Comparison of estimation models with a data set of limited number of animals but intensive recording

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〈Background〉

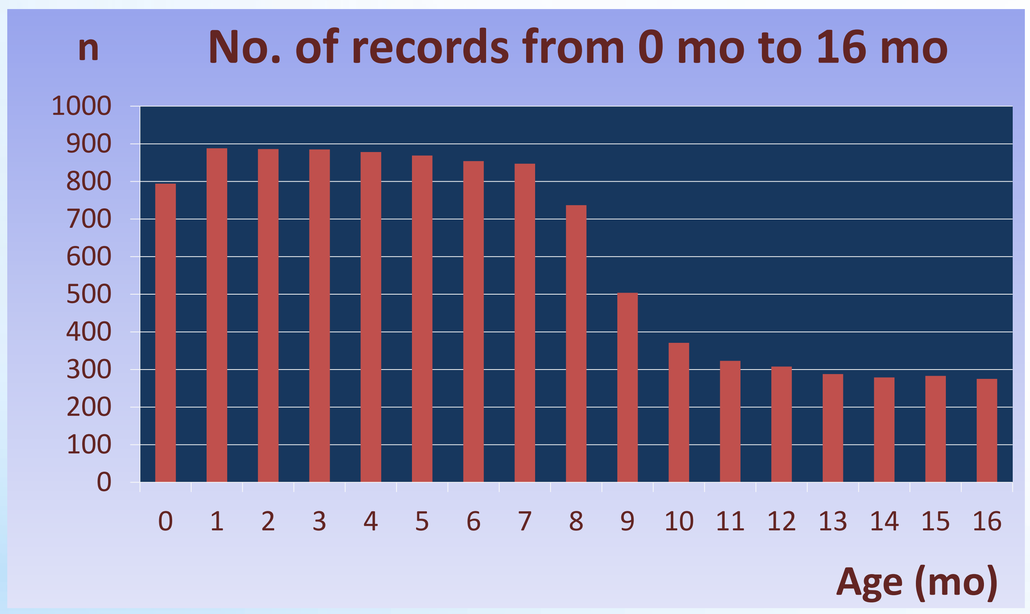
Analysis of random regression model (**RRM**) was firstly introduced to field of animal breeding as a model to investigate genetics of test day records of dairy cattle. Since then, RRM has been applied to longitudinal records related to animal production.

〈Objective〉

Objective of this study was to investigate a possibility of applying RRM to a data set of limited number of animals having intensively measured records and compare results of different estimation models.

〈Data〉

The data set included 10295 body weights (**BW**) of 887 calves measured from 1975 to 2008 at an experimental station of Okayama University. Calves were weaned at 2 or 3 mo of age. Selected heifers were dehorned soon after weaning. Culled heifers and all steers of 8 to 10 mo of age were shipped to a local calf market.



〈Analysis〉

Variance components of body weight were estimated by reml using vce602. Statistical model including fixed effects; 408 contemporary groups (year-season-sex), age of calves as a covariate and random effects; animal's direct genetic effect (**DGE**), random residuals and either of maternal genetic effect (**MG**) or permanent environmental effect (**PE**).

〈RR Model〉

$$y_{ij} = F + \sum_{m=0}^{kb-1} \beta_m \emptyset_m(t_i) + \sum_{m=0}^{kd-1} \alpha_{jm} \emptyset_m(t_{ij}) + \sum_{m=0}^{km-1} \gamma_{jm} \emptyset_m(y_{ij}) + \sum_{m=0}^{kp-1} \delta_{jm} \emptyset_m(t_{ij}) + E_{ij}$$

where F are the fixed effects in the model; ϕ_m (t_{ij}) are the covariates as a function of age with t_{ij}, the j^{th} age of animal i standardized to the range −1 to 1, and with ϕ_m, the m^{th} orthogonal Legendre polynomial for *n* the order of fit (with ϕ_m evaluated for t_{ij}, there will be k_b coefficients for each age); β_m is the m^{th} fixed regression coefficient; α_{im}, γ_{im} and δ_{im} are the m^{th} DGE, MG and PE random regression coefficients for animal i; k_d, k_m and k_P are orders of fit (set to be 3 according to a preliminary result) for the DGE, MG and PE; and E_{ij} is the effect of random error. Either of MG or PE were included in RRM.

