Utrecht University

Veterinary Medicine

Prediction of persistency at day 305 in lactation at the moment of the insemination decision

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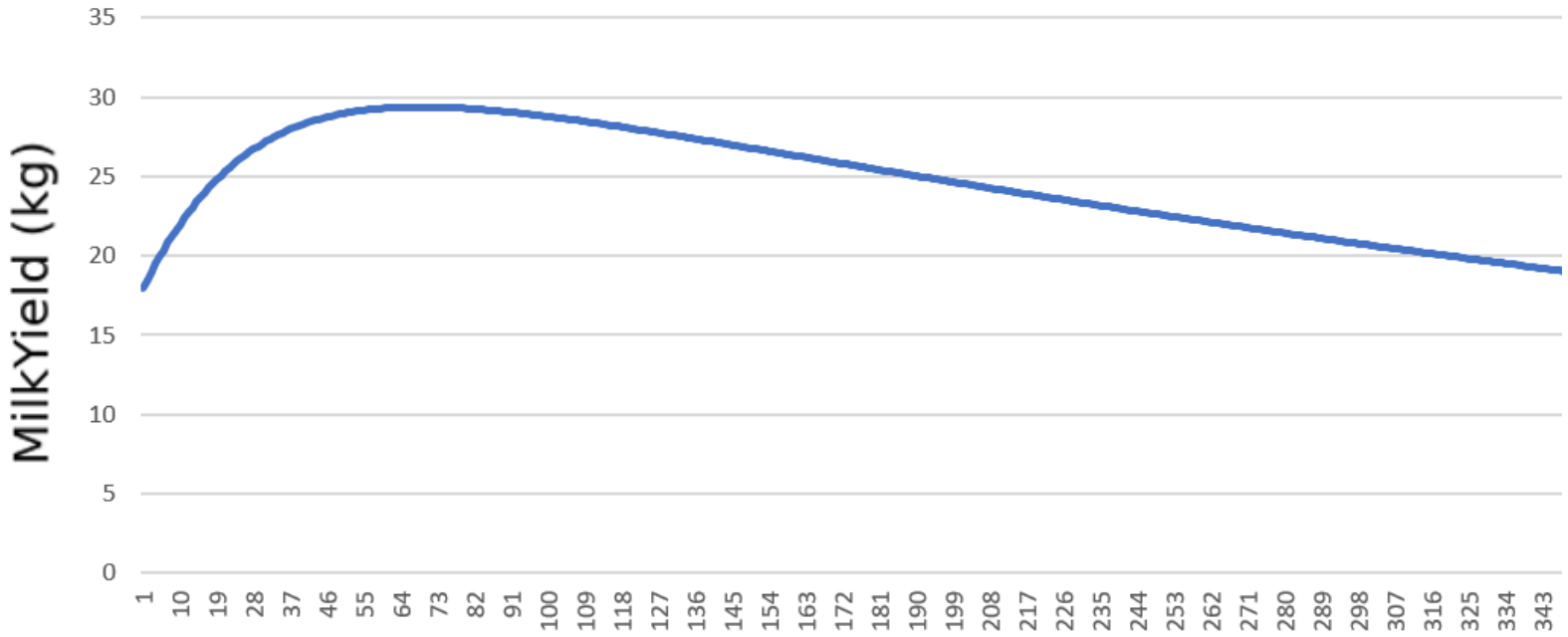
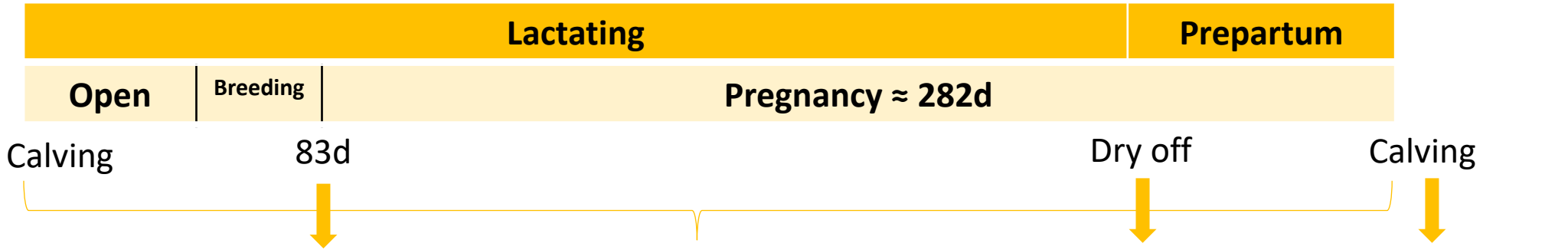
(Ingvartsen et al., 2003; LeBlanc et al., 2006)
(Rajala-Schultz et al., 2005; Odensten et al., 2007)
(Burgers et al., 2022)

