Combining purebred and crossbred information of nurse capacity and fertility

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Motivation

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- **Number of weaned piglets key for productivity**
  - Litter size
  - Nurse capacity
- **Nurse capacity reliable in crossbreds**
  - Crossbred sows are robust
  - Crossbred pigs have higher survival
- **Crossbred information can be used to select purebred lines**
  (Wei and van der Werf , 1994)

Objective

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To analyse nurse capacity of crossbred sows tracing the genetic effect back to purebred lines

and estimate genetic correlation to the total number of born and litter size at day 5 in the purebred lines

Objective

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To analyse nurse capacity of crossbred sows
tracing the genetic effect back to the purebred lines
and
to evaluate how crossbred information affect purebred selection

Experimental data

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Only gilts were recorded

Type of animal	Trait	Number of gilts
Crossbred gilts	TNB	11 247
Crossbred gilts	LS5	9 647
Crossbred gilts	NC	9 902
Purebred Landrace gilts	TNB	59 884
Purebred Landrace gilts	LS5	59 762
Purebred Yorkshire gilts	TNB	37 495
Purebred Yorkshire gilts	LS5	37 424
Animals in pedigree		133 205

Data of crossbred gilts

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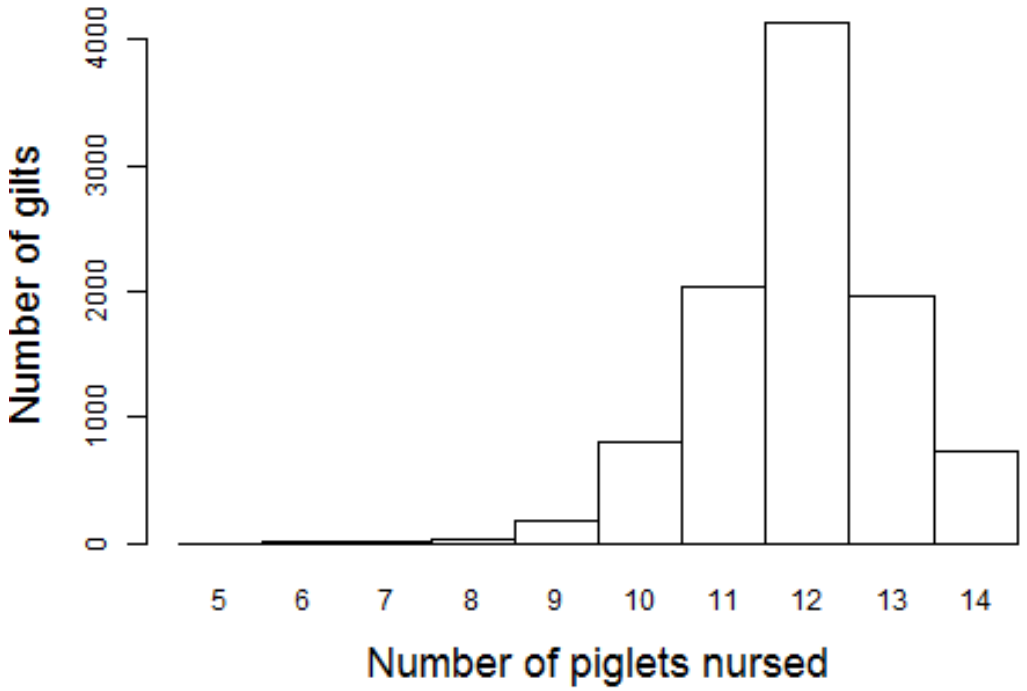
1. At farrowing TNB were recorded
2. Up to day 3 all gilts were given 14 piglets
3. At day 5 LS5 were recorded
4. At 3 weeks number of piglets nursed per litter was recorded



