

Comparison of fixed and random regression models in South African Holsteins under two production systems

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AIM

- ✓ Compare a **fixed regression model (FRM)** resembling the current model used for genetic evaluations in the South African Holstein (SAHST) breed (Interbull, 2018), with various **random regression models (RRM)**.
- ✓ Comparison done separately, under **pasture (PAST)** vs **total mixed ration (TMR)** production systems (PS).

DATA

Number of records, mean TD Milk Yield (MY, kg) and mean total 295 days MY for the three traits (LAC1, LAC2 and LAC3)

Trait	Production system	Number of records	Mean MY (TD)	Mean MY (295d)
LAC1	PAST	101,304	21.5	6,295
	TMR	440,118	29.8	8,746
LAC2	PAST	69,300	25.2	7,363
	TMR	252,664	33.9	9,894
LAC3	PAST	44,626	27.0	7,849
	TMR	122,480	34.6	10,049

FACTORS and MODELS

Effects considered:	Description / number of levels
Herd	(H) 12 (PAST) and 54 (TMR) herds
Calving Month	(Mo) 12 months
Calving Season	(S) April – Sept. and Oct. - March
Herd x Calving Year x Calving Month	(HYMo)
Parity	(P) First 3 parities
Calving Year x Parity	(YP)
Number of Milkings	(Mi) 2 or 3 times per day
Calving Age	(Ca) 8 classes
Calving Age x Calving Season	(CaS)
Previous Calving Interval	(Pci) 8 classes
H x TD (Test Day) x Mi	(HTMi) as contemporary group
H x TD x P x Mi	(HTPMi) as contemporary group

Multiple-trait (each lactation = 1 trait) fixed (FRM) and best random (RRM) models considered

Prod. Syst.	Effects			Type of regression on DIM
	Fixed (class)	Fixed reg. on DIM (Days In Milk)	Random regression on DIM	
FRM	HTMi HYMo Pci	CaS	Animal Perm. Envir.	Wilink curve (3 parameters)
RRM	HTPMi	H,YP, Mo,Ca, Pci	Animal Perm. Envir.	Natural splines with 6 knots

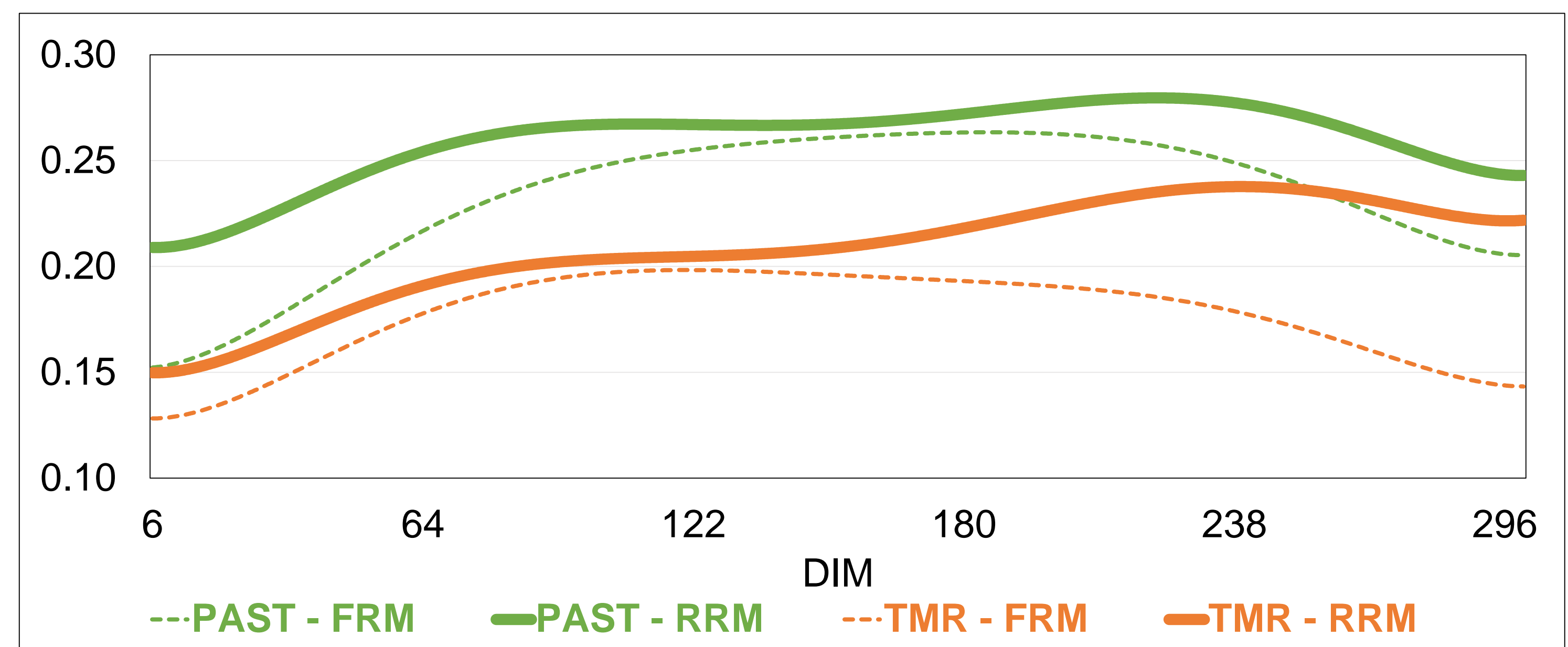
- ✓ 30-day classes of residual variance over 3 lactations (10 / lactation).
- ✓ REML estimation using WOMBAT (Meyer, 2007).
- ✓ Goodness of fit assessed using Akaike Information Criterion (AIC) and mean square error.

