AGBU
ANIMAL GENETICS AND BREEDING UNIT
A joint unit of I&I NSW and UNE

AUSTRALIAN Pork

Towards more uniform pig performance

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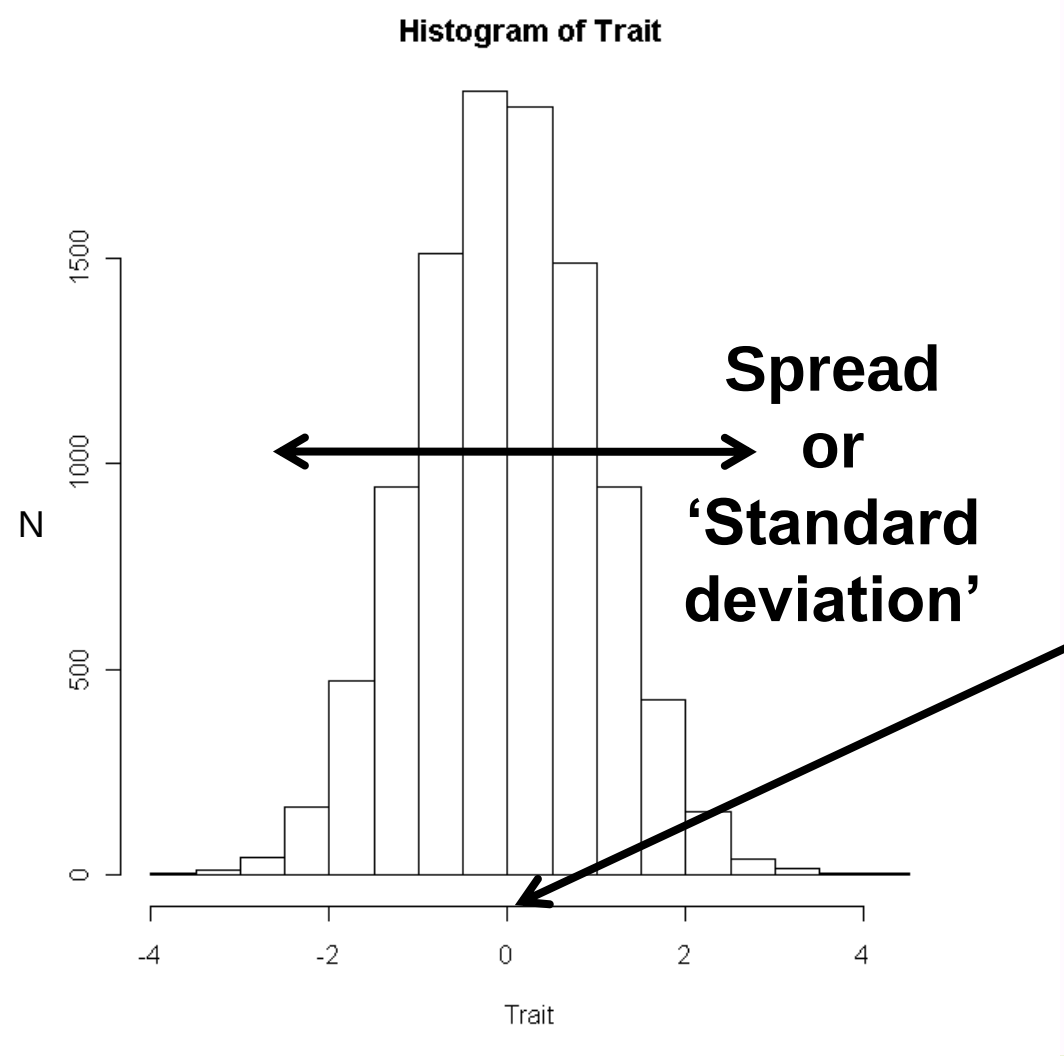
Variability: The issue...

