Towards more uniform pig performance

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Variability: The issue...

- Cost to industry $
- Stabilise the supply chain
  - Targeting the main traits that increase variability
- Maximise *pig numbers* and *growth* of pigs

‘*consistent performance to guarantee consistent supply of pork*’
Variability: Statistical definition

- Average or ‘Mean’
- Spread or ‘Standard deviation’

Histogram of Trait

N

Trait
Variability: Statistical definition

**Medium SD**

**High SD**

**Low SD**
Variability: Statistical definition

Medium SD

High SD

Low SD
Variability: Statistical definition

- Medium SD
- High SD
- Low SD

Normal Distribution
Variability: Statistical definition: It means...

- Mean $\pm$ 1 SD = 68.2 %
- Mean $\pm$ 2 SD = 95.4 %
- Mean $\pm$ 3 SD = 99.6 %

- EXAMPLE

- Farm mean Backfat = 11 & SD = 1 mm
- Penalty if Backfat greater than 12 mm
- 15.9 % of pigs will invoke penalty
Variability: The issue...

- Be aware!
  Mean and standard deviation linked!

- The SD will increase with a larger mean
  - This is called the ‘scaling effect’
Variability: What the issue means

- For **Backfat**
  - Lower backfat means less variation

- For **Growth**
  - If you want less variation *reduce the Mean*
  - **NOT IDEAL**
  - Can we increase the mean and:
    - Not increase the SD
    - Perhaps decrease the SD
Variability: Tackling the issue genetically

- General GOAL in breeding:

  ‘Can we favourably move the mean without detrimentally moving variability?’

- More specifically:

  ‘Can we breed for more uniform performance within a specific environment?’
Uniformity: The theory

A simple animal model:

\[ y_i = X\beta + Z_1a_i + e_i \]
Uniformity: The theory

A simple animal model:

\[ y_i = X\beta + Z_1a_i + e_i \]

- Trait
- Fixed effects
- Animal (genetic)
- ‘Error’
Uniformity: The theory

A simple animal model:

\[ y_i = X\beta + Z_1 a_i + e_i \]

- Error or ‘environmental’ component
  - Reflects the within-environmental and temporal sensitivity of the animals
Uniformity: Question

‘Is there genetic variation in the residual component?’

‘Are there genetic differences between sires in the residual (error) variation of their progeny?’
Uniformity: Basic two-step process

Use performance traits from multiple progeny of selected sires

Model One: (Use trait)
Estimate genetic (mean) and error effects

Model Two: (Use transformed error)
Estimate genetic effects for variation

Output of Model One & Two:
Estimated Breeding Values for mean and variance
Uniformity: Genetics conclusion

- The theory is still being developed

- Major data issues: ‘quality and quantity’!!!

- Hill and Mulder (2010) review show limited opportunities to select for reduced variation
  - Median $h^2_V$ for pig traits = 0.03
  - Moderate $GCV_E$ but unattainable currently
Variability: To the farm

- GOAL at the farm:

‘Can we identify and reduce variability at the farm level?’
Variability: Farm level: The causes

- Temporal – within and between year
- Breeds
- Herds – Location
- Sex
- Parity
- Age... – Management!
- Birth litter
- Genetics
- Etc etc etc.....
Variability: Trends

- Selection has improved traits
  - What has this genetic improvement done to variation?

- Data from National Pig Improvement Program
  - 15 years of records
  - 11 herds
  - 3 breeds
  - ~400,000 production records
  - ~85,000 reproductive records
Variability: Yearly trends: Production

Backfat

Lifetime growth

Corrected for end weight

~0.8mm

~80g/day
Variability: Yearly trends: Production SD

Backfat  

lifetime growth

See APSA 2011
Variability: Yearly trends: Reproduction

NBA

0.3 piglets

Year


piglets
Variability: Yearly trends: Reproduction SD
Variability: Within year trends: Production

**Backfat**

**Lifetime growth**

**Backfat Trends**

- Corrected for end weight

**Growth Trends**
Variability: Where is the variation from?

- Between and within year shown
- Quantification of ALL sources of variation
  - Used NPIP data once again
  - Examination of sources of variation
Variability: Proportion explained by each factor

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<thead>
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<th>Source</th>
<th>Backfat</th>
<th>Growth</th>
<th>NBA</th>
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<tr>
<td>Gestation length</td>
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<td>-</td>
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</table>
Variability: Total

- Total variation explained is not cumulative!
  - Variance partitioning, confounding, non-balanced

- Best model explains only around 50% of variability

- Higher variation explained for performance traits than reproductive traits
  - Backfat = 47%, Growth = 41%
  - NBA = 29%
Variability: Summary

- Farm and packers say variation needs to reduce
  - Reduce costs – improve profitability

- Currently, no genetic solution
  - Use selection on the mean
  - Control variation on farm...
Variability: Summary (2) – what you can do

- Controlling variation *on farm*
  - Use sire EBVs (mean) for more uniform groups
  - Optimal environment for each pig
  - Consistent long-term management strategy
  - Consistency of inputs
Variability: Summary (3) – what we can do

- Further **quantification of the variation** will help!
- Best models only explain **50%** of the variation
  - *Less for reproductive traits*
- Better **definition of environments** required
  - *In association* with accurate phenotypes & contemporary groups on farm
Thank you for your time.

Thank you to breeders who provided data
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