Integration of external information in genetic evaluations

T.J. Pitkänen[1], M. Koivula [1], I. Stranden[1], G.P. Aamand[2], E.A. Mäntysaari[1]

[1] Natural Resources Institute Finland (Luke)
[2] NAV Nordic Cattle Genetic Evaluation

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Luke
NATURAL RESOURCES INSTITUTE FINLAND

Introduction

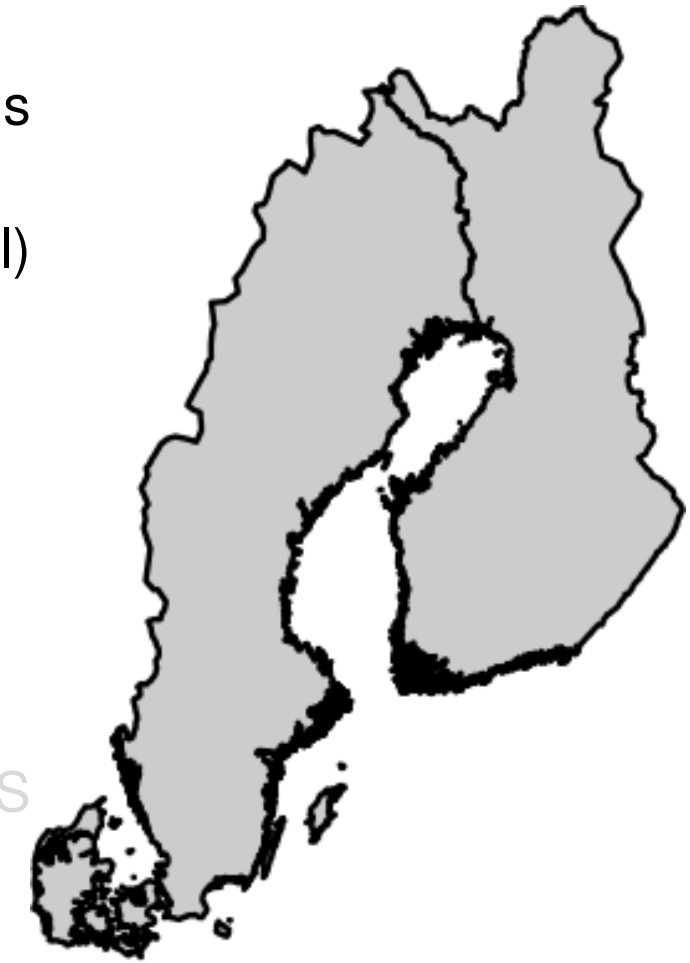
- Prerequisite of implementation of single-step GBLUP
  - Holstein reference population is largely based on Eurogenomics bulls
- In this presentation a method for integrating external information (ie. Interbull EBVs) into national genetic evaluation is presented
- The method is demonstrated using 305d protein yields from Nordic Holstein evaluation data

Demonstration of approach using Nordic evaluation data

Two multitrait evaluations for 305d protein yields

1. DFS including all data (represents Interbull)
   - 4,567,594 cows with obs, 8,517,853 obs, 7,762,484 animals in pedigree
2. DNK including only observations made in Denmark
   - 3,026,231 cows with obs, 5,787,266 obs, 4,506,156 animals in pedigree

The aim is to include information from DFS model to DNK model



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Models and parameters

The following 3 parity model was used for **DNK** observations

```
prot1 = hy1 ys1 cg1 ANIMAL1
prot2 = hy2 ys2 cg2 ANIMAL2
prot3 = hy3 ys3 cg3 ANIMAL3
```

Genetic			h^2
35.7	0.88	0.81	0.36
26.4	25.0	0.96	0.29
22.8	22.6	22.1	0.26

Variance , covariance, correlation

Model for **DFS** has each 9 traits with genetic correlation 1 between countries. The effects are the same.

Combined BV

- External information is available as **single combined EBV** defined as

$$\mathbf{EBV}^{\mathbf{DFS}}_{\mathbf{CMB}} = 0.5EBV_1^{DFS} + 0.3EBV_2^{DFS} + 0.2EBV_3^{DFS}$$

- Corresponding reliability $\mathbf{R2}^{\mathbf{DFS}}_{\mathbf{CMB}}$
- Similarly, $\mathbf{EBV}^{\mathbf{DNK}}_{\mathbf{CMB}}$ and $\mathbf{R2}^{\mathbf{DNK}}_{\mathbf{CMB}}$ for DNK model
- Genetic variance for the combined BV is 27.2
- Residual variance for weighted observation 33.8
- $\Rightarrow$ Heritability is 0.45

Selecting bulls to be blended

Bull were considered to have enough information in DFS to be blended to DNK if:

- $\mathbf{R2}^{\mathbf{DFS}}_{\mathbf{CMB}} - \mathbf{R2}^{\mathbf{DNK}}_{\mathbf{CMB}} > 0.05$
- $\mathbf{R2}^{\mathbf{DFS}}_{\mathbf{CMB}} > 0.85$
- At least 1 daughter in Denmark
- Birth year of bull > 1990

In total 364 bulls were selected. They had 11102 daughters with obs in DNK.