- 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

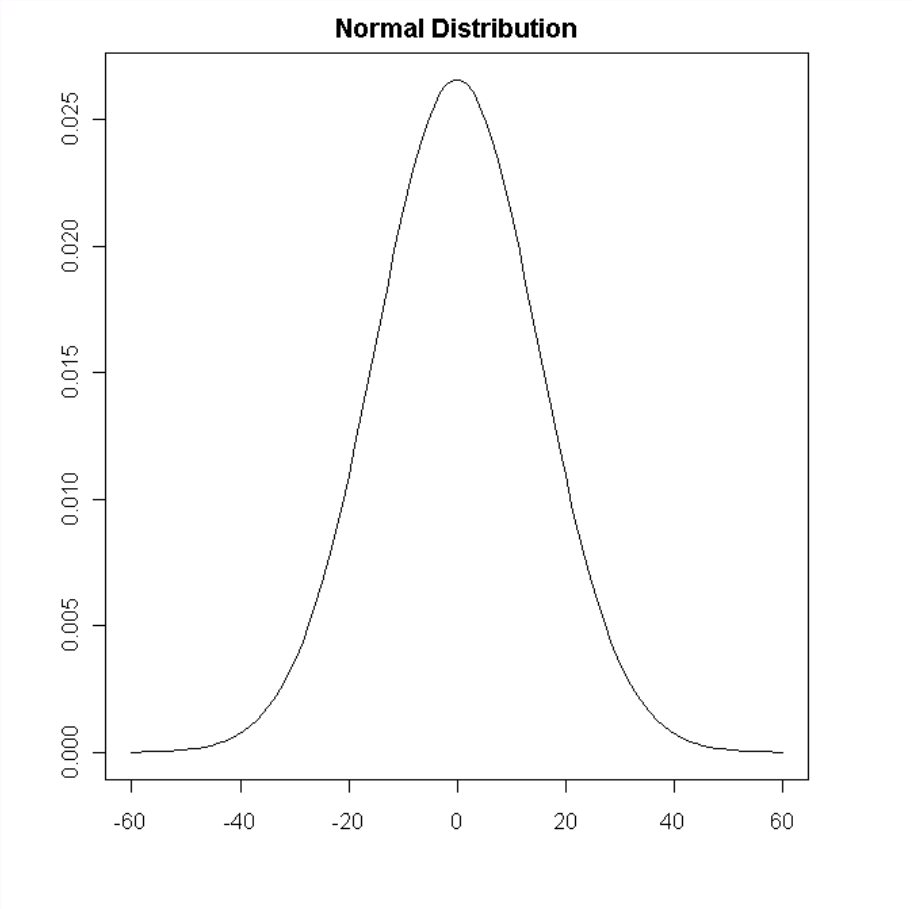


Variability: Statistical definition

Medium SD

High SD

Low SD



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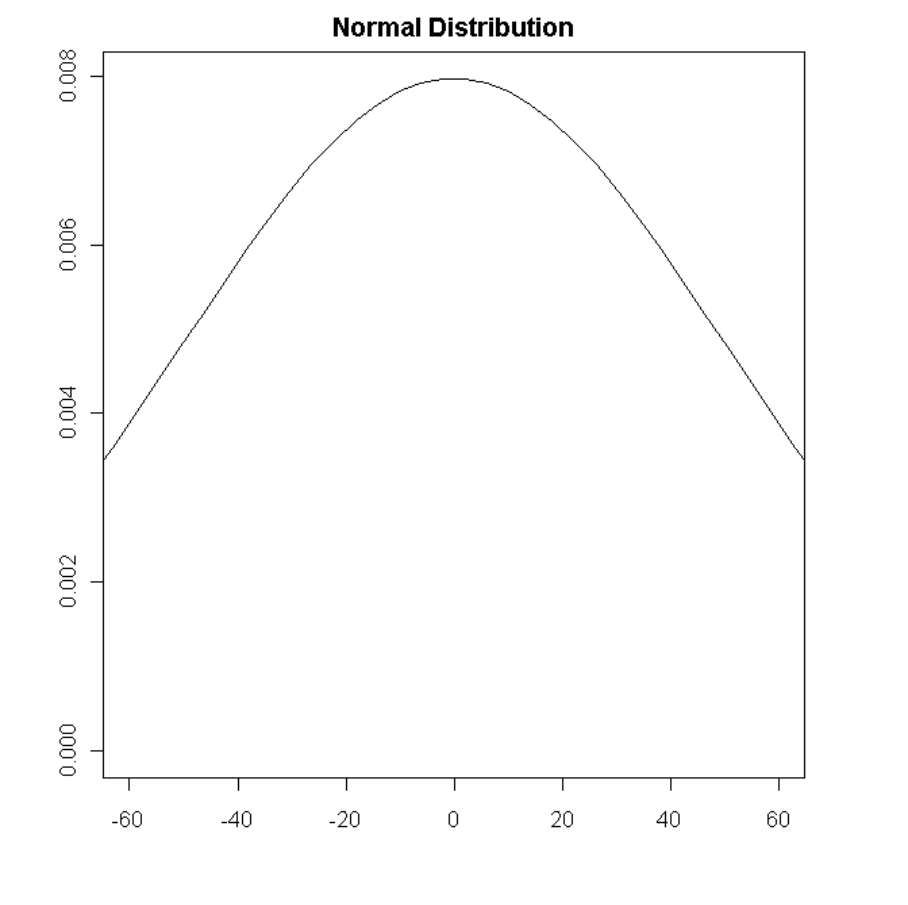