〈Results〉

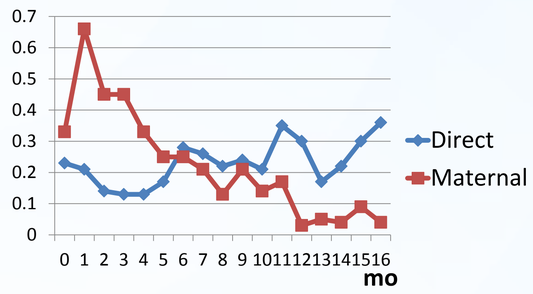


Figure 1. Heritabilities of DGE and MG by bi-trait model (BW of 3 mo and others).

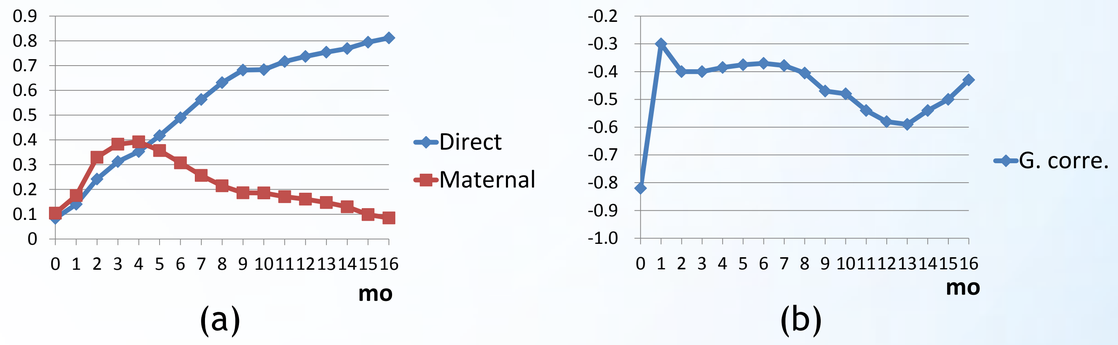


Figure 2. Heritabilities of DGE and MG (a) and genetic correlations between them (b) by RRM.

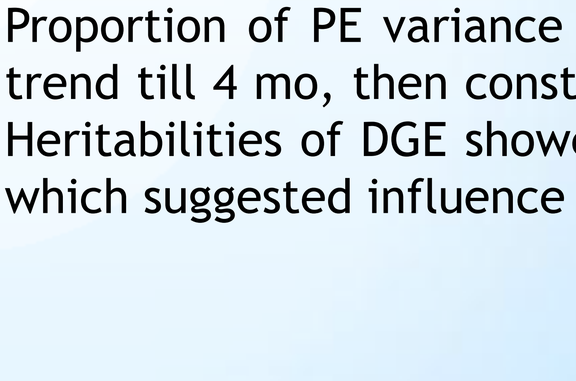


Figure 3. Heritabilities of DGE and proportions of PE variance by RRM with DGE and PE.

〈Discussion〉

Heritability in Fig.1 showed small upward trend for DGE and downward trend for MG. Genetic correlations were varied (not in Results).
Heritabilities in RRM estimates in Fig. 2 were more stable than the above results, however, range of them were large, probably due to homogeneous residual variance. Heritability of MG showed an apparent peak at 4 mo.
Proportion of PE variance in Fig. 3 had upward trend till 4 mo, then constant values afterwards.
Heritabilities of DGE showed L-shaped increase, which suggested influence of MG variance.