Designing a Validation Application for Genetic and Genomic Evaluation in the New Zealand Dairy Industry

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Interbull: Lake Bled, Slovenia, May 2024
• NZAEL 3.5 proposes significant improvements for the New Zealand dairy industry:

Context

Will the new NZAEL 3.5 genetic evaluation system be better than the old NZAEL 3.0 system?
Context

• Current national genetic evaluation system does not include genomics
  • Will allow farmers to rank bulls across companies on the same scale using genomic technology
  • Significant investment of farmer levy funds

• A robust validation process is crucial for the successful implementation of NZAEL 3.5.
  • System-wide overhaul of all current traits
  • Models developed using BOLT and Helical software
Project timeline

2023

1. Pipeline development

February 2024

2. Planning workshop

• **Build the NZAEL 3.5 validation map**: a practical guide for development decisions.
  • Define the scope of the project
    • Prioritise the target audience
    • Distinguish ‘core’ validation pipeline from ‘exploratory’ analysis

What do we need to feel confident that the new system is genuinely ‘better’?
Guiding principles

• How do we know the new EBVs are ‘better?’
  1. Do they make sense (e.g., genetic trends and breed differences)?
  2. Do differences in EBVs accurately predict differences in phenotypes?
  3. Are they stable when more information is included?
  4. Are they biased?
  5. Will they pass Interbull testing?

• What tests and metrics do we need to check for each of these?
• What are the trigger points for identifying a problem?
• Which focal groups should we track?
• How do we present these results?
Validation process

1. Pipeline development
2. Planning workshop
3. App development

- 2023
- February 2024
### Changelog

#### Version 1.1.8 (2024-05-11)
- Bull count column added to trend test tables.
- New BCS trend test 2 & 3 results added for Holstein PBLUP 3.0 & PBLUP 3.5.
- Removed redundant "mas" trait for SCS Interbull results.

#### Version 1.1.7 (2024-05-09)
- Fixed Interbull t4 file format, updated results - shows gen sd now rather than gen var.
- Added results for BCS (reviewer version), Lwt and TOP_TL

#### Version 1.1.6 (2024-05-07)
- Added Interbull results for trend test 4, and overview tables for all the traits (BCS is the only incomplete trait at this point).

#### Version 1.1.5 (2024-05-03)
- Added standard deviation trend plots.
- Added intercept plots.
- Updated genetic trend plots to define 'BirthYear' from the 1st of June onwards (season versus calendar year).
- New logic to dynamically determine (per trait & sex) count thresholds for datapoints of trend plots.
- Added Interbull results for trend tests 2 & 3 for MEM3.5_14 models.

#### Version 1.1.4 (2024-04-22)
- Reran MFPS and updated to _14 'relaxed filter' runs.
- Removed results for validation cows with number of herd tests < 3 due to unreliable phenotypes.
- Same-HT focal group adjusted using file AP2_F6_12_35.csv.bz2.
- LowInfor focal group counts fixed when using DLD file for daughter counts.
- Added Interbull trend test 2 (DYD trend) & 3 (EBV trend accounting for new daughters) results.
Example

For liveweight, how much does genotype data improve the predictive ability of EBVs?
# OmitPhn_Geno Cows

