Simple method to incorporate univariate Interbeef results into national multi-variate models

Raphael Mrode, Kirsty Moore and Mike Coffey

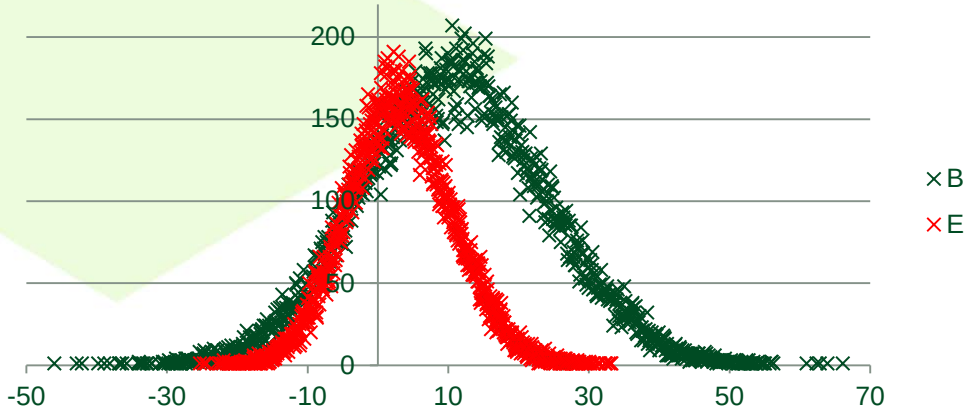
Leading the way in Agriculture and Rural Research, Education and Consulting

Introduction

- Currently Interbeef implements an across country model for the univariate analysis of weaning weight
- However most countries implement multi-trait animal models for the analyses of beef traits
- In the UK, the published evaluations for WWT is from a multi-variate analysis of 10 traits
- Also heritability estimated is different from that used in the UK evaluations

Introduction

- Consequently,
- The scale of evaluations for WWT from Interbeef and UK is different

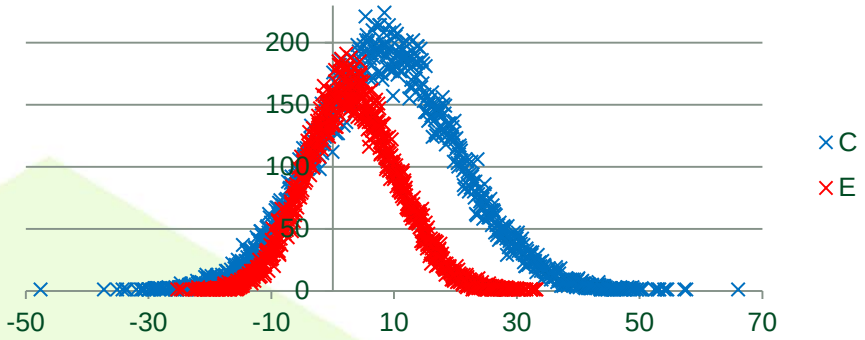


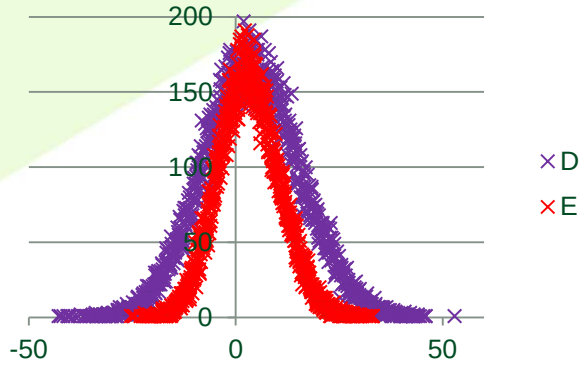
Introduction

- Gain in reliability is limited

	UK-off -	UK-UNI -	ITB -	UK-off	UK-UNI	ITB
min	46.017	42.727	25.306	0.35	0.34	0.38
max	66.082	52.882	33.201	0.95	0.94	0.83
mean	10.692	3.812	3.181	0.757	0.739	0.625
stdev	12.905	11.486	7.359	0.038	0.038	0.048

Distribution of evaluations





Objectives

- Simple method to incorporate Interbeef WWT into national WWT evaluations from multi-trait models
- Without double counting
- Combine increases in accuracy in WWT resulting from Interbeef across country evaluation with those from the national multi-trait model
-

Possible methods

- Blend Interbeef evaluations with UK official proofs.

- Carry out UK evaluations with WWT records removed and combined correlated EBV with Interbeef evaluations

  – Blend correlated EBV and interbeef evaluations
  – Combine correlated EBV and interbeef evaluations using MME approach (method 3)

The MME equations for a multi-trait model

- The equations for EBVs for a multi-trait model from the MME are:

$$\left(\mathbf{Z}'\mathbf{R}^{-1}\mathbf{Z} + \mathbf{A}^{-1}\mathbf{G}^{-1}\right)\hat{\mathbf{a}} = (\mathbf{Z}'\mathbf{R}^{-1}\mathbf{Z})\mathbf{YD}$$

$$(\mathbf{Z}'\mathbf{R}^{-1}\mathbf{Z} + \mathbf{G}^{-1}\alpha_{anim})\hat{\mathbf{a}}_{anim} = 2\mathbf{G}^{-1}\alpha_{par}(\mathbf{PA}) + (\mathbf{Z}'\mathbf{R}^{-1}\mathbf{Z})\mathbf{YD} + 0.5\mathbf{G}^{-1}\sum\alpha_{prog}(2\hat{\mathbf{a}}_{prog} - \hat{\mathbf{a}}_{mate})$$

$$\hat{\mathbf{a}}_{anim} = \mathbf{W}_1\mathbf{PA} + \mathbf{W}_2\mathbf{YD} + \mathbf{W}_3\mathbf{PC}$$