Traditional yearly calving interval



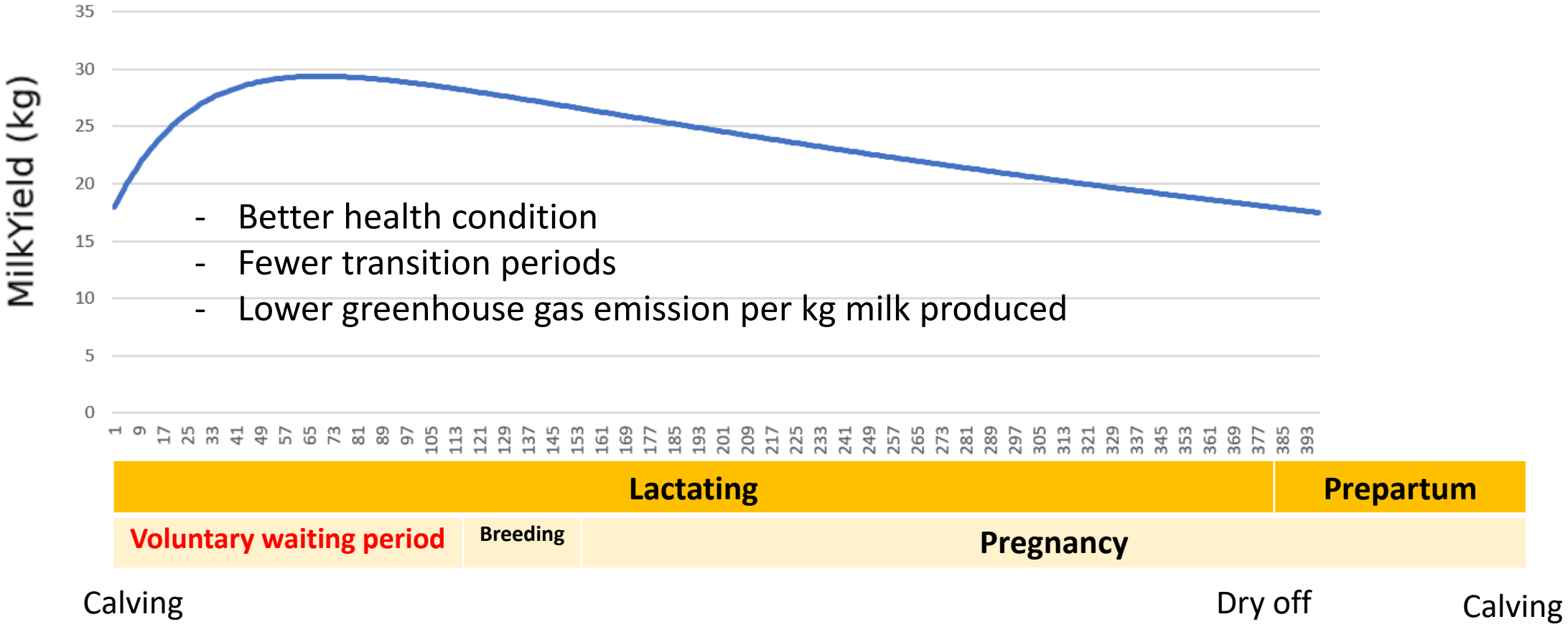


(Ma et al., 2022), (Lehmann et al., 2014), (Burgers et al., 2022)

(Wall et al., 2012; Lehmann et al., 2014; Browne et al., 2015)

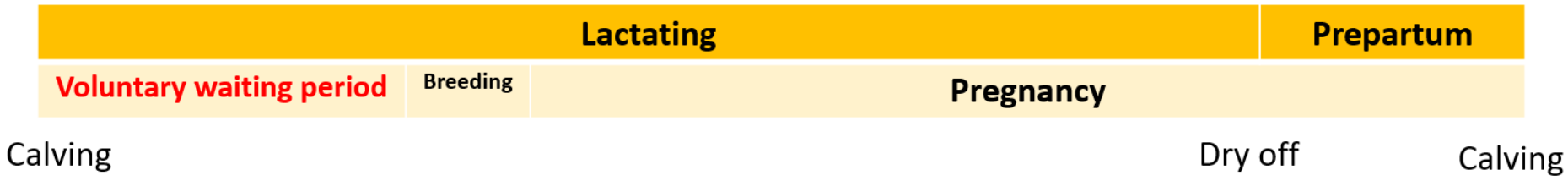
Extending lactation

- delay the first insemination time



(Lehmann et al., 2017; Sehested et al., 2019)