Crossbred and purebred lines

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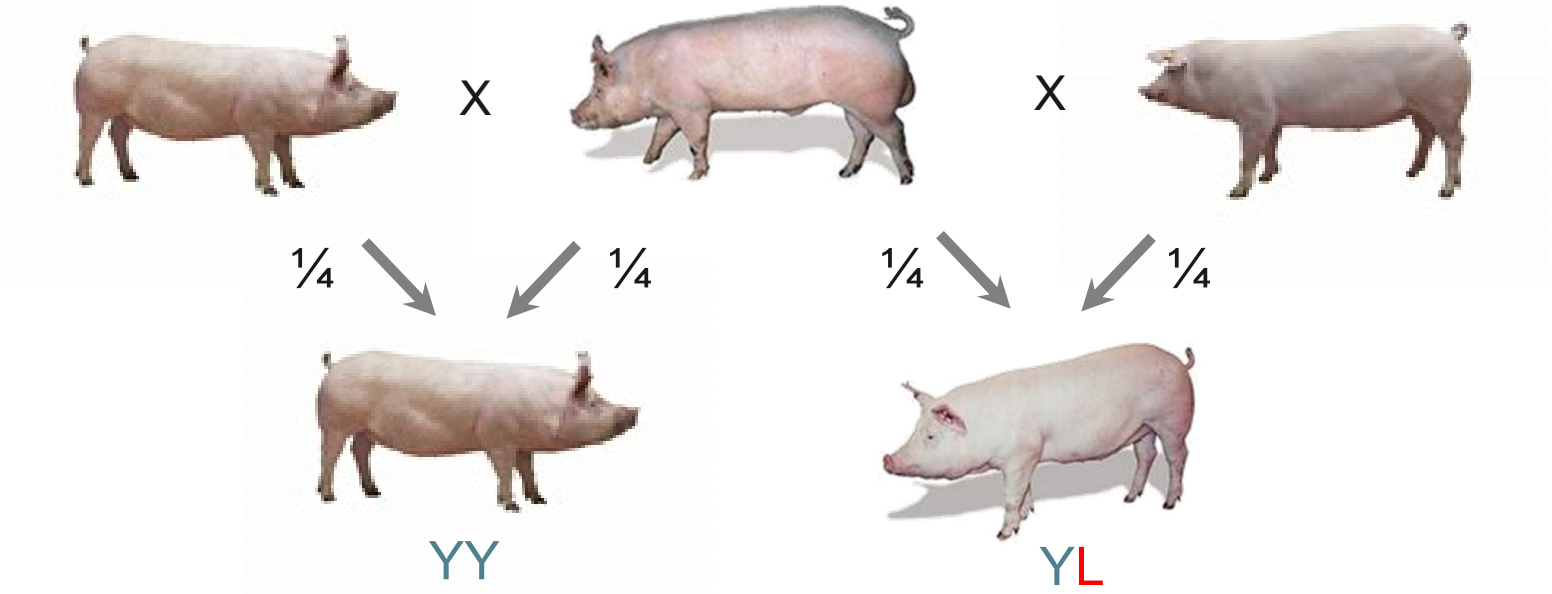
Yorkshire to Yorkshire Yorkshire to Landrace



Pedigree **only** related to Yorkshire

Pedigree related to **both** Yorkshire and Landrace

Model

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$$\begin{bmatrix} y_{TNB,L} \\ y_{TNB,Y} \\ y_{TNB,LY} \\ y_{NC,LY} \end{bmatrix} = \begin{bmatrix} X_{TNB,L} & 0 & 0 & 0 \\ 0 & X_{TNB,Y} & 0 & 0 \\ 0 & 0 & X_{TNB,LY} & 0 \\ 0 & 0 & 0 & X_{NC,LY} \end{bmatrix} \begin{bmatrix} b_{TNB,L} \\ b_{TNB,Y} \\ b_{TNB,LY} \\ b_{NC,LY} \end{bmatrix} +$$

