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Comparison of different models for estimating daily yields from a.m./p.m. milkings in Slovenian dairy scheme

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Introduction

- AT4 recording scheme
  - Implemented in Slovenia in March 2004
- Problems:
  - Systematic underestimation of daily protein content
  - Underestimation of high daily yields and contents
  - Overestimation of low daily yields and contents

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Find a solution

Data

- Collected from database of Slovenian cattle recording scheme (83,098 cows in May 2008)
- Combinations of regular and supervision control from March 2004 to February 2008
- After screening 483,813 test-day records from
  - 120,971 lactations
  - 89,376 cows
  - 26,046 milk tests
  - 5,051 herds

Data description

Trait	Daily		a.m.		p.m.	
	Mean	Std	Mean	Std	Mean	Std
DMY (kg)	18.06	7.12	9.23	3.76	8.83	3.56
DFY (kg)	0.74	0.29	0.38	0.16	0.37	0.15
DFC (%)	4.18	0.71	4.15	0.82	4.22	0.82
DPY (kg)	0.61	0.22	0.31	0.12	0.30	0.11
DPC (%)	3.41	0.38	3.40	0.39	3.43	0.39
MI (min)	1436.91	20.57	731.55	46.69	705.33	44.39

Model 1

- Model proposed by Klopčič (2003) and Klopčič *et al.* (2004)

$$y_i = \mu + b_1 * m_i + b_2 * t_i + e_i$$

y - DMY, DFC, DPC
μ - Intercept
b_1, b_2 - Regression coefficient
m - PMY, PFC, PPC
t - Milking interval in minutes
e - Residual
i - a.m. or p.m. milking

Model 2

- Factors proposed by ICAR (2007) for DeLorenzo and Wiggans model (1986)

$$DMY = FM * PMY + c * (DIM - 158)$$

$$DFC = FF * PFC$$

$$DPC = PPC$$

FM - Factor for milk yield
FF - Factor for fat content

Model 3

- Combination of Model 1 and Model 2

$$y_i = \mu + b_{1i} * t_i + e_i$$

$$y_i = \mu + b_{1i} * t_i + b_{2i} * t_i^{\,2} + e_i$$

$$y = \frac{PMY}{DMY} \qquad y = \frac{PFY}{DFY} \qquad y = \frac{PPY}{DPY}$$

y - Factor (FM, FF, FP)
μ - Intercept
b - Regression coefficient
t - Milking interval in minutes
e - Residual
i - a.m. or p.m. milking

Model 3

- Estimated DMY, DFY and DPY are then calculated with the formulas:

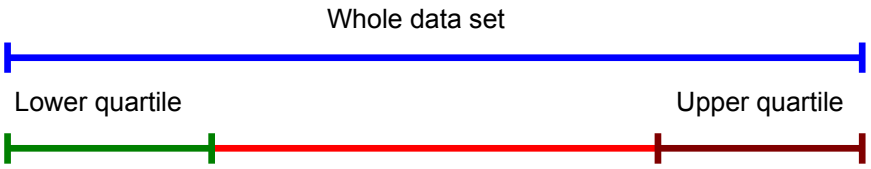
$$DMY = \frac{PMY}{FM}$$

$$DFY = \frac{PFY}{FF} \quad \Rightarrow \quad DFC = \left(\frac{DFY}{DMY}\right) * 100$$

$$DPY = \frac{PPY}{FP} \quad \Rightarrow \quad DPC = \left(\frac{DPY}{DMY}\right) * 100$$

Methods

Equation	Used model	Factors/coefficients obtained from
E1	M1	Klopčič (2004)
E2	M2	ICAR (2007)
E3	M1	Our data set
E4	M3 (t as lin. effect)	Our data set
E5	M3 (t as quadr. effect)	Our data set



Results (whole data set)

Trait	Equ. (Model)	r	**Bias**
DMY (kg)	E1 (M1)	0.979	**0.044**
	E2 (M2)	0.980	**-0.048**
	E3 (M1)	0.980	**-0.002**
	E4 (M3)	0.980	**-0.002**
	E5 (M3)	0.980	**-0.001**
DFC (%)	E1 (M1)	0.878	**-0.006**
	E2 (M2)	0.879	**0.001**
	E3 (M1)	0.879	**-0.000**
	E4 (M3)	0.879	**0.000**
	E5 (M3)	0.879	**-0.003**
DPC (%)	E1 (M1)	0.975	**-0.033**
	E2 (M2)	0.974	**0.001**
	E3 (M1)	0.975	**-0.000**
	E4 (M3)	0.975	**0.000**
	E5 (M3)	0.975	**0.000**

Bias detected!

Results (upper quartile)

	Trait	Equ. (Model)	r	Bias
> 22.4 kg for DMY	DMY (kg)	E1 (M1)	0.923	**-0.315**
		E2 (M2)	0.927	**0.080**
		E3 (M1)	0.925	**-0.392**
		E4 (M3)	0.928	**-0.014**
		E5 (M3)	0.928	**-0.011**
> 4.42% for DFC	DFC (%)	E1 (M1)	0.709	**-0.196**
		E2 (M2)	0.711	**-0.002**
		E3 (M1)	0.710	**-0.211**
		E4 (M3)	0.709	**-0.012**
		E5 (M3)	0.709	**-0.007**
> 3.66% for DPC	DPC (%)	E1 (M1)	0.920	**-0.047**
		E2 (M2)	0.920	**0.001**
		E3 (M1)	0.921	**-0.026**
		E4 (M3)	0.921	**-0.000**
		E5 (M3)	0.921	**-0.000**

Underestimation with E1(M1) and E3 (M1)

Results (lower quartile)

	Trait	Equ. (Model)	r	**Bias**
< 12.9 kg for DMY	DMY (kg)	E1 (M1)	0.892	**0.347**
		E2 (M2)	0.902	**-0.024**
		E3 (M1)	0.897	**0.329**
		E4 (M3)	0.908	**0.004**
		E5 (M3)	0.908	**0.003**
< 3.71% for DFC	DFC (%)	E1 (M1)	0.654	**0.170**
		E2 (M2)	0.653	**0.002**
		E3 (M1)	0.656	**0.195**
		E4 (M3)	0.657	**-0.004**
		E5 (M3)	0.657	**-0.000**
< 3.14% for DPC	DPC (%)	E1 (M1)	0.901	**-0.021**
		E2 (M2)	0.900	**0.001**
		E3 (M1)	0.902	**0.023**
		E4 (M3)	0.902	**0.001**
		E5 (M3)	0.902	**0.001**

Overestimation with E1(M1) and E3 (M1)

Underestimation of protein content with E1

Conclusions

- Systematic underestimation of daily protein content was detected with E1
- Bias can be removed with appropriate model
- The problem of bias with estimation of daily milk records can be solved with the M2 and M3
  - In M2 and M3 model ratio between partial and daily yield is used as a dependent variable

Thank you for your attention