

**Supplementary Table 1.** Prediction performance<sup>1</sup> of partial least squares regression (PLSR) and neural network (NN) to estimate body condition score change across 305 days in milk (DIM) using 1) a.m. spectra only, 2) p.m. spectra only, and 3) a.m. and p.m. spectra together as model features.

Dataset	Method	Calibration		Validation				
		RMSE <sup>2,3</sup> (SD <sup>2,3</sup> )	r (SD)	RMSEV <sup>2,3</sup> (SD <sup>2,3</sup> )	Bias <sup>2</sup> (SD <sup>2</sup> )	r (SD)	Slope (SE)	RPD (SD)
a.m.	PLSR	1.15 (0.017)	0.70 (0.008)	1.18 (0.019)	-0.02 (0.044)	0.70 (0.005)	1.04 (0.013)	1.40 (0.01)
	NN	1.04 (0.022)	0.76 (0.010)	1.08 (0.017)	-0.02 (0.030)	0.76 (0.011)	1.03 (0.011)	1.52 (0.03)
p.m.	PLSR	1.14 (0.015)	0.70 (0.007)	1.17 (0.018)	-0.02 (0.031)	0.70 (0.008)	1.03 (0.012)	1.40 (0.02)
	NN	1.03 (0.030)	0.77 (0.018)	1.07 (0.017)	-0.03 (0.020)	0.76 (0.011)	1.02 (0.010)	1.55 (0.03)
a.m. and	PLSR	1.15 (0.015)	0.70 (0.007)	1.18 (0.017)	-0.02 (0.029)	0.70 (0.003)	1.03 (0.012)	1.40 (0.01)
p.m.	NN	1.00 (0.011)	0.78 (0.007)	1.05 (0.020)	-0.02 (0.022)	0.77 (0.009)	1.01 (0.010)	1.57 (0.03)

<sup>1</sup>RMSE = root mean square error; RMSEV = root mean square error in validation data set; r = Pearson correlation between actual  $\Delta$ BCS and estimated  $\Delta$ BCS; SD = standard deviation across validation datasets; SE = standard error; RPD = ratio of performance to deviation.

<sup>2</sup> Values presented are values \*1,000

<sup>3</sup> BCS units (scale 1 to 5)

**Supplementary Table 2.** Prediction performance<sup>1</sup> of partial least squares regression (PLSR) and neural network (NN) to estimate body condition score change across 120 days in milk (DIM) using 1) a.m. spectra only, 2) p.m. spectra only, and 3) a.m. and p.m. spectra together as model features.

Dataset	Method	Calibration		Validation				
		RMSE <sup>2,3</sup> (SD <sup>2,3</sup> )	r (SD)	RMSEV <sup>2,3</sup> (SD <sup>2,3</sup> )	Bias <sup>2</sup> (SD <sup>2</sup> )	r (SD)	Slope (SE)	RPD (SD)
a.m.	PLSR	1.26 (0.027)	0.74 (0.006)	1.32 (0.019)	-0.05 (0.044)	0.75 (0.006)	1.05 (0.016)	1.50 (0.01)
	NN	1.16 (0.017)	0.79 (0.008)	1.23 (0.032)	-0.04 (0.037)	0.78 (0.003)	1.04 (0.015)	1.61 (0.01)
p.m.	PLSR	1.24 (0.021)	0.75 (0.007)	1.31 (0.043)	-0.05 (0.036)	0.75 (0.016)	1.03 (0.016)	1.51 (0.04)
	NN	1.13 (0.018)	0.80 (0.006)	1.21 (0.019)	-0.05 (0.032)	0.79 (0.007)	1.03 (0.014)	1.63 (0.02)
a.m. and	PLSR	1.24 (0.023)	0.76 (0.006)	1.29 (0.031)	-0.05 (0.036)	0.76 (0.004)	1.05 (0.016)	1.53 (0.01)
p.m.	NN	1.09 (0.016)	0.82 (0.006)	1.17 (0.018)	-0.04 (0.033)	0.80 (0.004)	1.04 (0.013)	1.69 (0.01)

<sup>1</sup>RMSE = root mean square error; RMSEV = root mean square error in validation data set; r = Pearson correlation between actual  $\Delta$ BCS and estimated  $\Delta$ BCS; SD = standard deviation across validation datasets; SE = standard error; RPD = ratio of performance to deviation.