Steps for blending

Blending approach has three steps

1. Calculation of **amount of external information** for selected bulls
2. Calculation of **pseudo-observations** for bulls
3. Running evaluation model with pseudo-observations

1. Calculation of amount of external information for selected bulls

Amount of extra information compared to DNK evaluation is obtained using **reversed reliability approximation**.
Input data:

- $\mathbf{R2}^{\mathbf{DFS}}_{\mathbf{CMB}}$ for bulls having external information in DFS model
- $\mathbf{R2}^{\mathbf{DNK}}_{\mathbf{CMB}}$ for bull **daughters** in DNK evaluation
- Pedigree pruned to have only selected bulls and their DNK daughters
- As result, **effective record contribution** (**ERC**) is obtained for all animals in pruned pedigree.

ERC for bull represents amount of information left after information already for bull in DNK evaluation is taken in to account

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2. Calculation of pseudo-observations for bulls

Pseudo-observations for bulls are **deregressed proofs** (**DRP**) obtained using deregression. Input data:

- **EBV^{DFS}_{CMB}** for **bulls** to be blended
- **EBV^{DNK}_{CMB}** for **daughters** of blended bulls
- **ERC** from previous step is used as a **weight** for **bulls** and **daughters**
- Same pedigree as for ERC calculation

Obtained **DRP**s for bulls are used as an external observation.

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3. Running evaluation model with pseudo-observations

- **DNK** evaluation model needs to be modified to allow **DRP** as an **observation** and **ERC** as **weight** for bulls to be blended

Blending model

```
prot1   = hy1 ys1 cg1 ANIMAL1
prot2   = hy2 ys2 cg2 ANIMAL2
prot3   = hy3 ys3 cg3 ANIMAL3
BULLDRP =  -   -   -  0.5*ANIMAL1 0.3*ANIMAL2  0.2*ANIMAL3 !weight=ERC
```

NOTE: Single observation for a bull, **BULLDRP** , contains external information for all three traits in DNK model.

Results

Correlations between DFS and DNK before and after blending for blended bulls

	Lact 1	Lact 2	Lact 3	Combined
Before blending	0.85	0.85	0.85	0.86
After blending	0.98	0.97	0.95	0.98