Extending lactation decisions



- not all cows are suitable for extending lactation
- the optimal VWP is different for every cow
- Prerequisite
  - Maintaining relatively high milk production in late lactation

  = persistency, milk production

Introduction

M & M

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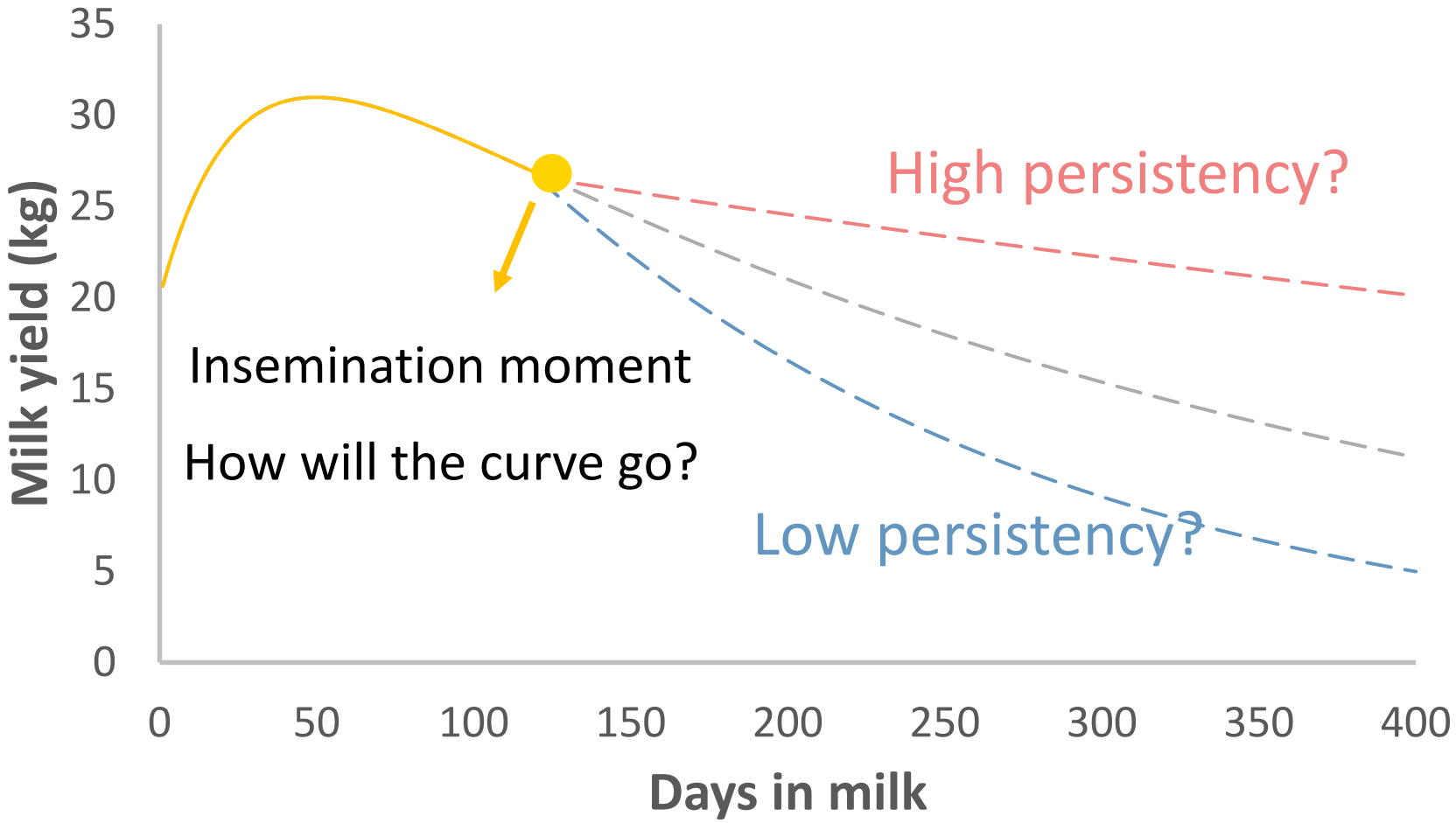
Conclusions



Aim

Can we predict persistency at 305d in early lactation?

