A study on recursive relationships between performance and visual score traits in swine

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Outline

Introduction

- Visual scores of muscling are commonly included as selection criteria in an attempt to make inferences about carcass composition
- However, genetic studies on visual scores are scarce
- Their genetic and phenotypic relationships with carcass composition remain unknown

Introduction

- Recursive models allow to study the relation between cause and effect
- Carcass composition(lean and fat) is related to Growth (live weight)
- This relation can be dependent on the sex

Objectives

1. The objective was to analyze the recursive relationships of live weight (LW) nested within sex on lean depth (LD), backfat thickness (BT) and musculature visual score (MVS) in Pietrain breed pig

Data

- Belong to Selección Batallé S.A
- Station testing records between 160-200 days
- Period 2000-2009
- 26964 $\rightarrow$ pedigree and 25268 $\rightarrow$ Records

Records

	Live weight	Lean depth	Backfat thickness
Mean	100.6 kg	62.72 mm	6.79 mm
Sd	12.36 kg	5.30 mm	1.29 mm

Visual Score

	1	2	3	4
Number	966	7112	17007	183
%	4	28	67	1

Recursive model LW $\Rightarrow$ LD, BT, MVS

- Joint Multivariate distribution for LW, LD, BT and MVS
- Records of the individual *i* belong to the sex *k*

$$\mathbf{\Lambda_k y_i} = \mathbf{X_i b} + \mathbf{Z_i a} + \mathbf{W_i p} + \mathbf{e}$$

Where

$$\mathbf{y_i}|\mathbf{\Lambda_k}, \mathbf{b}, \mathbf{a}, \mathbf{p}, \mathbf{R_0} \sim \mathbf{N}(\mathbf{\Lambda_k}(\mathbf{X_i b} + \mathbf{Z_i a} + \mathbf{W_i p}), \mathbf{\Lambda_k^{'-1} R_0 \Lambda_k^{-1}})$$

- $\mathbf{y_i} \rightarrow$ 4 x 1 records LW, LD, BT and MVS
- $\mathbf{b} \rightarrow$ days(LW), sex(2) and batch (194)
- $\mathbf{a} \rightarrow$ additive genetic effect(26964)
- $\mathbf{p} \rightarrow$ litter effects(6600)
- $\mathbf{X_i}, \mathbf{Z_i}, \mathbf{W_i}$ incidence matrices

Model

- $\mathbf{\Lambda}_k$ is the structural coefficient matrix

$$\mathbf{\Lambda}_k = \begin{pmatrix} 1 & 0 & 0 & 0 \\ -\lambda_{k\,LD \leftarrow LW} & 1 & 0 & 0 \\ -\lambda_{k\,BT \leftarrow LW} & 0 & 1 & 0 \\ -\lambda_{k\,MVS \leftarrow LW} & 0 & 0 & 1 \end{pmatrix}$$

- $k = 1, 2$

McMC

- Posterior distribution $p(\theta|\boldsymbol{y})\alpha p(\boldsymbol{y}|\theta) * p(\theta)$
  $\theta = \boldsymbol{\Lambda}_k, \mathbf{b}, \mathbf{a}, \mathbf{p}, \mathbf{G_0}, \mathbf{P_0}, \mathbf{R_0}$
  $p(\theta) = p(\boldsymbol{\Lambda}_k)p(\boldsymbol{b})p(\boldsymbol{a}|\boldsymbol{G}_0)p(\boldsymbol{G}_0)p(\boldsymbol{p}|\boldsymbol{P}_0)p(\boldsymbol{P}_0)p(\boldsymbol{R}_0)$
- Priors
  - $\boldsymbol{\lambda_k}$, $\mathbf{b}$, $\mathbf{a}$, $\mathbf{p}$ $\Rightarrow$ Multivariate Normal
  - $\mathbf{G_0}$, $\mathbf{R_0}$, $\mathbf{P_0}$ $\Rightarrow$ Inverted Wishart ($\mathbf{R_0}$ is diagonal)
- Gibbs Algorithm

Parameters interpretation as SMM (Gianola and Sorensen, 2004)

"adjusted" by $\boldsymbol{\Lambda}_k$

$$\mathbf{G}_* = \boldsymbol{\Lambda}_k^{-1}\mathbf{G_0}\boldsymbol{\Lambda}_{\mathbf{k}}^{'-1}$$

$$\mathbf{P}_* = \boldsymbol{\Lambda}_k^{-1}\mathbf{P_0}\boldsymbol{\Lambda}_{\mathbf{k}}^{'-1}$$