CONCLUSION

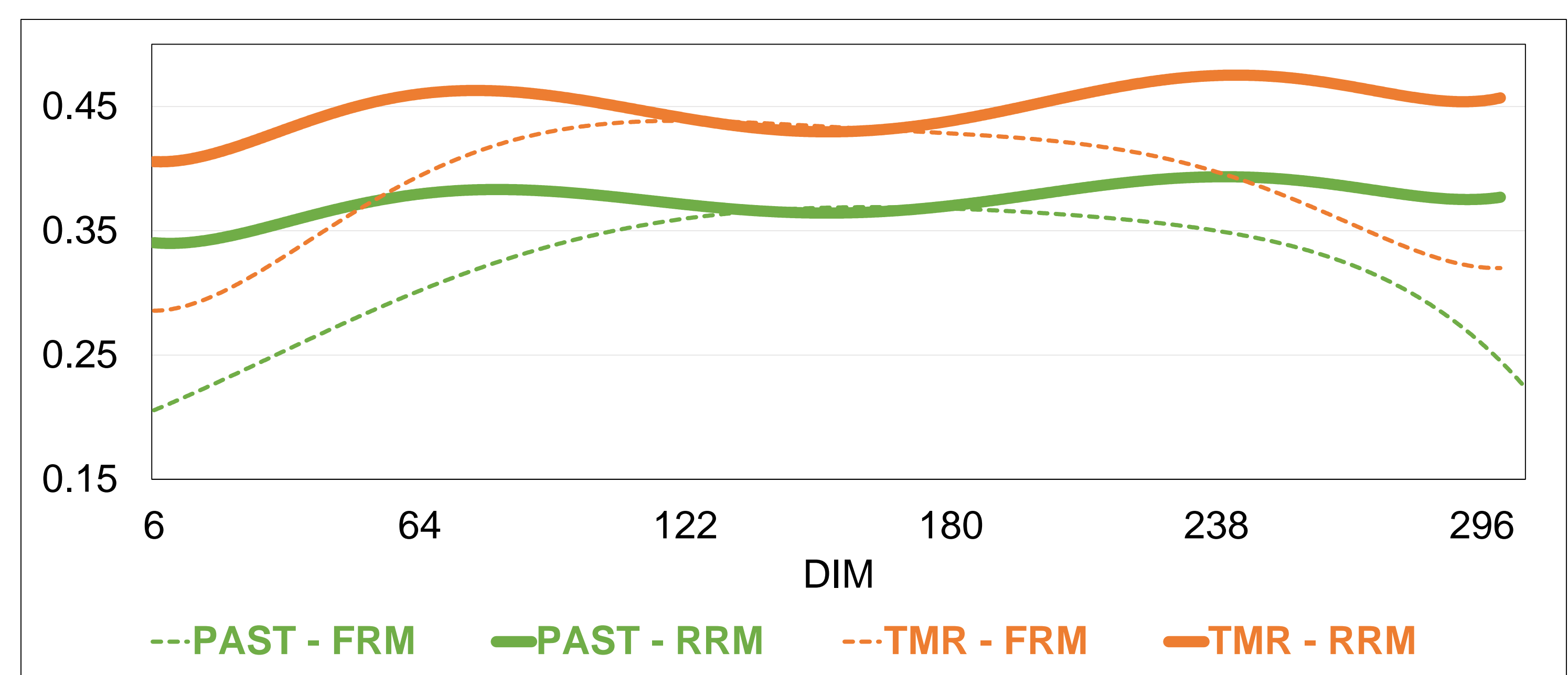
- ✓ Best RRM more complicated and computationally demanding than current FRM, **but**:
- ✓ More favorable genetic parameters → increased accuracy of genetic predictions, including for lactation persistency.
- ✓ Differences in genetic parameters between the two PS suggest the existence of genotype by environment interaction.