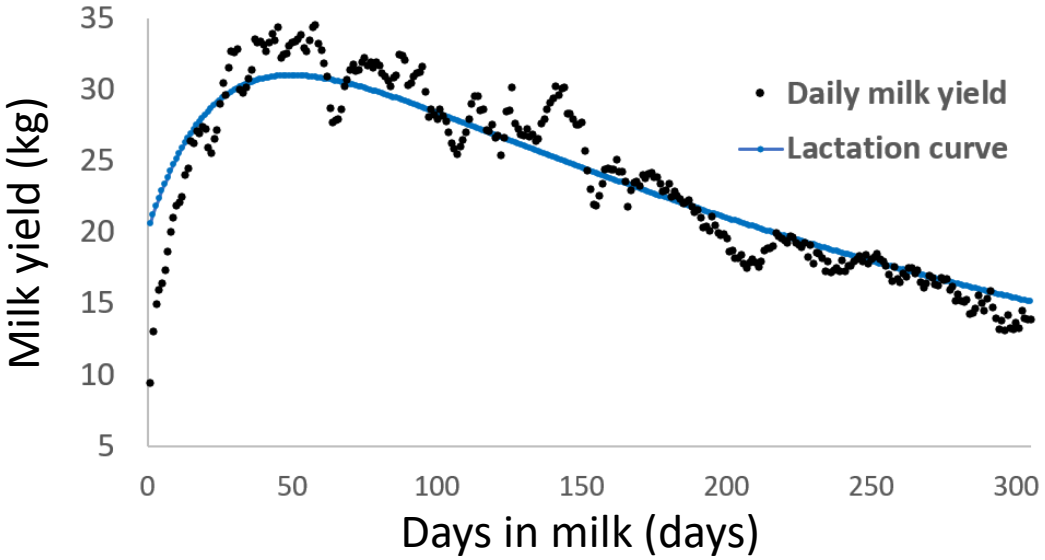
potential insemination moments:
DIM 50, 75, 100 and 125

(Ehrlich, 2011, 2013)

Define persistency

- correct for normal lactation curve
- estimate actual production from incomplete data sets

MilkBot (2011)



Lactation curve characteristics

Magnitude (kg/day)	Time to peak yield (day)	Offset	Decay (day^{-1})	Persistency (day)
39.3	27.1	-0.5	0.00313	221

$$Persistency = \frac{0.693}{Decay}$$

Being more normally distributed than persistency, decay is preferred for most statistical calculations and converted to persistency afterwards

Introduction

16,980 cows 84 herds from years 2005–2022

95,529,301 milking robot visit records

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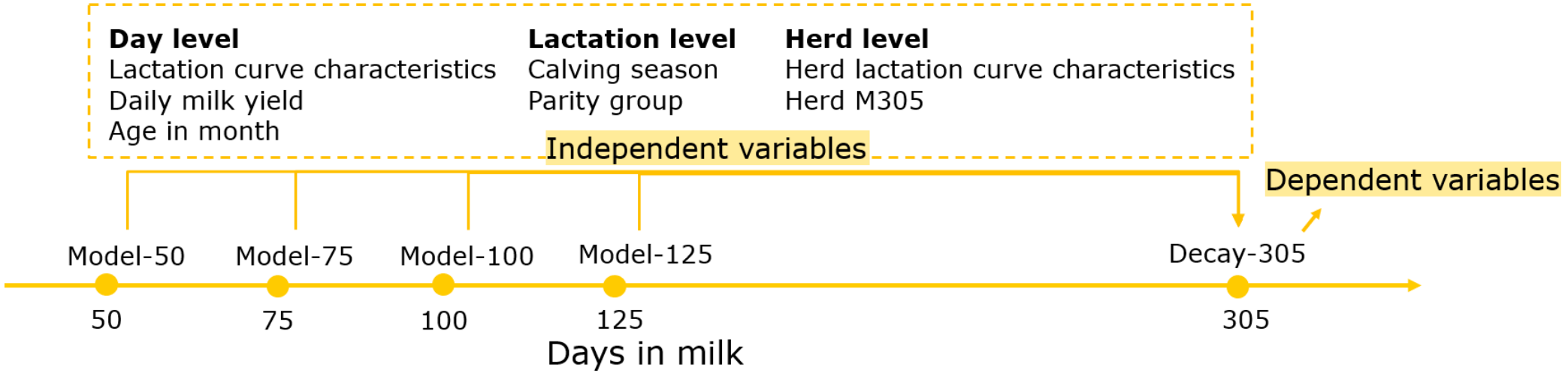
Cow-parity records were randomly split into two parts: 80% (training set) and 20% (test set).