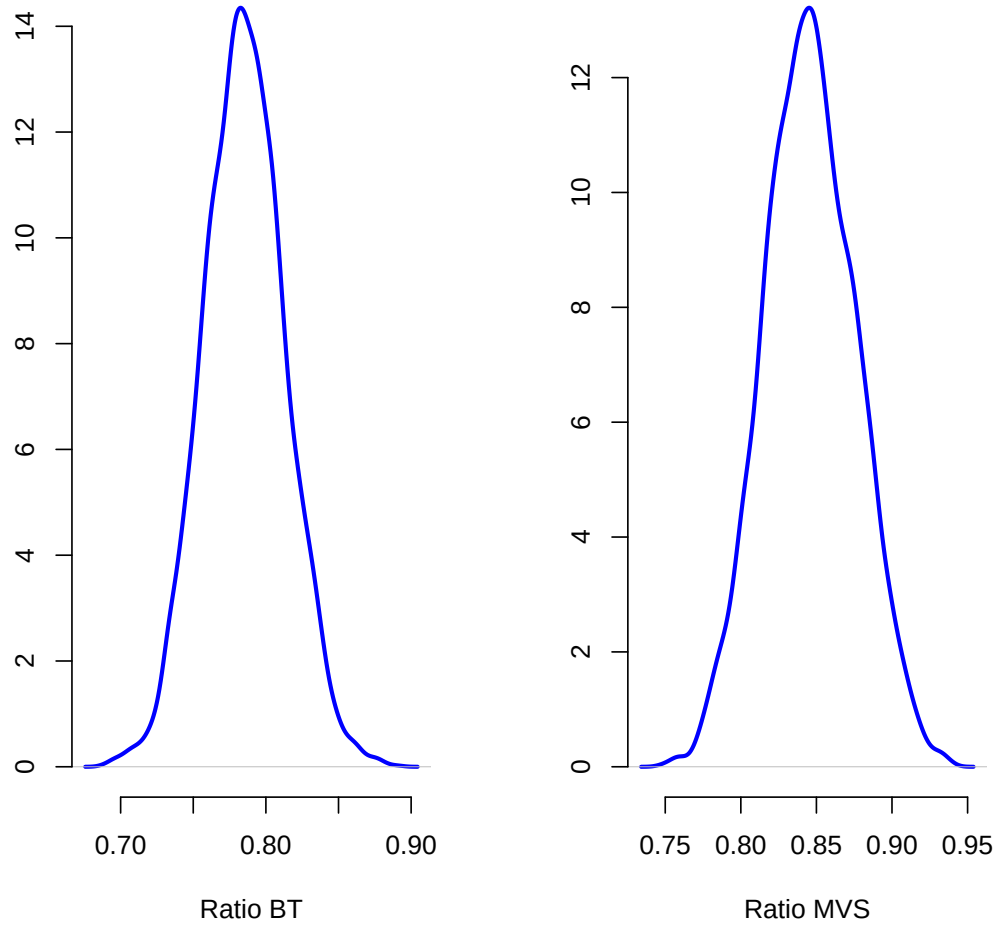
$$\mathbf{R}_* = \boldsymbol{\Lambda}_k^{-1}\mathbf{R_0}\boldsymbol{\Lambda}_{\mathbf{k}}^{'-1}$$

Posterior means of λ

λ	Sex_{Male}	Sex_{Female}	P(ratio)>1	
$\lambda_{LD \leftarrow LW}$	0.210 (0.006)	0.206 (0.007)	0.69	*a*
$\lambda_{BT \leftarrow LW}$	0.034 (0.002)	0.044 (0.002)	0.00	
$\lambda_{MVS \leftarrow LW}$	0.030 (0.001)	0.036 (0.001)	0.00	

[a]ratio= Sex_{Male}/Sex_{Female}

Posterior distribution of the λ_k ratios



Posterior means of Heritabilities and Genetic correlations for Males

Trait	LW	LD	BT	MVS
LW	0.43 (0.01)	0.69 (0.01)	0.76(0.01)	0.86(0.01)
LD	-	0.42(0.02)	0.40 (0.02)	0.91(0.01)
BT	-	-	0.43 (0.02)	0.55(0.01)
MSV	-	-	-	0.45 (0.02)

[a]

- h^2_{MVS} =0.18 (0.01)