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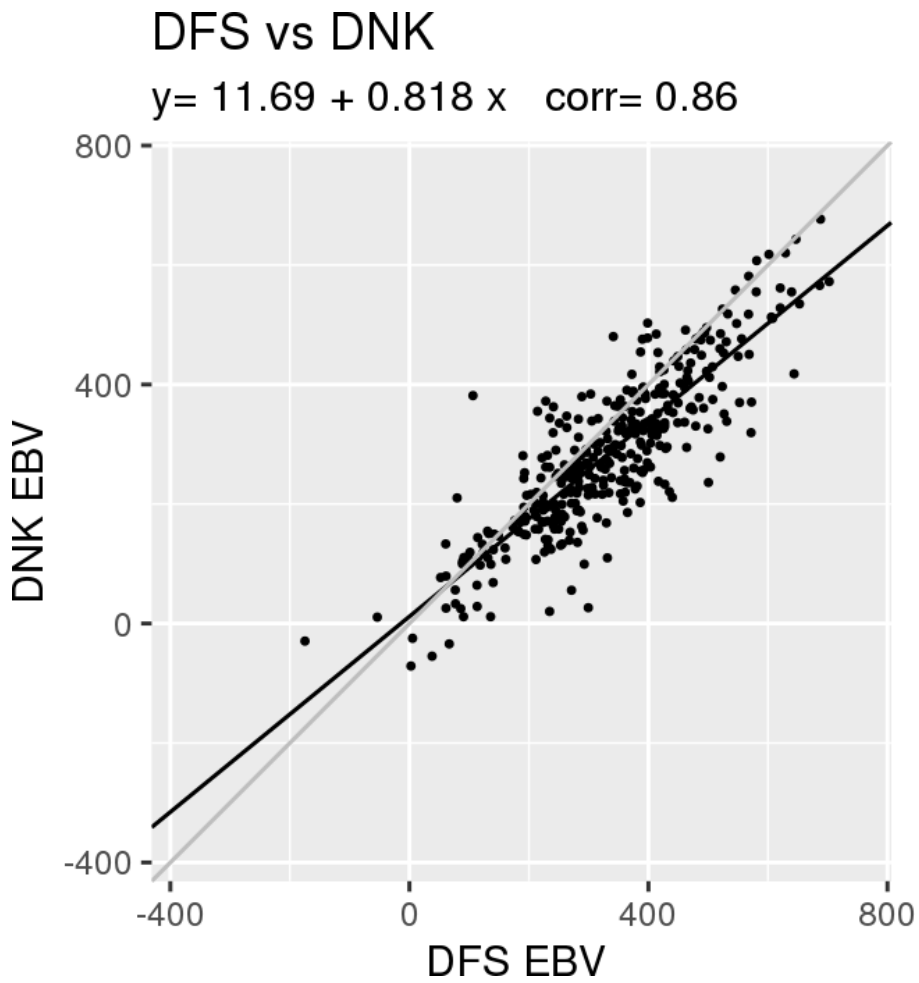
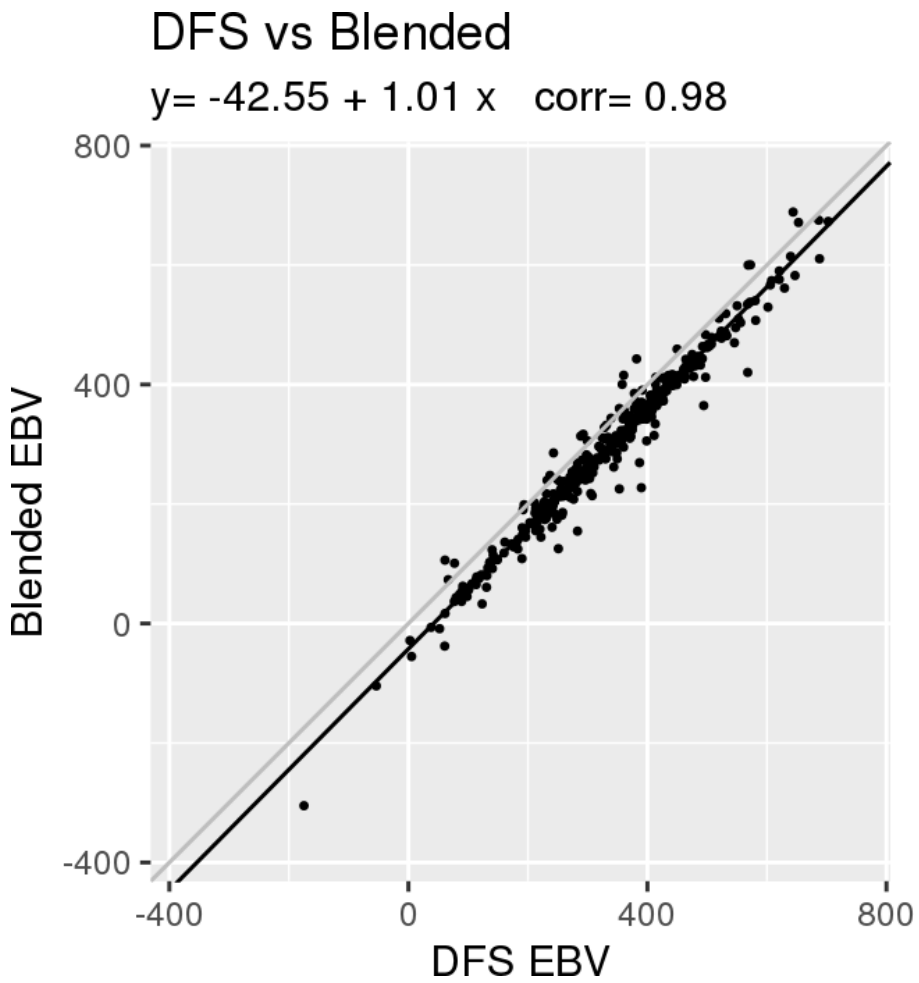
Plots of combined EBVs for blended bulls





Conclusions

Blending

- Blending method works reasonably well
- Relatively straightforward to **implement with MiX99** software
- Requires multiple steps

Further development

- Blending of external information to test-day models
- Test how blending works in practise with low heritable traits