Linear regression

Results



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Potential insemination moments	Number of cow-parity			Number of cows	Number of herds
	Training set	Test set	Total		
50	11,601	2,947	14,548	10,907	82
75	14,733	3,695	18,428	13,036	83
100	13,172	3,333	16,505	12,100	84
125	10,277	2,657	12,934	10,099	83

	Primiparous cows					Multiparous cows			
Variables	Mean	SD	5%[a]	95%		Mean	SD	5%	95%
Dependent variable									
Decay-305 (*10^{-3}, day^{-1})	1.7[b]	0.7	0.7	2.9		2.3[b]	0.7	1.2	3.4
=persistency	408					301			
Independent variables [c]									
Cow level variables									
Magnitude (kg)	39.7	5.2	31.7	48.5		50.7	6.7	39.0	60.8
Time to peak yield (day)	27.9	2.3	24.0	31.2		21.6	2.5	16.7	25.5
Offset (day)	-0.50	$2.5*10^{-5}$	-0.50	-0.50		-0.61	0.31	-0.78	0.01
Decay (*10^{-3}, $days^{-1}$)	1.5[b]	0.7	0.6	2.9		2.0[b]	0.8	0.6	3.3
=persistency	462					347			
Daily milk yield (kg)	33.3	4.9	25.8	41.6		42.2	6.0	31.7	51.5
Age in months	28.2	2.5	25.2	33.2		53.5	16.1	37.9	86.5
Herd level variables									
Herd magnitude (kg)	38.6	2.8	34.1	43.3		49.9	3.6	43.8	55.1
Herd time to peak yield	27.7	1.5	25.4	30.0		22.2	0.8	20.9	23.7
Herd offset (day)	-0.50	$1.3*10^{-5}$	-0.50	-0.50		-0.57	0.09	-0.70	-0.43
Herd decay (*10^{-3}, day^{-1})	1.7[b]	0.3	1.1	2.3		2.3[b]	0.3	1.9	2.8
Herd M305 (kg)	9,858	894	8,331	11,373		9,879	855	8,450	11,314

Result

Model performance indicators of prediction models on test set for decay-305 at different selected insemination moments (DIM 50, 75, 100 and 125).

Model	R^2	RMSE	MAE	MAPE
50	0.235	$6.5*10^{-4}$	$5.3*10^{-4}$	0.313
75	0.262	$6.4*10^{-4}$	$5.2*10^{-4}$	0.311
100	0.254	$6.4*10^{-4}$	$5.1*10^{-4}$	0.307
125	0.324	$6.0*10^{-4}$	$4.8*10^{-4}$	0.296

Predictions were improved at later insemination moments

R^2: coefficient of determination; RMSE: root mean squared error; MAE: mean absolute error; MAPE: mean absolute percentage error.

