

Development of a generator of virtual pigs based on a generic covariance pattern

for modelling growth performance to account for variability among individual pigs in deterministic growth models

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Introduction

Most pig growth models are deterministic and consider only the mean pig and not the group of pigs. Inclusion of variability among individuals in modelling approaches is required to better understand the effects of feeding strategies on mean growth, economic and environmental performance, but also the variability of these traits.

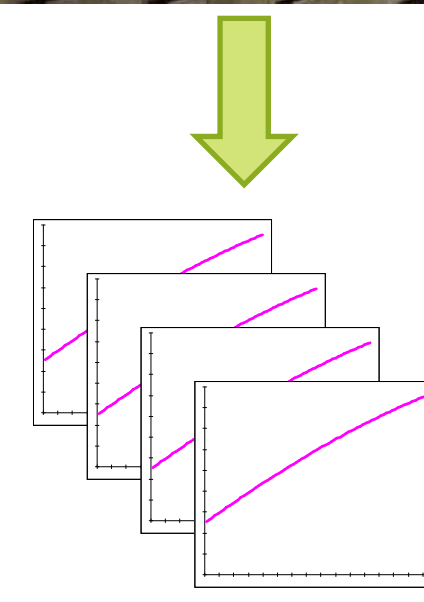
Objectives

- To analyze growth and intake data of individual pigs from different terminal crossbreeds reared in France
- To obtain, describe and use covariance structure of model parameters, such as those used in InraPorc model
- To propose a generator to create virtual pig populations with realistic variability

Material and methods

Data collection

- **Animals:**
 - 10 batches x 144 gilts and barrows (70 d of age → 110 kg)
 - 10 sire lines (2 per batch)
- **Feeding level:** *ad libitum* (9.7 net energy (NE)/kg)
- **Measurements**
 - Individual daily feed intake (DFI)
 - Body weight (BW) : every 3 weeks



	Pig1	Pig2	Pig3	...
BW ₇₀				
PDm				
B _{Gompertz}				
DFI ₅₀				
DFI ₁₀₀				

Statistics

➤ Means of parameters

Vector of means

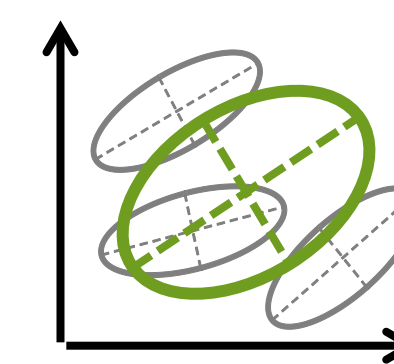
BW ₇₀	PDm	B _{Gomp}	DFI ₅₀	DFI ₁₀₀
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Analyses of the effects of crossbreed, sex, batch, and their interactions (proc Mixed, SAS)

➤ Comparison of covariance matrices

- Method of Flury hierarchy (1988) based on comparison of principal components (PC). Matrices described as unrelated, or with a common PC, or two common PC, etc. If with all common PC, matrices can be proportional or equal
- Comparison depending on crossbreed, sex, batch and combination → comparison of 2 to 40 matrices
- Comparison of 40 matrices from groups defined by crossbreed, sex, batch combinations
 - with a "raw" matrix computed from the 1288 individuals
 - with a "median" matrix

= weighted median of the 40 matrices



Median covariance matrix

	BW ₇₀	PDm	B _{Gomp}	DFI ₅₀	DFI ₁₀₀
BW ₇₀	11.8	13.5	-0.00036	-0.118	1.95
PDm		267	-0.00588	4.58	19.6
B _{Gomp}			0.00011	-0.00201	-0.00043
DFI ₅₀				5.23	1.82
DFI ₁₀₀					9.68

Data analyses

➤ Characterization of DFI and BW kinetics for each individual pig by 5 parameters used in InraPorc model:

- BW₇₀: BW at 70 d of age (kg)
 - PDm: mean protein deposition (70 d → 110 kg BW) (g/d)
 - B_{Gompertz}: precocity (/d)
 - DFI₅₀: NE intake at 50 kg BW
 - DFI₁₀₀: NE intake at 100 kg BW
- $BW = f(\text{age})$
 Gompertz function
 $DFI = f(BW)$
 Gamma of maintenance

➤ Database: 1288 pigs

Results

Means of parameters

➤ The mean values of parameters depended on crossbreed, sex and batch → A specific vector of parameter means per group

Covariance matrices

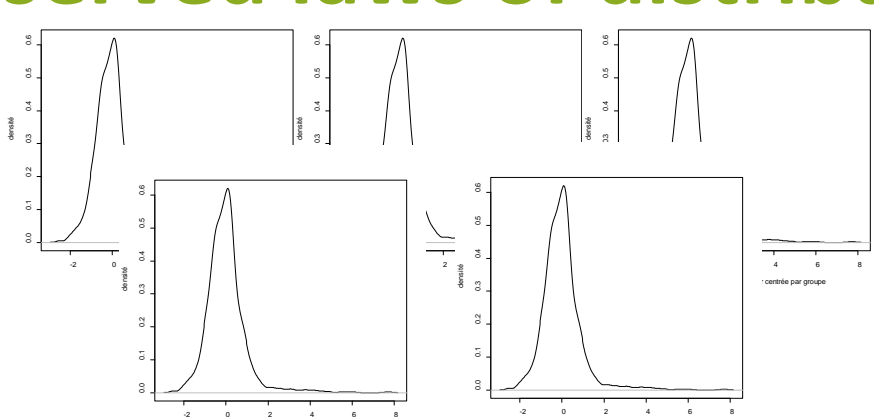
- The covariance structure of parameters differed from one group to another → No common structure to generate sets of parameters
- The median matrix is a better estimator of the observed covariance than the raw covariance matrix for 72% of the 40 group matrices → Selected as generic model of covariance matrix

Proposition of a generator of virtual pig populations

➤ Observed distributions of parameters ≠ known laws

➤ Proposal of an adapted multivariate generator

- Observed laws of distribution



Transformation to obtain uncorrelated independent laws of distribution

- Vector of parameter means
- Median covariance matrix

Multivariate generation of X sets of individual parameters

Iterations to avoid unrealistic values and to obtain a population of chosen size

Virtual population

	Pig1	Pig2	Pig3	...
BW ₇₀				
PDm				
B _{Gomp}				
DFI ₅₀				
DFI ₁₀₀				

Conclusions

This work allows considering the inclusion of stochasticity aspects in models and decision support tools, such as InraPorc software. This will help users to study and propose innovative feeding strategies, meeting performance and environmental goals and considering / using realistic variability among individual pigs.