<sup>2</sup> Values presented are values \*1,000

<sup>3</sup> BCS units (scale 1 to 5)

**Supplementary Table 3.** Standard deviation for each validation dataset and prediction performance<sup>1</sup> of neural network using a.m. spectra and days in milk as model features in the first 120 days in milk to estimated body condition score change across different validation scenarios.

		SD <sup>2</sup>	RMSEV <sup>2,3</sup>	Bias <sup>2</sup>	r	Slope (SE)
Farm	1	2.14	1.137	0.118	0.87	1.28 (0.07)
	2	1.93	1.126	0.096	0.83	0.85 (0.01)
	3	2.08	1.169	0.065	0.83	0.92 (0.01)
	4	2.13	1.371	-0.424	0.79	0.96 (0.02)
	5	1.91	1.062	-0.169	0.84	0.93 (0.02)
Parity	1	2.07	1.060	-0.065	0.86	0.99 (0.01)
	2	1.92	0.954	0.285	0.88	0.94 (0.01)
	3	2.03	1.019	0.036	0.86	0.98 (0.01)
	4	2.14	1.152	-0.269	0.85	1.04 (0.01)
	5+	2.12	1.096	-0.148	0.86	1.01 (0.01)
Year	2015	2.04	1.263	-0.506	0.83	0.91 (0.01)
	2016	2.20	1.280	0.014	0.82	1.16 (0.01)
	2017	1.75	1.204	-0.608	0.84	0.79 (0.01)
	2018	1.58	1.234	-0.558	0.74	0.82 (0.01)
	2019	2.07	1.719	0.253	0.76	0.60 (0.01)
Breed <sup>4</sup>	Ho-Fr	2.07	1.389	-0.671	0.86	0.99 (0.01)
	JE	2.18	1.012	0.072	0.83	1.07 (0.04)
	Crossbred	2.03	1.058	-0.031	0.87	0.98 (0.01)