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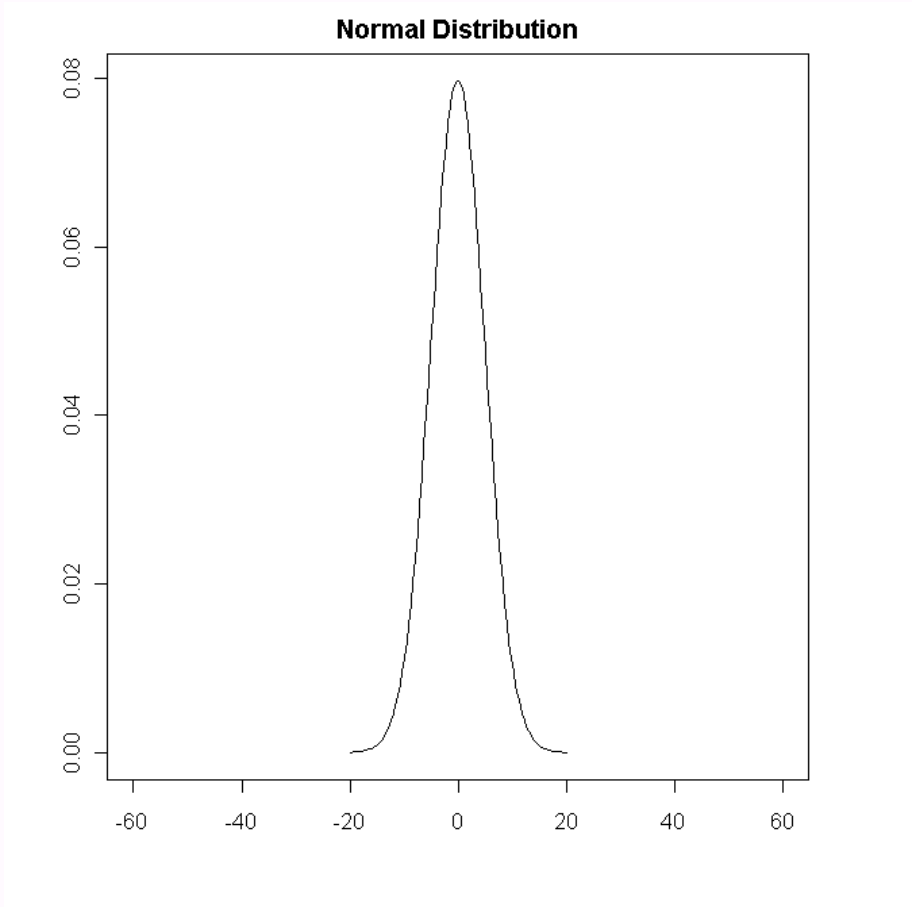
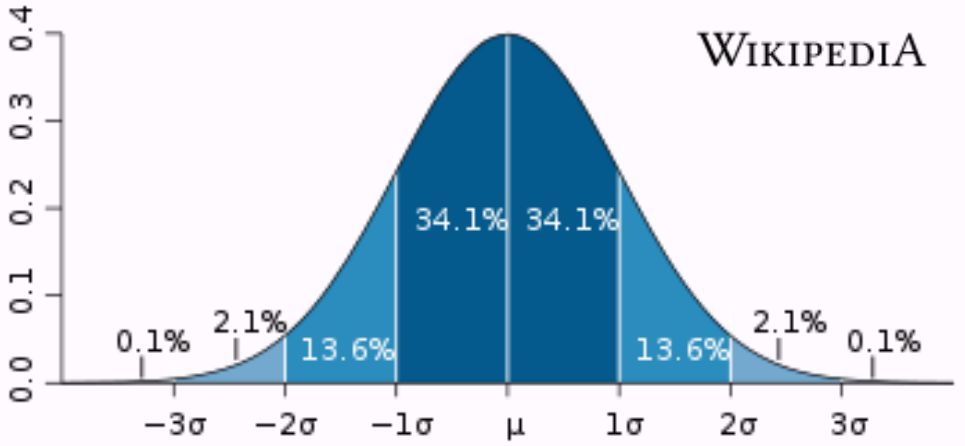


Variability: Statistical definition: It means...

