

GENE638 - Homework 4

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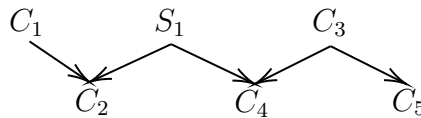
Texas A&M University

COW	HERD	LACTATION	MILK FAT (lb)
1	1	1	600
1	1	2	680
2	1	1	500
3	2	1	800
3	2	2	895
4	2	1	775
5	2	1	600
5	2	2	715

Given $y_{ijk} = \mu + H_i + L_j + C_k + e_{ijk}$ where μ , herd (H_i) and lactation L_j are fixed effects; cows (C_k) and residuals (e_{ijk}) are random effects and $\text{var} \begin{bmatrix} \underline{c} \\ \underline{e} \end{bmatrix} = \begin{bmatrix} A\sigma_c^2 & 0 \\ 0 & I\sigma_e^2 \end{bmatrix}$ so the MME are: $\begin{bmatrix} X'X & X'Z \\ Z'X & Z'Z + A^{-1}\lambda \end{bmatrix} \times \begin{bmatrix} \hat{\underline{\beta}} \\ \hat{\underline{u}} \end{bmatrix} = \begin{bmatrix} X'y \\ Z'y \end{bmatrix}$ with $\lambda = \frac{\sigma_e^2}{\sigma_c^2}$.

1. In the above model, indicate what each subscript indexes.
2. What are the elements in $\hat{\underline{\beta}}$ and $\hat{\underline{u}}$

New pedigree:



3. Calculate A^{-1} using the Henderson's method for rapid inversion of A .
4. Write the observations in terms of the model $\underline{y} = X\underline{\beta} + Z\underline{u} + \underline{e}$
5. Construct MME with $\lambda = 1.5$
6. Show algebraically that $\lambda = \frac{1-h^2}{h^2}$
7. The row equation in the MME corresponding to \hat{S}_1 is:

$$0.75\hat{C}_1 - 1.5\hat{C}_2 + 0.75\hat{C}_3 - 1.5\hat{C}_4 + 3\hat{S}_1 = 0$$

$$\hat{S}_1 = -0.25\hat{C}_1 + 0.5\hat{C}_2 - 0.25\hat{C}_3 + 0.5\hat{C}_4$$

$$\hat{S}_1 = 0.5 \left(\hat{C}_2 - 0.5\hat{C}_1 \right) + 0.5 \left(\hat{C}_4 - 0.5\hat{C}_3 \right)$$

- (a) Look at the pedigree above (and this prediction equation) and describe in words how \hat{S}_1 is being predicted here.

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- (b) Show that $\mu = 818.87$; $\hat{H}_1 = -165.15$; $\hat{H}_2 = 0$; $\hat{L}_1 = -100.57$; $\hat{L}_2 = 0$; $\hat{C}_1 = 14.63$; $\hat{C}_2 = -9.27$; $\hat{C}_3 = 31.57$; $\hat{C}_4 = 24.55$; $\hat{C}_5 = -47.63$; and \hat{S}_1 (calculated as above) provides a solution to the system of equations.
8. What do \hat{H}_1 and \hat{L}_1 estimate?
9. Show that $1'A^{-1}\underline{\hat{u}} = 0$. What does this mean?
10. What are the predicted phenotypes $\hat{p} = \underline{y} - X\underline{\hat{\beta}}$
11. Find $\underline{\hat{e}}'\underline{\hat{e}}$ and compare results to those in Homework 3.
12. Do the predicted cow breeding values rank the same as they did in Homework 3 when all cows were treated as unrelated? Explain why or why not.