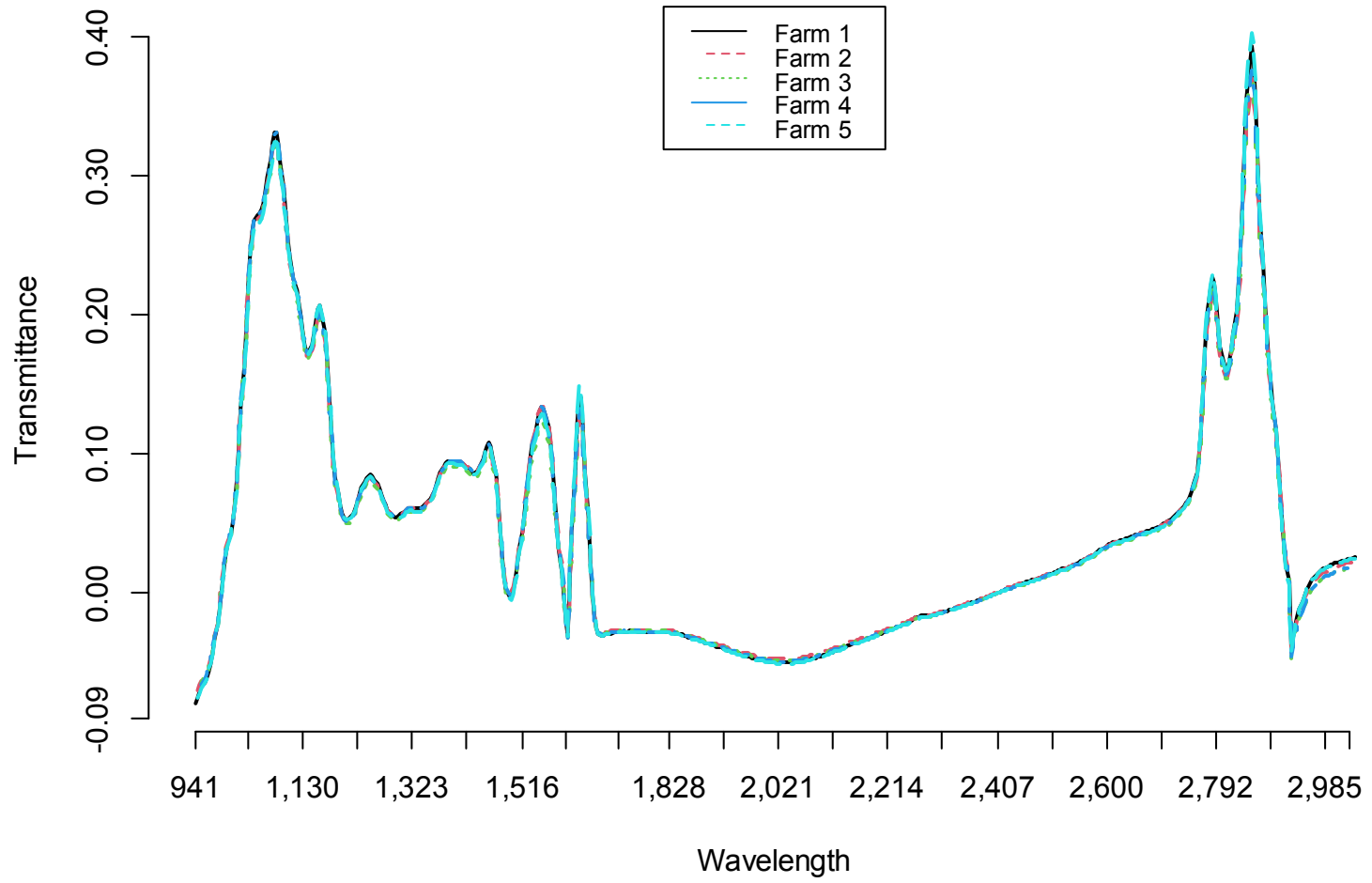
<sup>1</sup>SD = standard deviation of the validation dataset; RMSEV = root mean square error in validation data set; r = Pearson correlation between actual  $\Delta$ BCS and estimated  $\Delta$ BCS; SE = standard error.

