

Comparison of random regression test-day models for production traits of dairy cattle in Poland

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The Aim:

to compare various RRM for genetic evaluation of dairy cattle in Poland for first lactation milk yield.

Material

- 51 365 test-day milk yields
- 6319 first lactations collected from
- 55 randomly selected herds

Methods

Model:

$$Y_{ijklm} = \text{HTD}_i + \sum b_{jl} z_{mnl} + \sum c_{kl} z_{mnl} + \sum a_{ml} z_{mnl} + \sum p_{ml} z_{mnl} + e_{ijklm}$$

HTD_i - fixed or random herd test day

$\sum b_{jl} z_{mnl}$ - fixed regressions for age*season (AS) of calving

$\sum c_{kl} z_{mnl}$ - fixed regressions for herd*years (HY)

$\sum a_{ml} z_{mnl}$ - random regressions for animals (AG)

$\sum p_{ml} z_{mnl}$ - random regressions for perm.envirom (PE)

Methods

Submodels for fixed and random regressions:

- A&S - Ali & Schaeffer (1987)
- W - Wilmink (1987)
- L2-4 - Legendre polynomials of different order (Kirkpatrick et al.. 1990)
- WL - L2 + Wilmink hybrid

Methods

The covariance structure for models with fixed HTD effect:

$$\text{var} \begin{bmatrix} \mathbf{a} \\ \mathbf{p} \\ \mathbf{e} \end{bmatrix} = \begin{bmatrix} \mathbf{G} \otimes \mathbf{A} & 0 & 0 \\ 0 & \mathbf{P} \otimes \mathbf{I} & 0 \\ 0 & 0 & \mathbf{I} \sigma_e^2 \end{bmatrix}$$

Methods

Models were compared based on:

BIC - Bayesian information criterion (BIC)
(Schwarz, 1978)

PSB - percentage of squared bias (Ali and
Schaeffer, 1987)

ACC – correlation between true and
estimated breeding values.

Results

Ranking of models based on BIC:

HTD	AS	HY	AG	PE	BIC	PSB	ACC
F	L4	L4	L3	L2	361743	1641.090	0.3829
F	L3	L3	L3	L3	363425	0.866	0.3540
F	L2	L2	L2	L2	365288	0.990	0.3583
R	L4	L4	L3	L3	383492	0.860	0.3504
R	L3	L4	L3	L3	383493	0.860	0.3505
R	L4	L4	L3	L2	383523	0.878	0.3837
R	L4	L4	L4	L4	383675	0.887	0.3434
R	L4	L3	L3	L4	385273	0.877	0.3594
R	L3	L3	L3	L2	385340	0.896	0.3865
R	L3	L3	L3	L3	385587	0.879	0.3504
R	L3	L3	L3	L4	385594	0.883	0.3620
R	L2	L2	L4	L4	387329	0.923	0.3353
R	L2	L2	L2	L2	387497	1.008	0.3564
R	W	W	L3	L3	388543	0.870	0.3694
R	W	W	WL	WL	389017	0.887	0.3609

Results

Ranking of models based on PSB:

HTD	AS	HY	AG	PE	BIC	PSB	ACC
R	L4	L4	L3	L3	383492	0.860	0.3504
R	L3	L4	L3	L3	383493	0.860	0.3505
F	L3	L3	L3	L3	363425	0.866	0.3540
R	W	W	L3	L3	388543	0.870	0.3694
R	L4	L3	L3	L4	385273	0.877	0.3594
R	L4	L4	L3	L2	383523	0.878	0.3837
R	L3	L3	L3	L3	385587	0.879	0.3504
R	L3	L3	L3	L4	385594	0.883	0.3620
R	L4	L4	L4	L4	383675	0.887	0.3434
R	W	W	WL	WL	389017	0.887	0.3609
R	L3	L3	L3	L2	385340	0.896	0.3865
R	L2	L2	L4	L4	387329	0.923	0.3353
F	L2	L2	L2	L2	365288	0.990	0.3583
R	L2	L2	L2	L2	387497	1.008	0.3564
F	L4	L4	L3	L2	361743	1641.090	0.3829