MAIN RESULTS

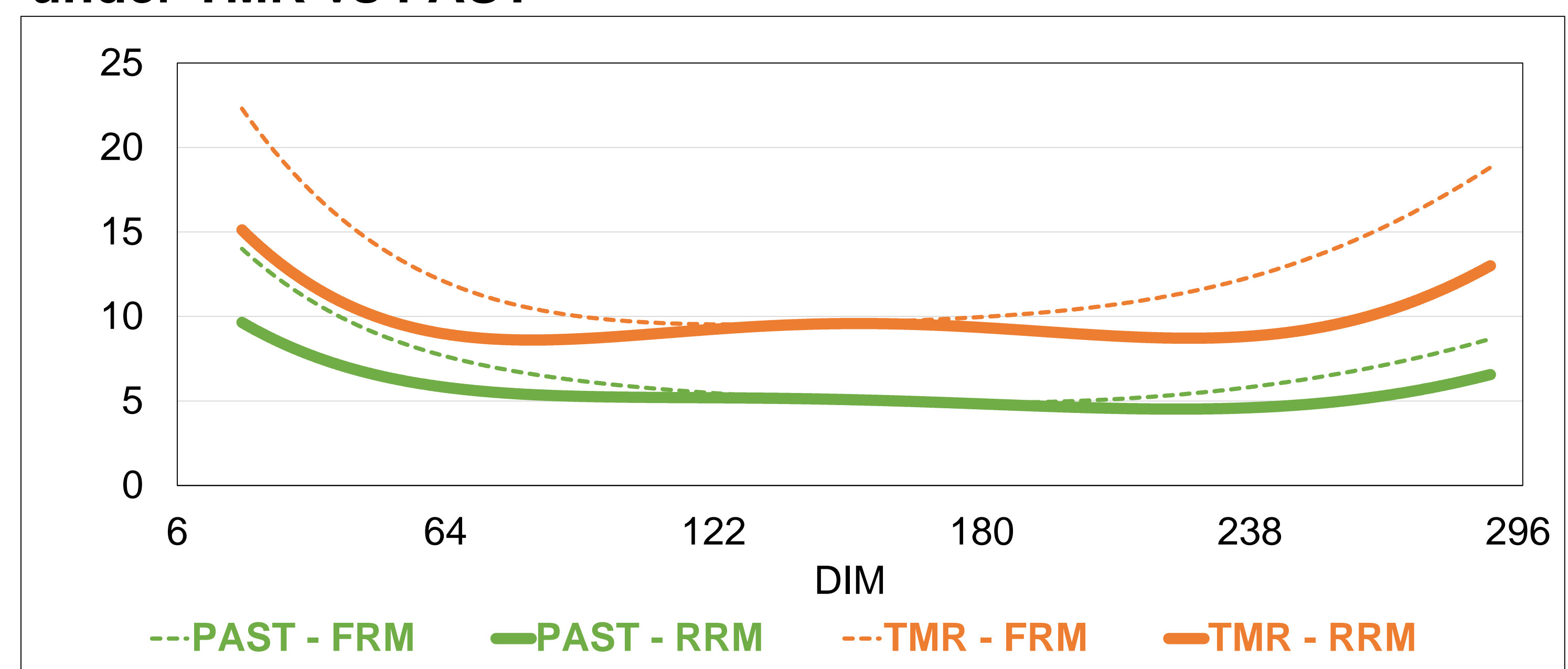
Heritability as a function of DIM in LAC1 under TMR vs PAST (😊 relatively similar results in LAC2 and LAC3)



Permanent environment (as a fraction of total variance) as a function of DIM in LAC1 under TMR vs PAST



(Smoothed) residual variance as a function of DIM in LAC1 under TMR vs PAST



Genetic correlations

between components
between lactations

		TMR	LAC1		LAC2		LAC3	
Prod. Syst.	Trait	Mean	Pers.	Mean	Pers.	Mean	Pers.	
		FRM	HTMi	0.05	-0.33	0.87	-0.10	0.81
RRM	HTPMi	0.07	0.42	0.07	-0.35	0.98	-0.40	
	HTMi	0.00	0.33	0.05	0.99	-0.16	-0.49	

	LAC1-LAC2	LAC1-LAC3	LAC2-LAC3
PAST	0.79	0.76	0.94
TMR	0.75	0.66	0.91