<sup>2</sup> Values presented are values \*1,000

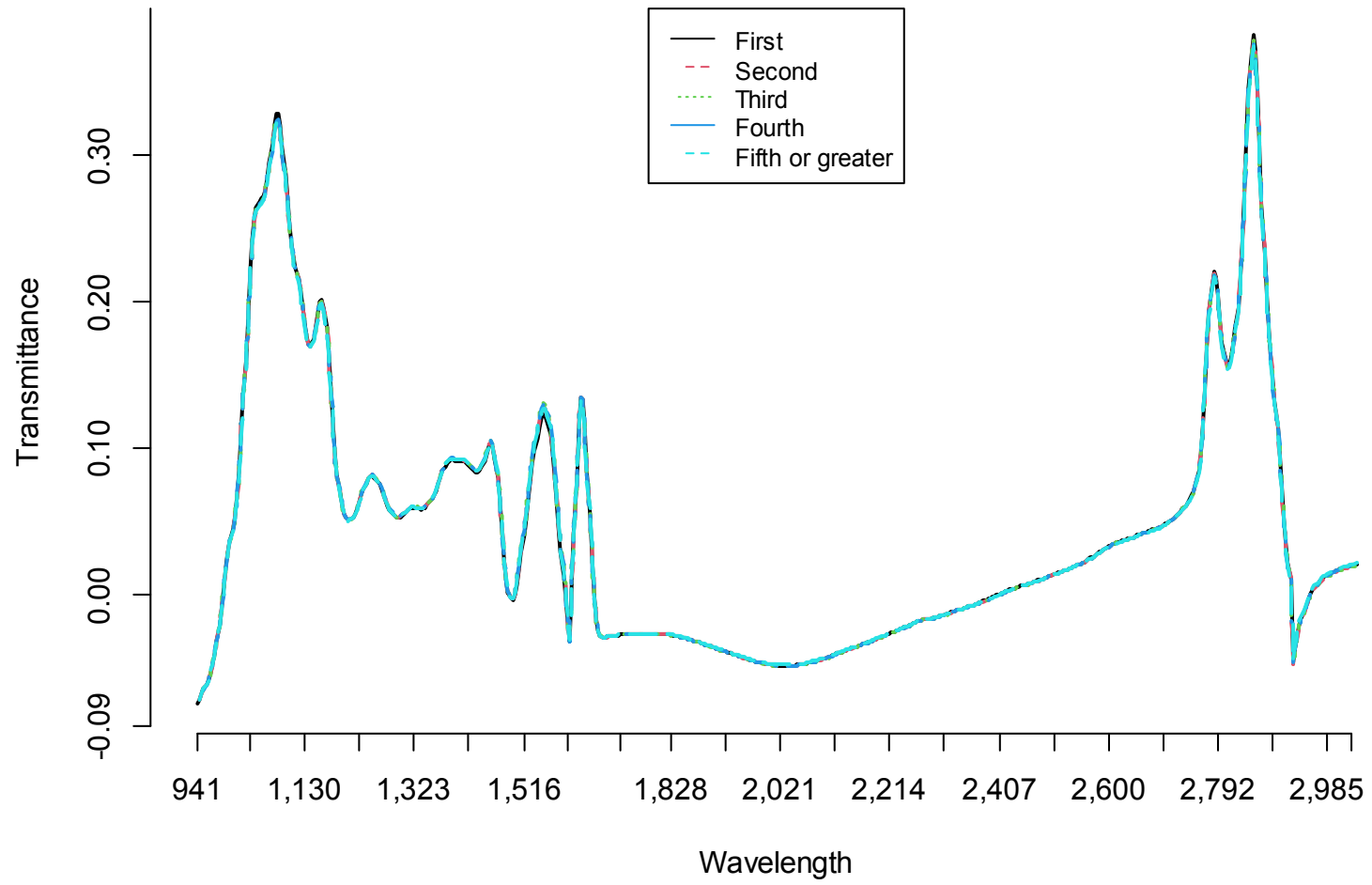
<sup>3</sup> BCS units (scale 1 to 5)