[a] h^2 diagonal; ρ upper diagonal

Posterior means of Heritabilities and Genetic correlations for Females

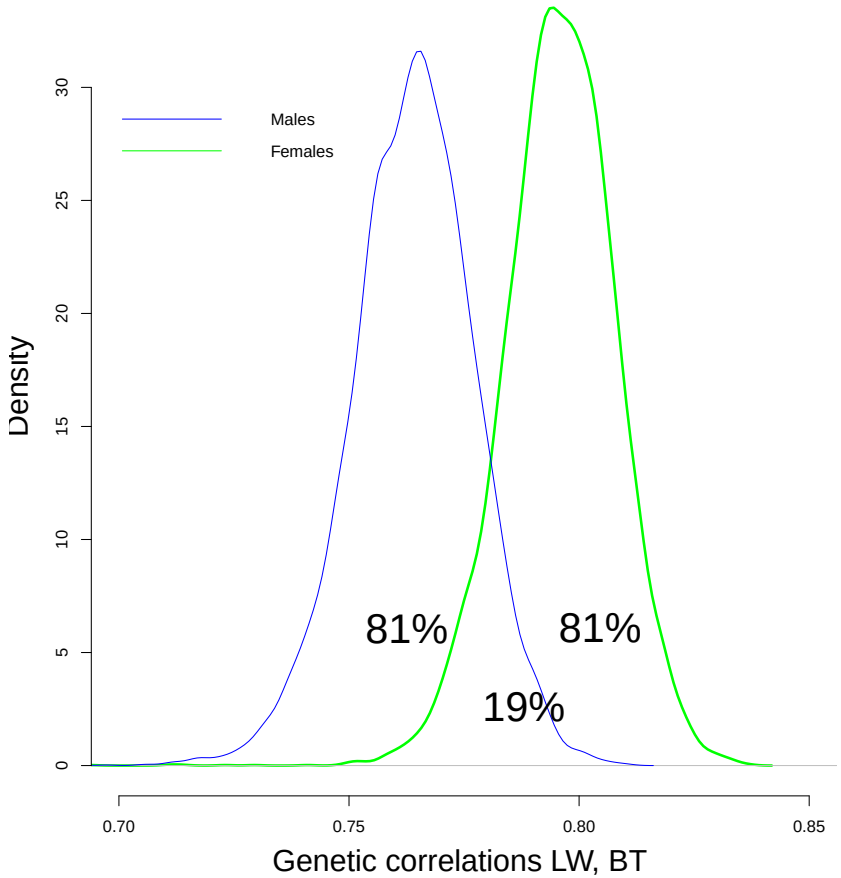
Trait	LW	LD	BT	MVS
LW	0.43 (0.01)	0.69 (0.01)	0.80(0.01)	0.88(0.01)
LD	-	0.42(0.02)	0.43 (0.02)	0.90(0.01)
BT	-	-	0.43 (0.02)	0.60(0.02)
MSV	-	-	-	0.46 (0.02)

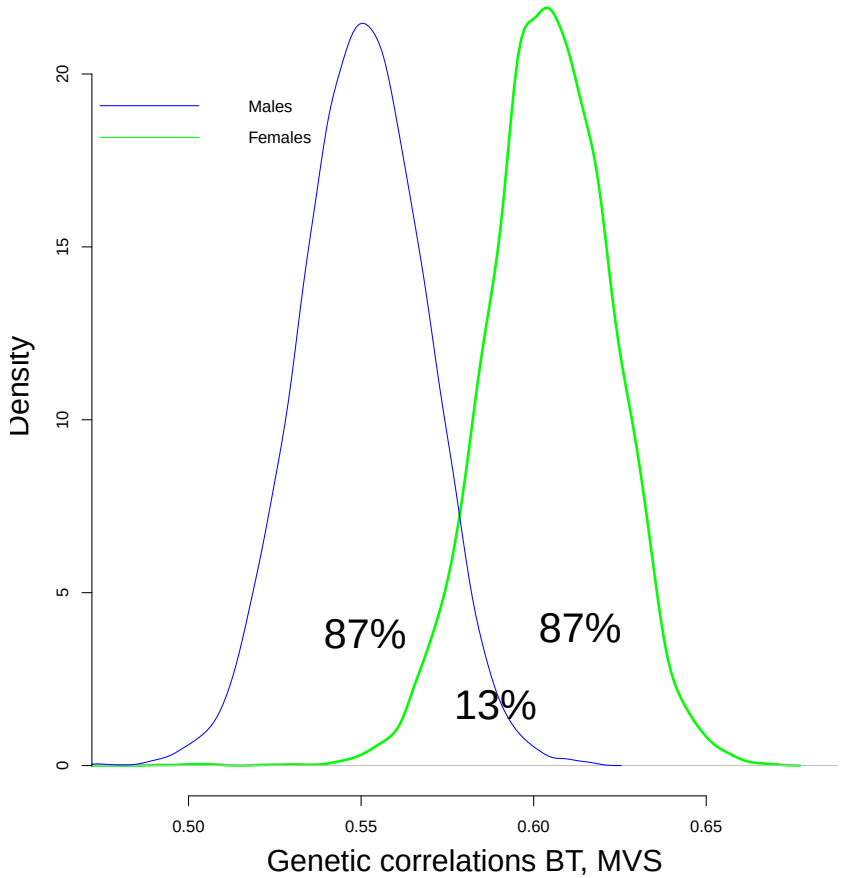
[a]

- h^2_{MVS} =0.18 (0.01)

[a] h^2 diagonal; ρ upper diagonal

Posterior distribution of the Genetic correlations





Summary

- Positive relation between LW and LD, BT, MVS
- A higher increase of BT and MVS in Females when LW increase
  - $\Uparrow$ 10 kg BT increase 1.5% more in Females
  - $\Uparrow$ 10 kg the probability to change from 3 to 4 MVS is 5% > in Females
- MVS is genetically highly correlated with LW and LD
- Females showed higher genetic correlation than Males between LW and BT and BT and MVS

Conclusions

1. These results would suggest that, although lean depth and musculature score are highly genetically correlated, the visual score of musculature could be related with a higher backfat deposition in the female muscles
2. More research would be needed to deeply study the relationship between these traits and confirm these outcomes