- Mean ± 1 SD = **68.2 %**
- Mean ± 2 SD = **95.4 %**
- Mean ± 3 SD = **99.6 %**

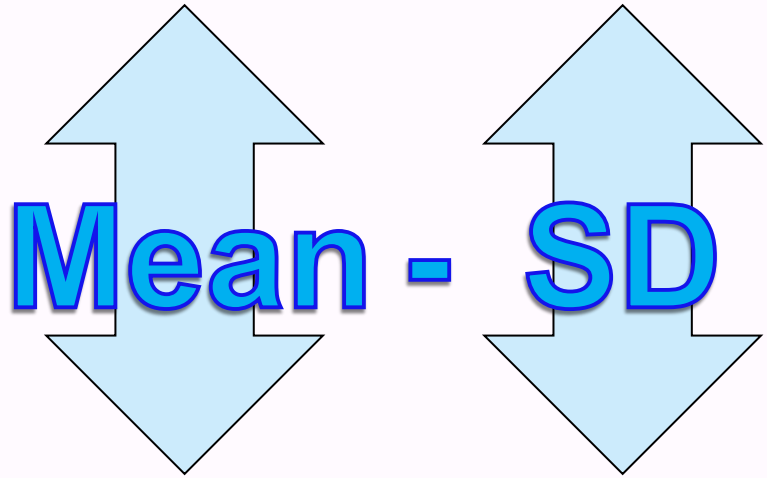


- **EXAMPLE**
- Farm mean Backfat = 11 & SD = 1 mm
- Penalty if Backfat greater than 12 mm
- **15.9 % of pigs will invoke penalty**

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:

$$y_i = \mathbf{X}\beta + \mathbf{Z}_1\boldsymbol{a}_i + \boldsymbol{e}_i$$

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Trait | Fixed effects | Animal (genetic) | ‘Error’

Uniformity: The theory

A simple animal model:

$$y_i = X\beta + Z_1 a_i + e_i$$

Trait | Fixed effects | 'Error'

Genetics???

- 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

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

2 **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.....