MME equations for a multi-trait model

- EBV from multivariate Equations are:

$$\mathbf{a_{i-m} = W_1(YD_j - PA_j) + W_1PA_i + W_2YD_i}$$

EBV from missing trait

- $$\mathbf{a_{i-rm} = W_1(YD_j - PA_j) + W_1PA_i}$$

- EBV from Univariate

$$\mathbf{a_{i-u} = 0 + W_1PA_i + W_2YD_i}$$

- EBV from univariate combined with correlated EBV

$$\mathbf{a_{i-c} = a_{i-rm} + a_{i-u} - W_1PA_i}$$

MME equations for a multi-trait model

- EBV from univariate combined with correlated EBV

$$\mathbf{a_{i-c} = W_1(YD_j - PA_j) + W_1PA_i + W_2YD_i}$$

$$MS_i = \mathbf{= W_1(YD_j - PA_j)} = G_{jj}^{-1}G_{i,j}(a_j - PA_j).$$

- It results in over-prediction

$$\mathbf{a_{i-c} = W^*_1(YD_j - PA_j) + W_1PA_i + W_2YD_i}$$

$\mathbf{W^*_1}$ = the W_1 from the full model = MS*

Small example

Calves	sex	sire	dam	WWG	PWG
4	male	1	-	4.5	6.8
5	female	3	2	2.9	5.0
6	female	1	2	3.9	6.8
7	male	4	5	3.5	6.0
8	male	3	6	5.0	7.5

- Animal 8 : Multi-trait MME : 0.392 Univariate = 0.384
- Combined EBV = MS + UNI = 0.1032 + 0.384 = 0.487
- Combined EBV = MS* + UNI = 0.0136 + 0.384 = 0.397

Results

- Tried the various methods on about 7000 animals
- Have 2 traits and missing records for the other traits

1. Simple blend

	UK-UNI	ITB	UK-OFF
Means	0.241	1.056	6.499
STD	11.934	7.136	12.925

Means	3.426	4.201	6.499
STD	12.152	10.152	12.925

- Double counting. How to handle foreign animals?

Results

- Blend correlated EBV blend

	UK-UNI	ITB	UK-OFF
Means	0.241	1.056	6.499
STD	11.934	7.136	12.925

Means	6.126	6.941	6.499
STD	19.879	14.908	12.925

Correlations

UK-UNI	ITB	UK-OFF
1.0	0.88	0.96
0.95	1.0	0.85
0.90	0.96	1.0

Results

- Method 3

	UK-UNI	ITB	UK-OFF
Means	0.2410	1.0558	6.4990
STD	11.9344	7.1357	12.9252

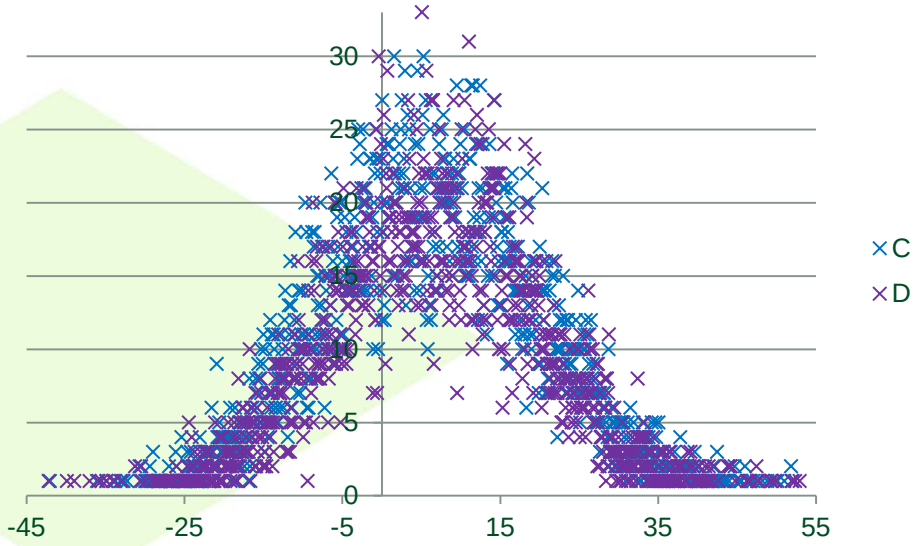
Means	2.3909	4.2744	6.4990
STD	14.4410	12.5373	12.9252

Correlations

UK-UNI	ITB	UK-OFF
1.0	0.87	0.96
0.93	1.0	0.85
0.97	0.91	1.0

Results

- Combined results and UK-official



Combined reliabilities + Foreign animals

- Accuracy from correlated run corrected from parent- Rel_{nopa}
- Combined reliabilities = DE_{itb} + $DE_{relnopa}$
- Foreign animals (approximations)
  - Regression of MS* for UK animals with only WWT records on ITB EBV
  - Similar regression for gain in accuracies
  - Or $Rel_i = \Sigma r_g^2 Rel_{nopa}$

Conclusion

- Incorporation of information from the multi-trait model into evaluations from Interbeef is necessary
- Simple blending seems inadequate as there is double counting
- Blending correlated EBVs is possible but has some limitations but it is easy to implement.
- Incorporating correlated evaluations using the MME approach seems the best method

Thank you