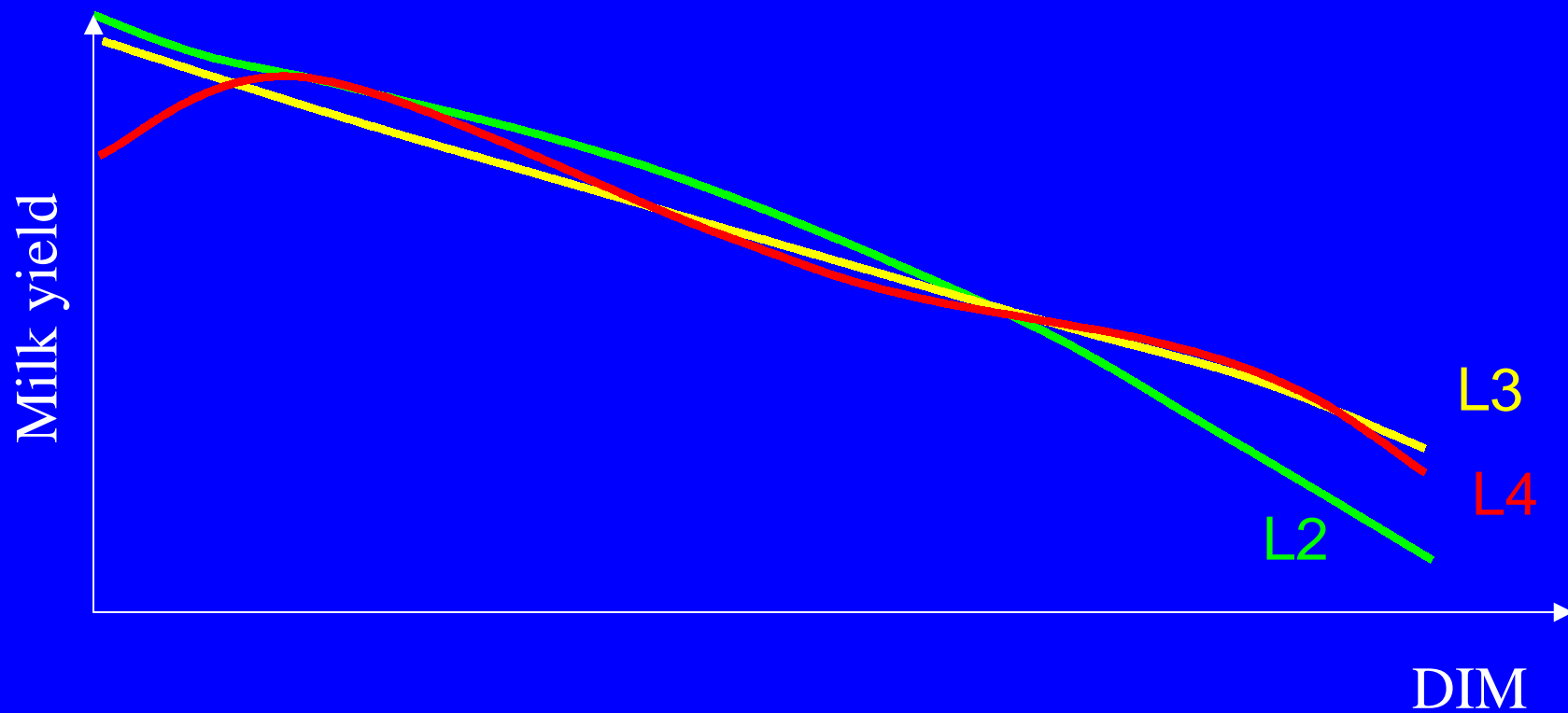
Results

Ranking of models based on ACC:

HTD	AS	HY	AG	PE	BIC	PSB	ACC
R	L3	L3	L3	L2	385340	0.896	0.3865
R	L4	L4	L3	L2	383523	0.878	0.3837
F	L4	L4	L3	L2	361743	1641.090	0.3829
R	W	W	L3	L3	388543	0.870	0.3694
R	L3	L3	L3	L4	385594	0.883	0.3620
R	W	W	WL	WL	389017	0.887	0.3609
R	L4	L3	L3	L4	385273	0.877	0.3594
F	L2	L2	L2	L2	365288	0.990	0.3583
R	L2	L2	L2	L2	387497	1.008	0.3564
F	L3	L3	L3	L3	363425	0.866	0.3540
R	L3	L4	L3	L3	383493	0.860	0.3505
R	L4	L4	L3	L3	383492	0.860	0.3504
R	L3	L3	L3	L3	385587	0.879	0.3504
R	L4	L4	L4	L4	383675	0.887	0.3434
R	L2	L2	L4	L4	387329	0.923	0.3353

