>
</tr>
<tr>
<td>DIM + yield + composition</td>
<td>0.54 (0.09)</td>
<td>0.64 (0.05)</td>
</tr>
</tbody>
</table>
Validation dataset

- Calibration
  - N = 3,047
  - From 2020 to 2022

- Validation
  - N = 1,715
  - From 2023
Validation dataset
Results

- Correlation between actual and predicted of 0.38 *
- Root mean square error of 78.76 g/d

* Correlation in the training dataset of 0.64
Results

Low 10% emitting cows

High 10% emitting cows
Results

N = 242
N = 1,218
N = 255

Methane (g/d)

> 1 sd from mean
between 1 and -1 sd from mean
< 1 sd from mean

Actual CH4  Predicted CH4
Conclusions

- Accuracy of the prediction relatively low
- Ability in identifying high and low emitting cows
- Ability in identifying groups of cows