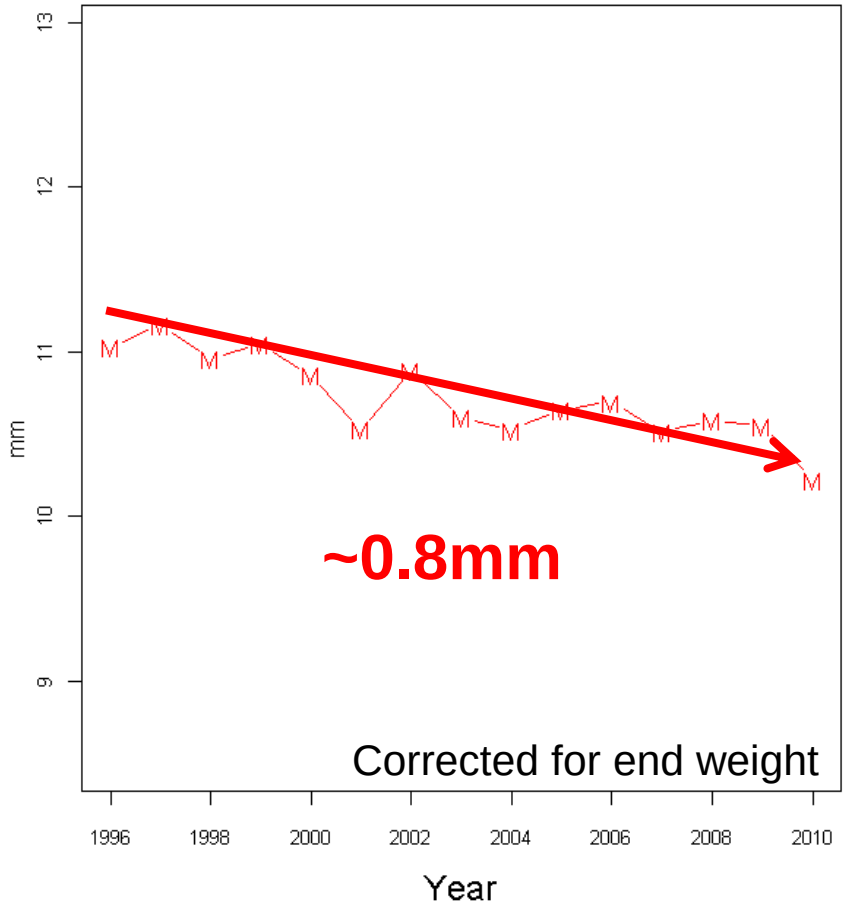
Variability: Trends

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

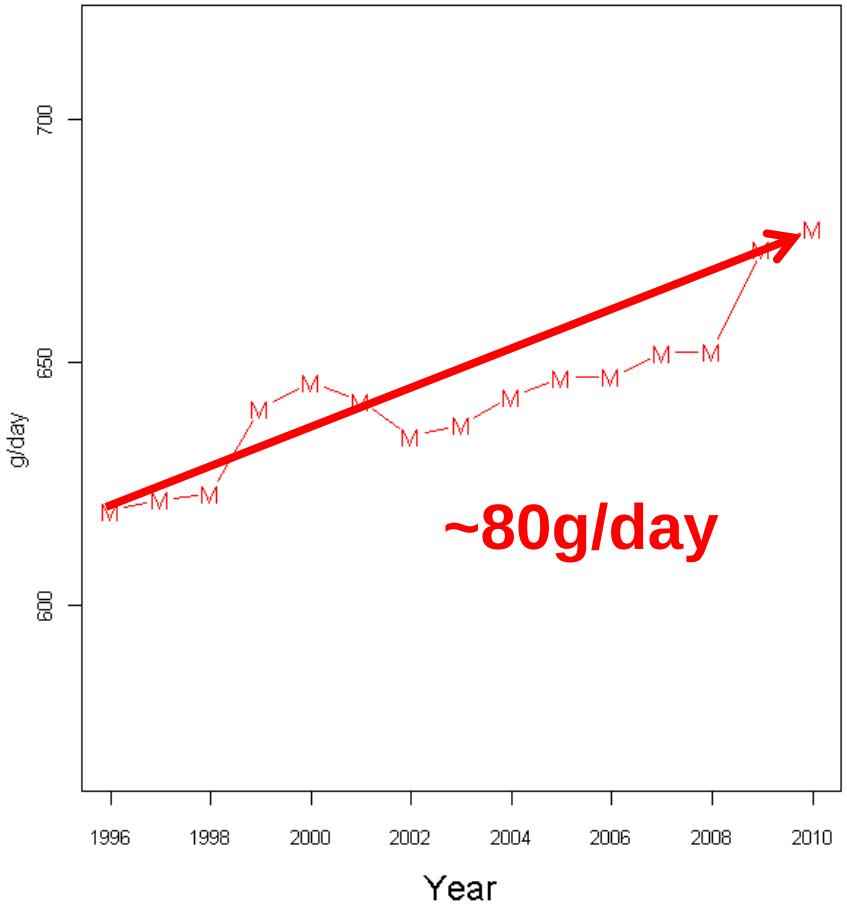
- Data from National Pig Improvement Program
  - 15 years of records
  - 11 herds
  - 3 breeds
  - ~400,000 production records
  - ~85,000 reproductive records