<table>
<thead>
<tr>
<th>Focal group - count</th>
<th>ALL</th>
<th>Hol</th>
<th>HF</th>
<th>HFX</th>
<th>HFJ</th>
<th>JX</th>
<th>Jer</th>
<th>Oth</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>(D)YD on EBV - corr</td>
<td>0.83</td>
<td>0.57</td>
<td>0.58</td>
<td>0.55</td>
<td>0.52</td>
<td>0.46</td>
<td>0.48</td>
<td>0.50</td>
<td>P3.0</td>
</tr>
<tr>
<td>(D)YD on EBV - corr</td>
<td>0.85</td>
<td>0.53</td>
<td>0.59</td>
<td>0.56</td>
<td>0.53</td>
<td>0.49</td>
<td>0.49</td>
<td>0.58</td>
<td>P3.5</td>
</tr>
<tr>
<td>(D)YD on EBV - corr</td>
<td>0.89</td>
<td>0.60</td>
<td>0.70</td>
<td>0.72</td>
<td>0.72</td>
<td>0.69</td>
<td>0.62</td>
<td>0.63</td>
<td>G3.5</td>
</tr>
<tr>
<td>(D)YD on EBV - slope</td>
<td>1.03</td>
<td>1.22</td>
<td>0.99</td>
<td>1.08</td>
<td>1.10</td>
<td>0.89</td>
<td>0.94</td>
<td>1.11</td>
<td>P3.0</td>
</tr>
<tr>
<td>(D)YD on EBV - slope</td>
<td>1.02</td>
<td>1.14</td>
<td>0.98</td>
<td>1.07</td>
<td>1.08</td>
<td>0.91</td>
<td>0.95</td>
<td>1.10</td>
<td>P3.5</td>
</tr>
<tr>
<td>(D)YD on EBV - slope</td>
<td>1.00</td>
<td>0.98</td>
<td>0.94</td>
<td>1.02</td>
<td>1.04</td>
<td>0.97</td>
<td>0.85</td>
<td>0.98</td>
<td>G3.5</td>
</tr>
</tbody>
</table>

| EBV on EBV - bias  | -1.36 | 15.30 | -0.01 | 1.78 | -0.14 | -2.98 | -4.63 | 2.34 | P3.0 |
| EBV on EBV - bias  | -0.12 | 12.73 | 1.46  | 2.98 | 0.58  | -1.92 | -3.00 | 3.37 | P3.5 |
| EBV on EBV - bias  | 0.03  | 10.52 | 1.90  | 2.72 | 0.63  | -1.55 | -2.60 | 2.24 | G3.5 |

| EBV on EBV - corr  | 0.89  | 0.66  | 0.67  | 0.63 | 0.58  | 0.55  | 0.58  | 0.57 | P3.0 |
| EBV on EBV - corr  | 0.90  | 0.65  | 0.69  | 0.66 | 0.60  | 0.59  | 0.60  | 0.67 | P3.5 |
| EBV on EBV - corr  | 0.94  | 0.76  | 0.82  | 0.82 | 0.81  | 0.81  | 0.76  | 0.76 | G3.5 |

| EBV on EBV - slope | 1.07  | 1.26  | 1.03  | 1.09 | 1.09  | 0.91  | 0.94  | 1.11 | P3.0 |
| EBV on EBV - slope | 1.06  | 1.21  | 1.03  | 1.10 | 1.10  | 0.96  | 0.99  | 1.12 | P3.5 |
| EBV on EBV - slope | 1.04  | 1.05  | 0.99  | 1.04 | 1.06  | 1.01  | 0.91  | 1.02 | G3.5 |

| Quintile - q1q5    | 109.97 | 66.77 | 56.68 | 51.81 | 45.92 | 42.52 | 36.30 | 56.85 | P3.0 |
| Quintile - q1q5    | 114.65 | 69.34 | 60.07 | 55.30 | 46.69 | 44.71 | 37.19 | 68.52 | P3.5 |
| Quintile - q1q5    | 123.00 | 67.72 | 71.86 | 70.62 | 66.58 | 61.58 | 44.67 | 73.37 | G3.5 |
Next steps

2023
1. Pipeline development

February 2024
2. Planning workshop
3. App development

April-May
4. External review

June
5. Board approval

Internal review and exploratory analysis
Continuous updates to the pipeline
Continuous updates to the app
Conclusion

- Acknowledgements
  - The Helical Company
  - New Zealand Animal Evaluation Limited (NZAEL)
  - DairyNZ
  - New Zealand dairy farmers

- Questions?