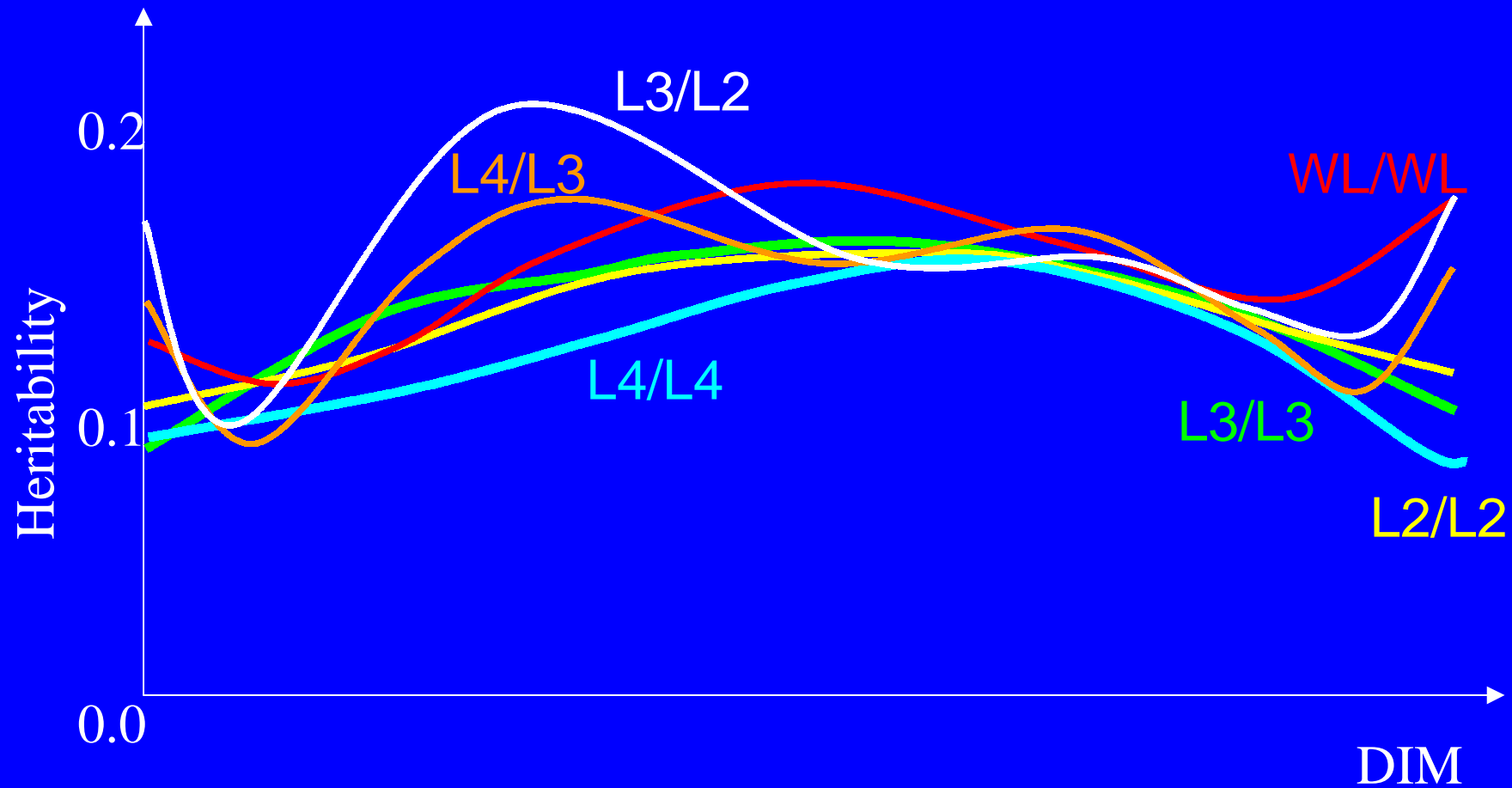
Results

Lactation curves for the youngest group of cows calved in summer season estimated with various submodels



Results

Daily heritability estimates for selected models with different functions for AG/PE effects



Conclusions

- BIC, PSB, ACC ranked models in different way
- Differences between the best ranking models were negligible
- Random rather than fixed HTD effect should be used
- The average lactation curve should be described by Legendre polynomials of order four.

Conclusions

- The best results in describing individual lactation curves were obtained with third order Legendre polynomials.
- For permanent environmental effect lower order polynomials fitted better.
- Models with different order polynomials for AG and PE effects yielded undesired shapes of heritabilities curves.