Variability: Yearly trends: Production

Backfat

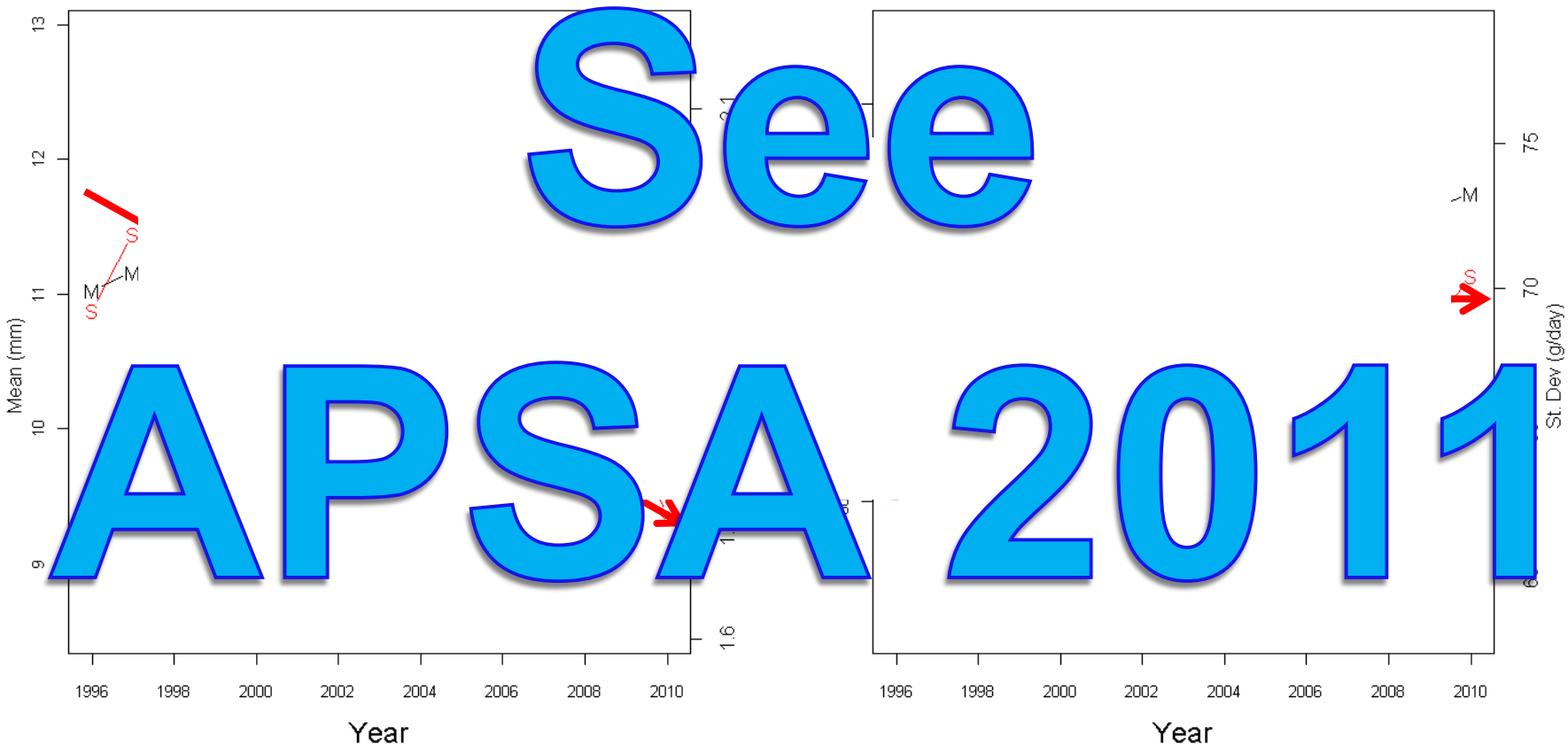


Lifetime growth



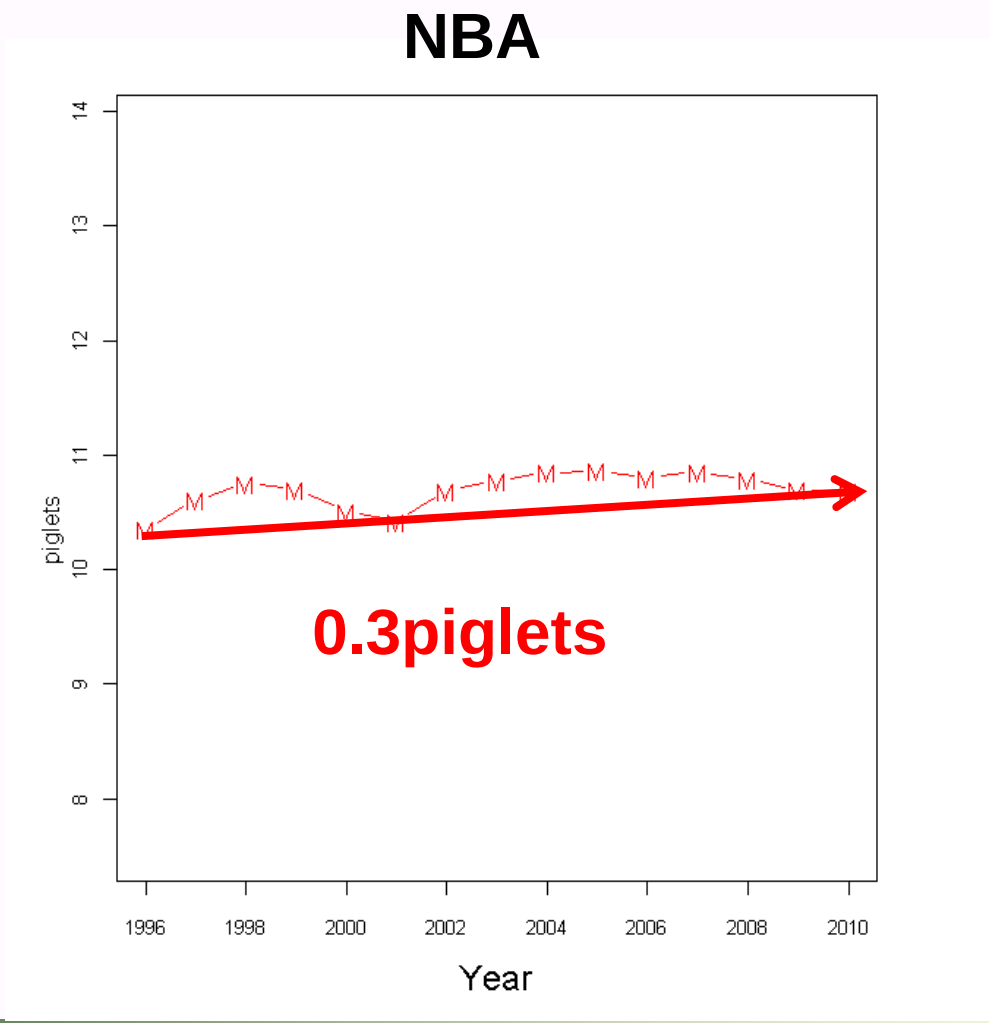
Variability: Yearly trends: Production SD

