The effect of correlated herd effects on their variance component estimate INR AgroParisTech / Universite



<u>Beatriz CD Cuyabano^{1*}</u>, Cedric Gondro², and Gabriel Rovere¹

¹INRAE, AgroParisTech, GABI, Université Paris Saclay, 78350 Jouy-en-Josas, France

²Department of Animal Science, Michigan State University, 474 S Shaw Ln, East Lansing, MI 48824 USA



beatriz.castro-dias-cuyabano@inrae.fr

Genetic evaluation model in beef cattle:



Herds are often treated as independent

Herds are in geographical proximity/distance

Results on the Hanwoo data

(farms were all on a relatively similar environment)

Heritability and environmentability estimates $(\hat{h}^2 = \sigma_g^2 / \sigma_y^2)$ and $\hat{e}^2 = \sigma_\eta^2 / \sigma_y^2)$, Table prediction accuracy of genomic breeding values and herd effects ($r_{PGBV} = cor(\tilde{g}_{test}, y_{test})$) and $r_{\eta} = cor(\tilde{\eta}_{test}, y_{test}))$, reliability of predicted genomic breeding values and herd effects $R_{PGBV}^2 = r_{PGBV}^2 / \hat{h}^2$ and $R_{\eta}^2 = r_{\eta}^2 / \hat{e}^2$), over 100 cross-validation replicates of each model.

Trait	Model	\widehat{h}^2	\widehat{e}^2	<i>r_{PGBV}</i>	rη	R^2_{PGBV}	R_{η}^2
Backfat Thickness	GRM + FARM	0.35 ¤.†	0.03 a.†	0.34 ª	0.10 ª	0.34 ª	0.32 ª
	GRM + GPS	0.30 a,†	0.15 b.†	0.34 a	0.15 ^b	0.39 ^b	0.15 ^b
Eye Muscle Area	GRM + FARM	0.34 a.†	0.09 a.†	0.34 ª	0.28 °	0.34 ª	0.87 °
	GRM + GPS	0.17 b.†	0.53 b.†	0.34 a	0.30 b	0.66 ^b	0.17 d
Carcass Weight	GRM + FARM	0.39 ¤.†	0.05 ∘.†	0.38 a	0.17 ª	0.36 ª	0.67 °
	GRM + GPS	0.29 b.†	0.30 d.†	0.38 a	0.18 a,b	0.50 ^b	0.11 ^b
Marbling Score	GRM + FARM	0.36 a.†	0.10 c.†	0.37 ª	0.13 °	0.38 ^b	0.16 °
	GRM + GPS	0.22 ^{b,†}	0.44 ^{b,†}	0.37 a	0.39 b	0.63 °	0.35 ^b

a, b, c, d: Different letters indicate statistically different values using Tukey's multiple comparison test at a significance level of 0.05, comparing the results in each column within each trait. [†] Variance component statistically different from zero

> table extracted and modified from https://doi.org/10.3390/ani11072050

Two datasets with farms GPS coordinates: 1. Hanwoo beef cattle data

Results on the Angus data

(farms were on different environments)

Trait	Model	Var_animal	Var_herd	Var_residual
Birth weight (Var_y = 17,10)	PED + FARM	3.86	2.92	9.21
	PED + GPS	3.72	169.6	8.99
Weaning weight (Var_y = 1,642)	PED + FARM	396	536	588
	PED + GPS	319	38,309	627
Post-weaning weight (Var_y = 5,151)	PED + FARM	773	1,383	1,466
	PED + GPS	27	99,811	2,140

Variance component estimates associated to the herd, with the GPS model greatly exceeded the total phenotypic variance (Var_y).

Variance component estimates within the phenotypic variance.

GPS can be used as a proxy for correlation between herds, but if herds are on very different environments, it may cause an explosion of the variance component associate to the herd.

y = Xb + g + h + e

- b: fixed effects
- g: breeding values