<sup>4</sup>Ho-Fr = Holstein-Friesian; JE = Jersey

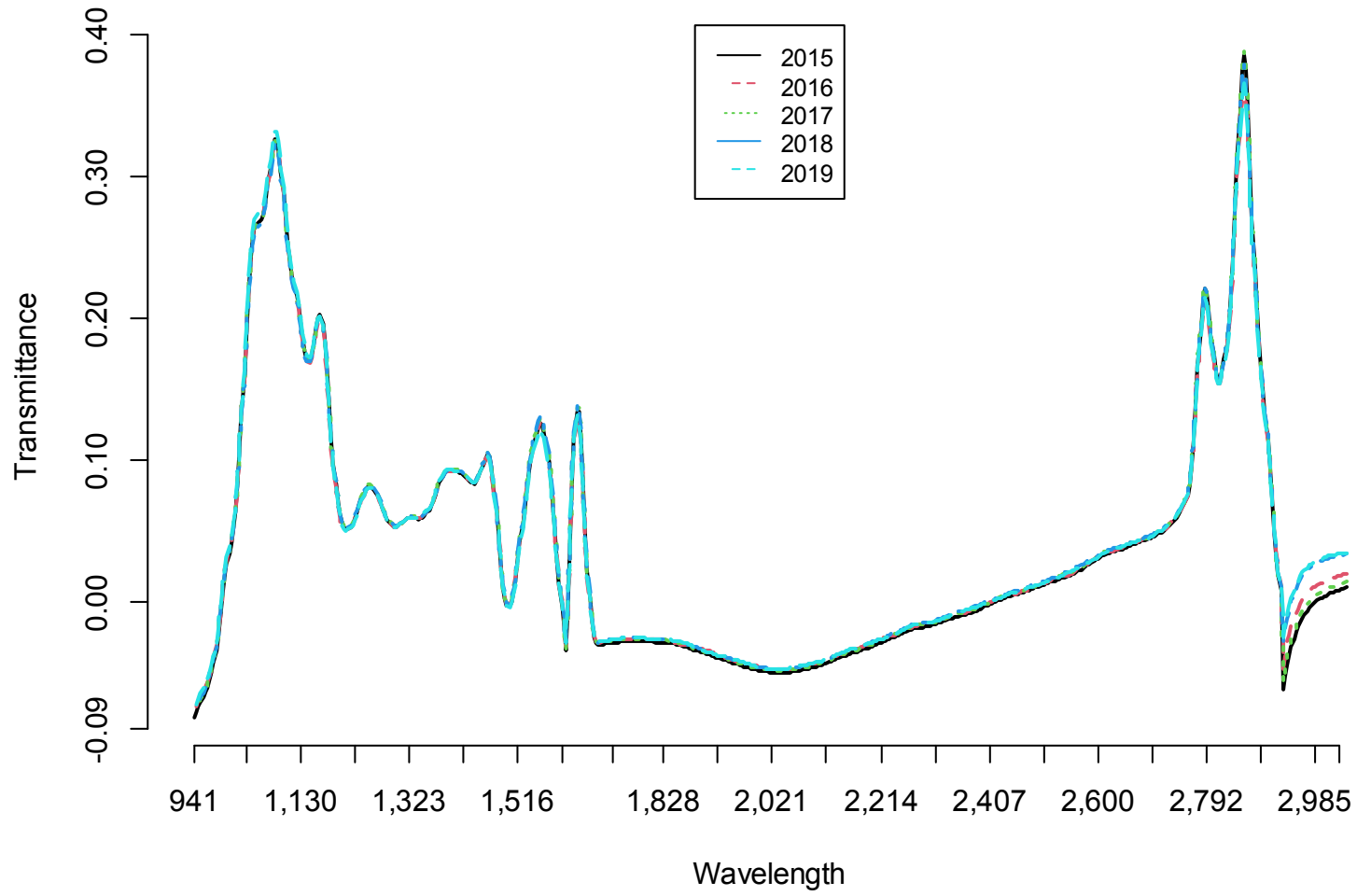
**A**

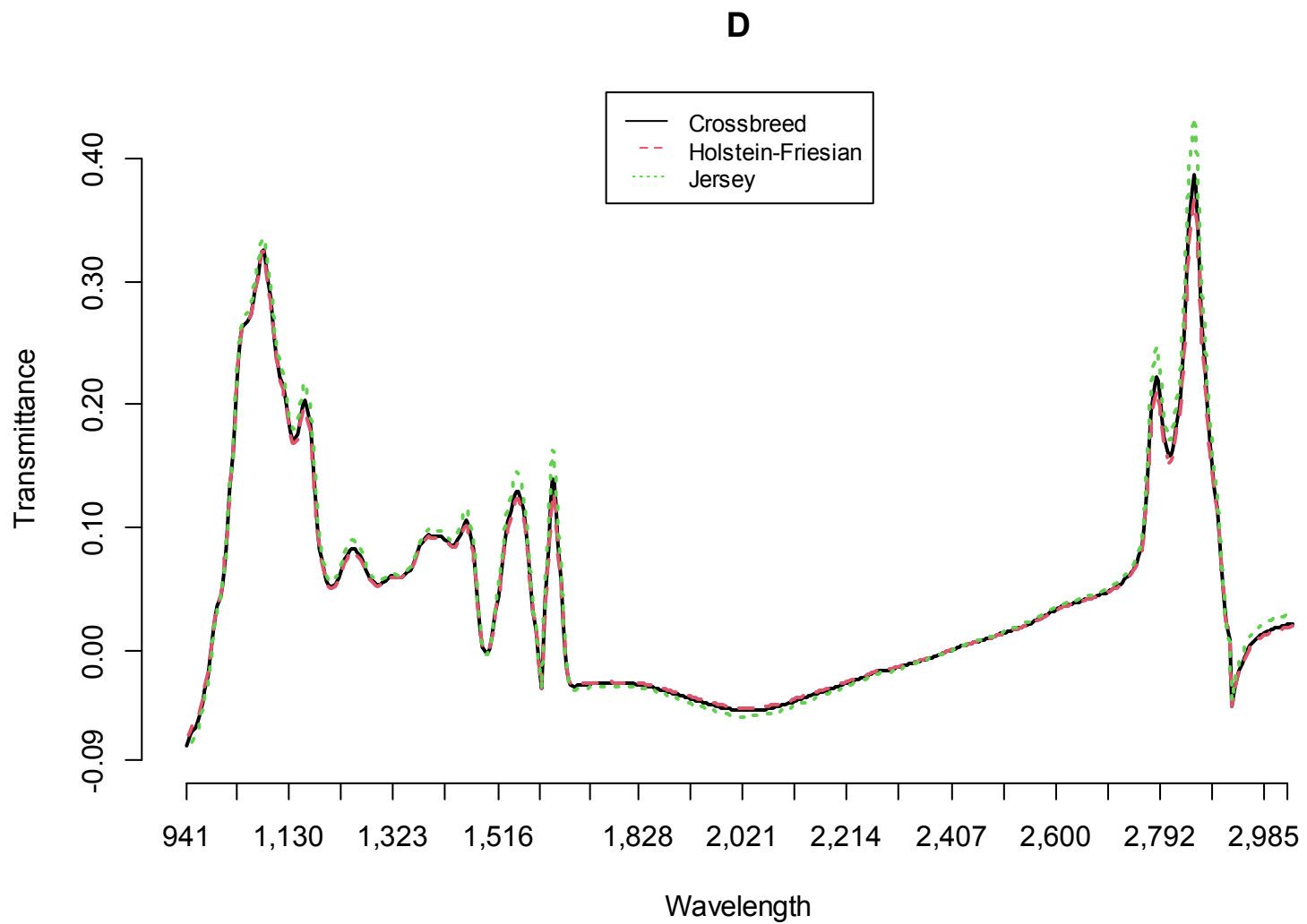


**B**



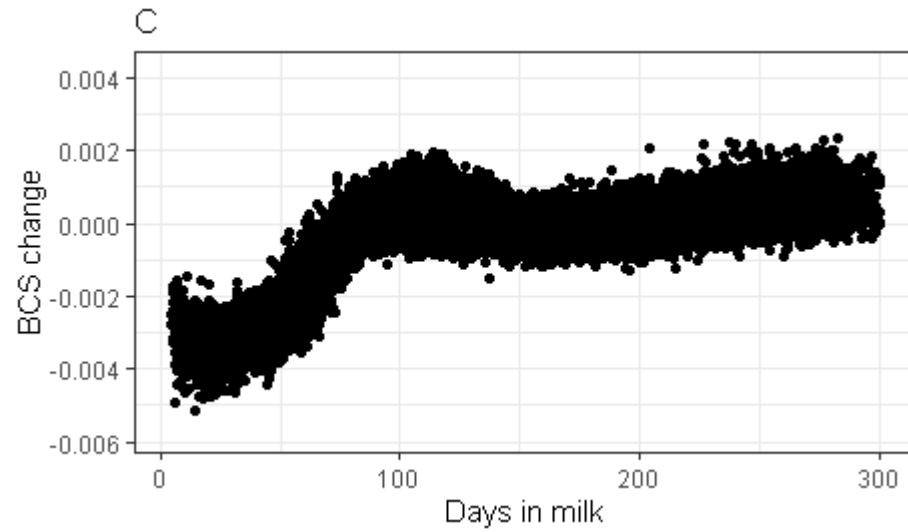
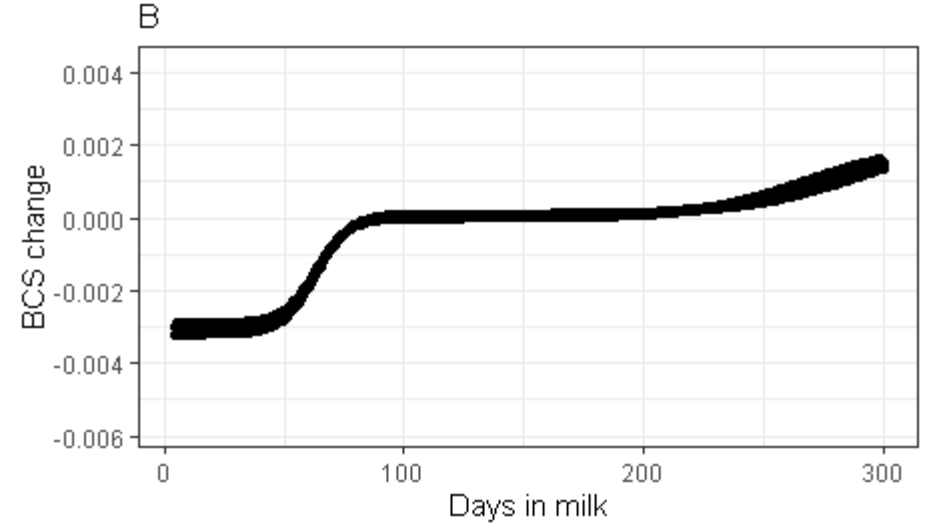