Backfat **Lifetime growth**

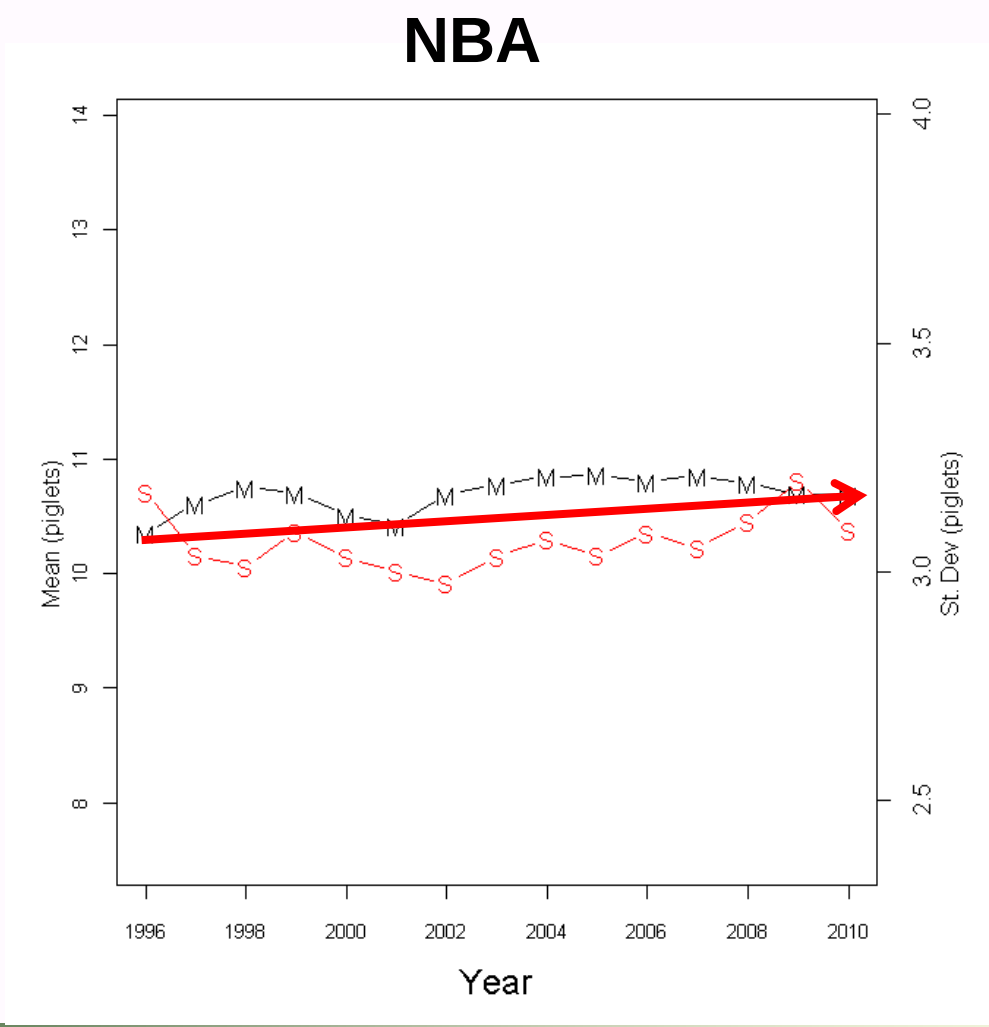


See APSA 2011

Variability: Yearly trends: Reproduction

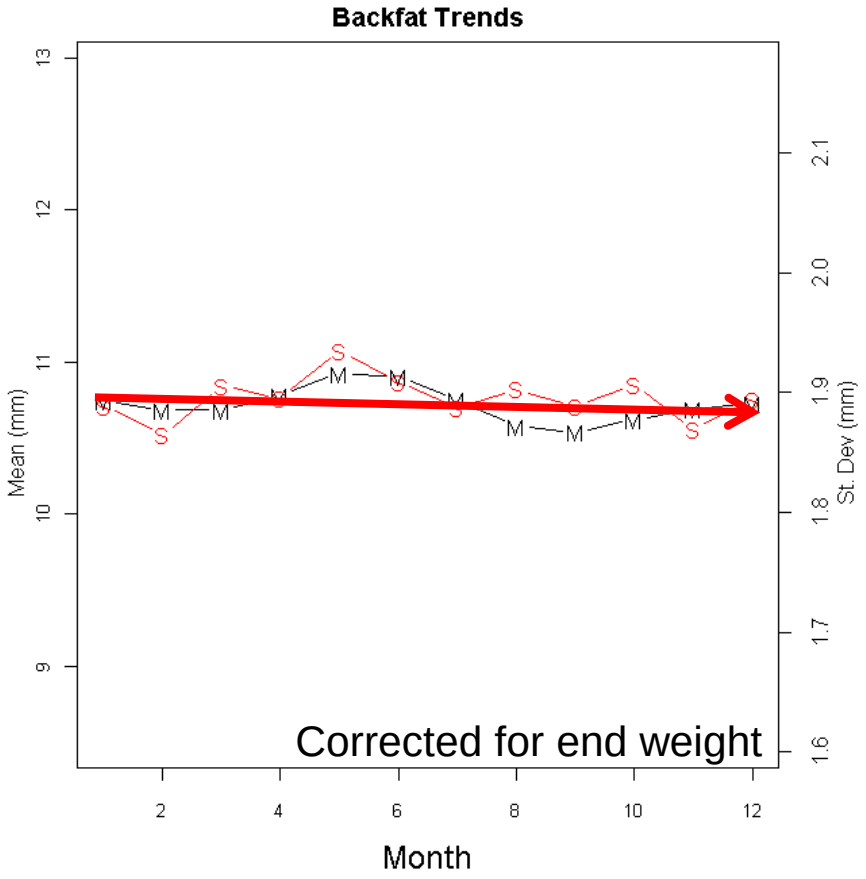


Variability: Yearly trends: Reproduction SD

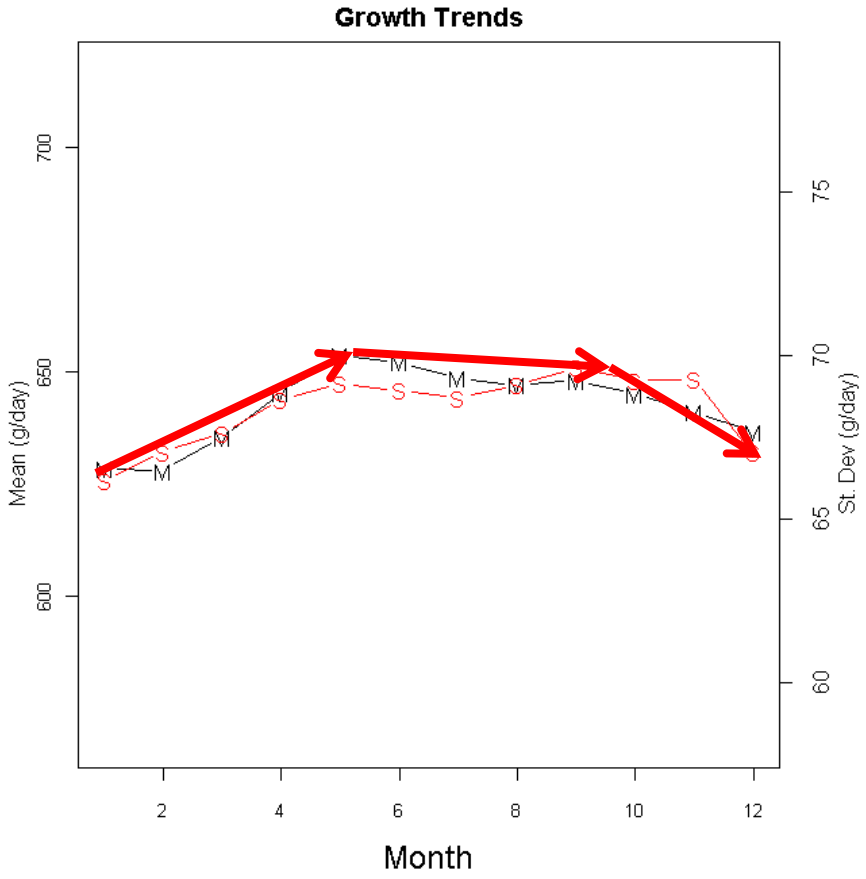


Variability: Within year trends: Production

Backfat



Lifetime growth



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

Source	Backfat	Growth	NBA
Year	2	5	0
Month	1	1	0
Year/month	3	7	1
Breed	1	0	1
Herd	12	9	6
Sire	22	22	11
Litter	36	39	-
Weight	11	37	-
Gestation length	-	-	6

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
This work was supported by APL (Project 2133)