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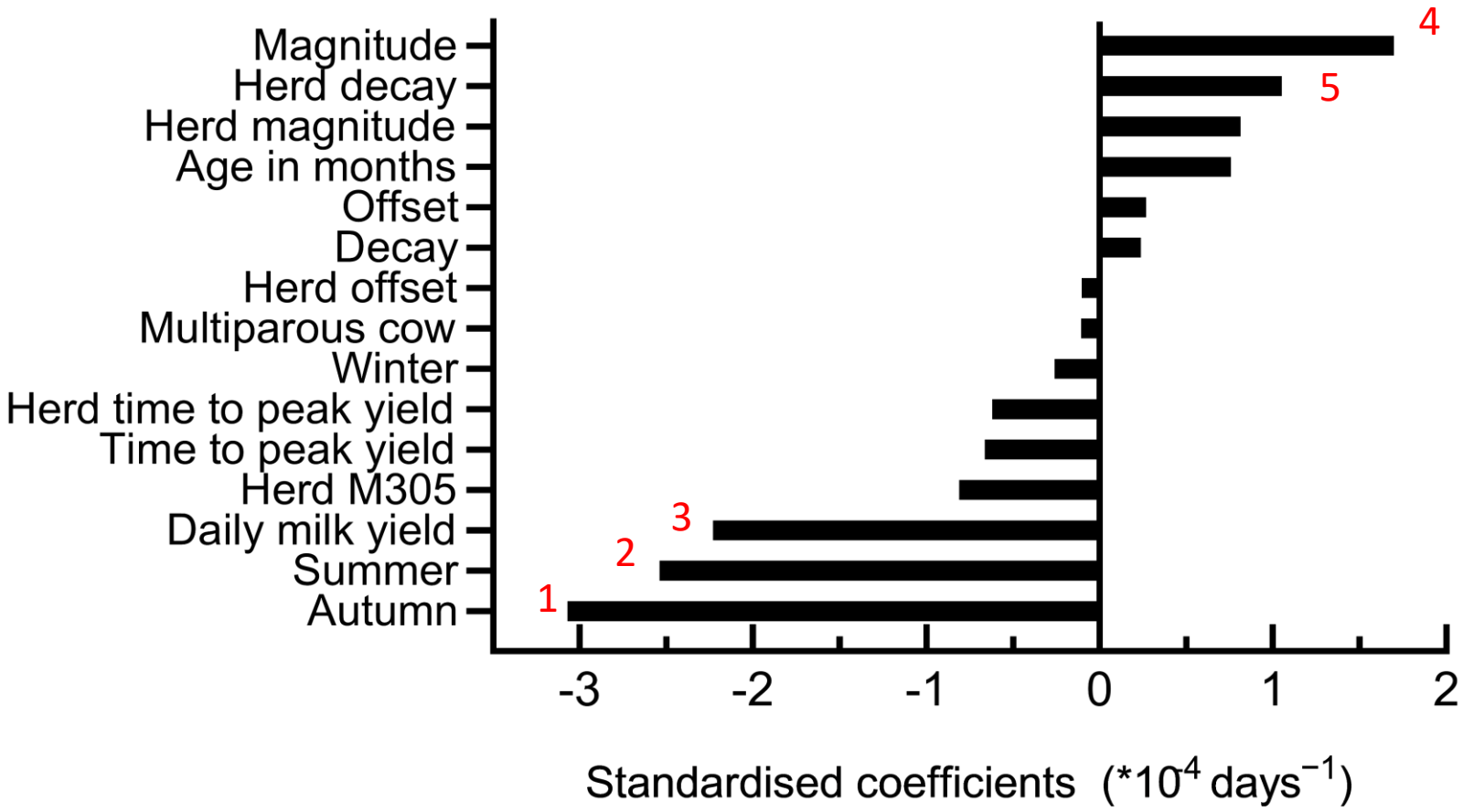
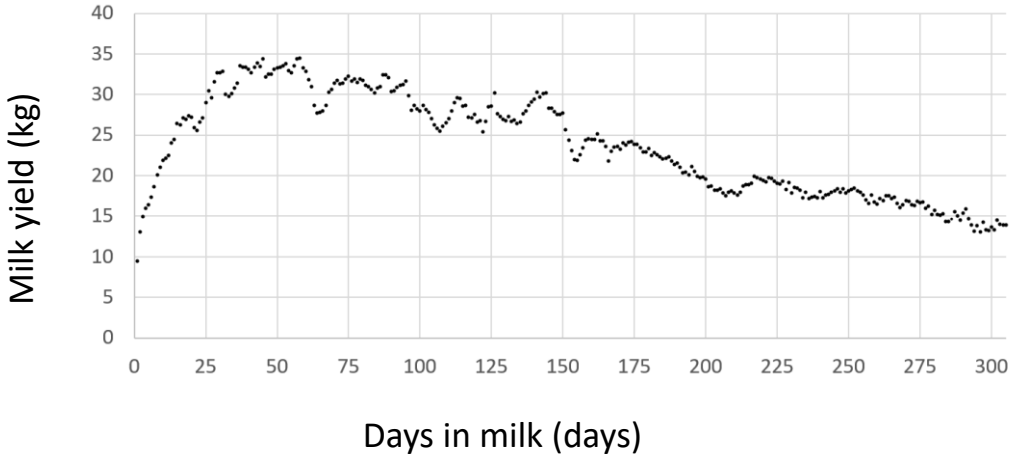
Predict Decay-305 at DIM75



Discussion



- Why Decay305 is not predictable at early lactation?
  - The declining stage does not start yet or just begins
  - The decay is still changing in the late lactation
  - Other effects (pregnancy, milk frequency…)

- Our methodology can predict M305 very well (R^2 0.8-0.9)

Conclusion

- At the moment of insemination…
  - Decay / persistency at DIM305 is not predictable

- Other information is needed to improve the accuracy in predicting persistency.

"However beautiful the strategy, you should occasionally look at the ~~results~~ data."

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