Animal model

"L-Y" model

$$\begin{bmatrix} Z_L & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & Z_Y & 0 & 0 \\ 0 & Z_{L-LY} & 0 & 0 & Z_{Y-LY} & 0 \\ 0 & 0 & Z_{L-LY} & 0 & 0 & Z_{Y-LY} \end{bmatrix} \begin{bmatrix} a_{TNB,L} \\ a_{TNB,L-LY} \\ a_{NC,L-LY} \\ a_{TNB,Y} \\ a_{TNB,Y-LY} \\ a_{NC,Y-LY} \end{bmatrix} + \begin{bmatrix} e_{TNB,L} \\ e_{TNB,Y} \\ e_{TNB,LY} \\ e_{NC,LY} \end{bmatrix}$$

Reduced animal model

Genetic variance

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$$\begin{pmatrix} a_{TNB,L} \\ a_{TNB,L-LY} \\ a_{NC,L-LY} \\ a_{TNB,Y} \\ a_{TNB,Y-LY} \\ a_{NC,Y-LY} \end{pmatrix} \sim N(0,G), \quad G = \begin{bmatrix} G_L \otimes A_L & 0 \\ 0 & G_Y \otimes A_Y \end{bmatrix}$$

Genetic results

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Landrace

	Model of TNB and NC			Model of LS5 and NC		
Landrace	1.42			0.69		
Crossbred	0.73	0.55		0.86	0.34	
Crossbred, NC	-0.26	-0.12	0.05	-0.15	-0.02	0.05

Yorkshire

	Model of TNB and NC			Model of LS5 and NC		
Landrace	1.02			0.72		
Crossbred	0.51	0.90		0.79	0.62	
Crossbred, NC	-0.38	-0.11	0.07	-0.30	-0.02	0.06

Variance in the diagonals, and correlations below

Results for TNB

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Landrace

Trait	TNB-L	TNB-LY	NC-LY
TNB in Landrace	1.42	0.73	-0.26
TNB in crossbred	0. 64	0.55	-0.12
NC in crossbred	-0. 06	-0.02	0.05

Yorkshire

Trait	TNB-Y	TNB-LY	NC-LY
TNB in Yorkshire	1.02	0.51	-0.38
TNB in crossbred	0.49	0.90	-0.11
NC in crossbred	-0.10	-0.03	0.07

Results for LS5

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Landrace

Trait	LS5-L	LS5-LY	NC-LY
LS5 in Landrace	0.69	0.86	-0.15
LS5 in crossbred	0. 42	0.34	-0.02
NC in crossbred	-0. 03	-0.00	0.05

Yorkshire

Trait	LS5-Y	LS5-LY	NC-LY
LS5 in Yorkshire	0.72	0.79	-0.30
LS5 in crossbred	0.52	0.62	-0.02
NC in crossbred	-0.06	-0.00	0.06

Heritability

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Trait	h^2 L	h^2 Y
TNB in Landrace	0.09	-
TNB in Yorkshire	-	0.07
TNB in crossbred	0.06	0.09
LS5 in Landrace	0.05	-
LS5 in Yorkshire	-	0.06
LS5 in crossbred	0.04	0.07
NC in crossbred	0.04	0.05

Information in crossbreds

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In a bivariate Gaussian distribution we have conditional expectation where

$$\beta_{y|x} = \frac{\sigma_{xy}}{\sigma_x^2}$$

	TNB	LS5
Transfer from Landrace	45 %	61 %
Transfer from Yorkshire	48 %	73 %
Total transfer	93 %	134 %

Information only from crossbred

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Difficult to estimate

- Related to expected response to selection

$$R = ir\sigma_a$$

- Missing information from
  - — Full sibs
  - — Purebred half sibs

- Information from crossbred half sibs only

Summary and conclusion

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Summary

- ✓ Nurse capacity recorded in crossbreds were heritable
- ✓ Genetic variances for nurse capacity were low (0.05 to 0.07)
- ✓ Selection in purebreds affect crossbred (TNB: 93%, LS5: 134%)

Conclusion

The genetic gain of nurse capacity is expected to be low