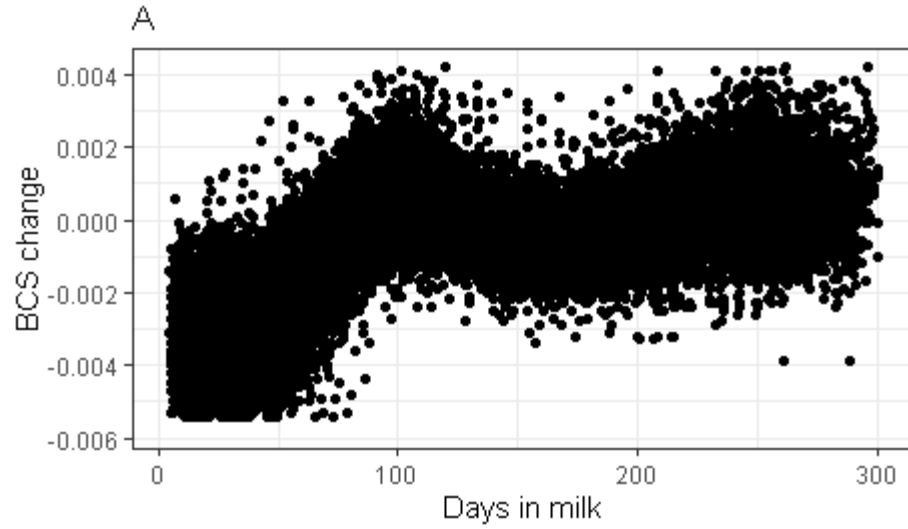
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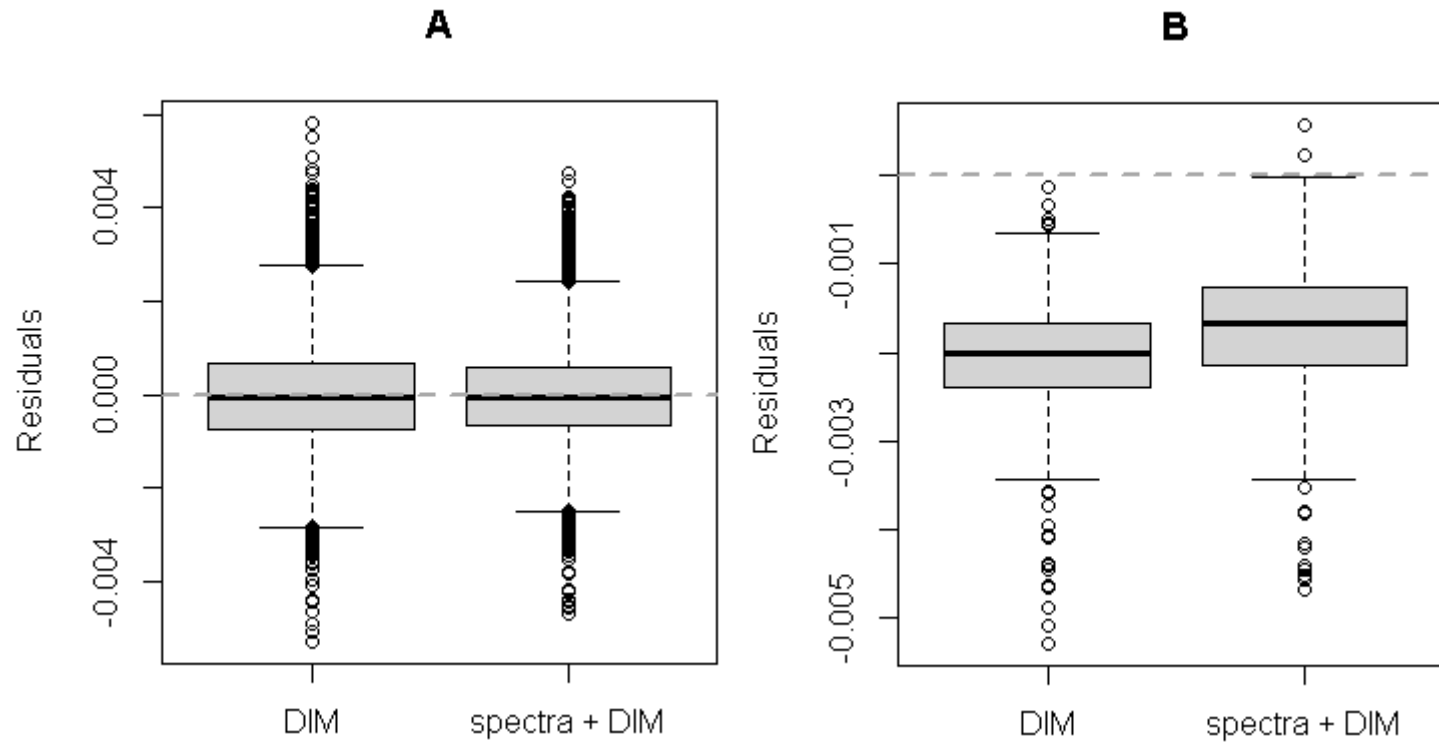


**Supplementary Figure S1.** Average wavelengths values by A) farm, B) parity, C) year of sampling, and D) breed.





**Supplementary Figure 2.** (A) Actual body condition score (BCS) change ( $\Delta$ BCS), and  $\Delta$ BCS estimated using (B) DIM only, and (C) DIM and a.m. spectra only, for all the records up to 305 DIM.



**Supplementary Figure 3.** Boxplot of the residuals for the prediction models using DIM alone (DIM) or spectra and DIM together (spectra + DIM) when (A) all the records were considered and (B) only the fastest losing BCS records were considered, using data up to 305 DIM.