

# Estimating macro- and micro-environmental sensitivity with unbalanced data

M. D. Madsen<sup>1</sup>, J. van der Werf<sup>1</sup>, V. Börner<sup>2</sup> and S. Clark<sup>1</sup>

<sup>1</sup>University of New England, Armidale NSW, Australia. <sup>2</sup>Animal Genetics and Breeding Unit, Armidale NSW, Australia.

madsen3@myuneedu.au

## Aim:

Examine the use of unbalanced data to estimate macro- and micro-environmental sensitivity

## Approach:

Simulation of unbalanced datasets  
Analysed using a reaction norm double hierarchical generalized linear mixed model (RN-DHGLMM)

## Conclusion:

Unbalanced data does not impact estimation of variance components  
Unbalanced data reduces accuracy of EBVs

## Background:

- Environmental sensitivity (ES) determines how much a phenotype varies due to environmental changes.
- Macro-ES are in response to changes in macro-environments.
- Micro-ES, caused by micro-environments, affects the variability of phenotypes.
- A RN-DHGLMM model can estimate macro- and micro-ES simultaneously.
- The possibility of using the RN-DHGLMM on unbalanced data has not previously been investigated in detail.

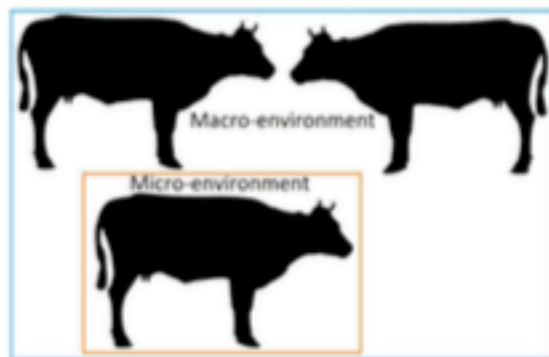


Figure 1: Illustration of macro- (blue box) and micro-environments (orange box)

## Macro- versus micro-environments

Macro-environments are definable and/or quantifiable environments often shared by groups of animals

Micro-environments are undefinable and individual environments.

## Simulated phenotype:

- $Y = \mu + a + a_{ma}x + \exp(0.5 \ln(\sigma_{\varepsilon}^2) + 0.5 a_{mi})\varepsilon$
- $a$ ,  $a_{ma}$  and  $a_{mi}$  were base genetic, macro-ES and micro-ES effects drawn from

$$N\left(\mathbf{0}, \mathbf{A} \otimes \begin{pmatrix} \sigma_a^2 & 0 & 0 \\ 0 & \sigma_{a_{ma}}^2 & 0 \\ 0 & 0 & \sigma_{a_{mi}}^2 \end{pmatrix}\right)$$

- $x$  was random effect of herd drawn from  $N(0, \sigma_x^2)$
- $\sigma_{\varepsilon}^2$  was environmental variance of exponential model
- $\varepsilon$  was scalar drawn from  $N(0,1)$

## Data structures:

Name (symbol)	Half sib design	Distribution of offspring across macro-environments
Even (■)	Balanced	Balanced
Uneven (●)	Unbalanced	Balanced
Unbalanced (▲)	Unbalanced	Unbalanced

## Analysis:

- RN-DHGLMM were used to estimate all simulated components
- ASReml4.1

