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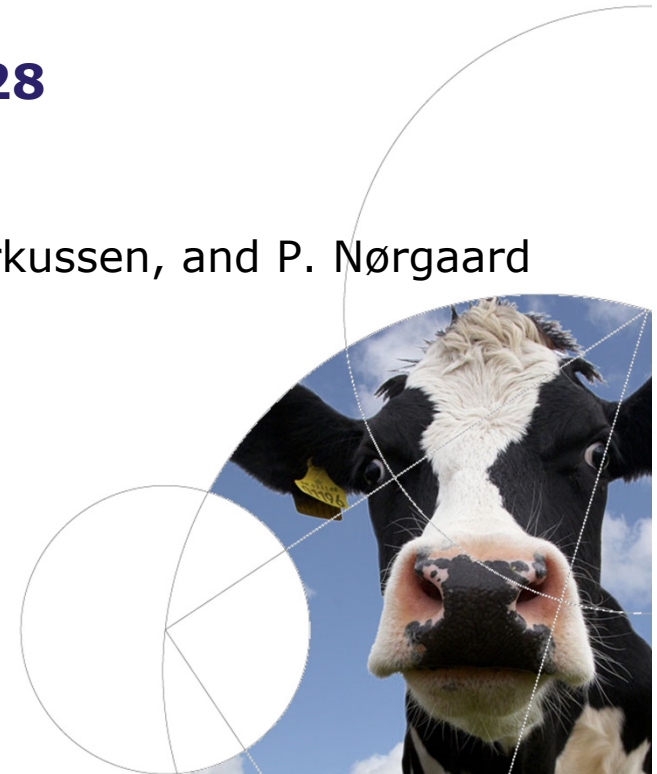
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Evaluation of five intake models predicting feed intake by dairy cows fed total mixed rations

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Evaluation of feed intake models –

Why?

- Reveals the **accuracy and robustness** of the existing models

- Gives rise to an **extended understanding** of effect of model parameters on prediction performance

- This can be used in development of **new and improved** models

Evaluation of feed intake models –

Objective

To evaluate the ability of different models to predict dry matter intake in dairy cows fed total mixed rations

Feed intake models –

Short model description

NRC (NRC, 2001):

Incl. fat corrected milk yield, body weight, and weeks of lactation, but **no dietary characteristics**

NorFor (Volden et al. 2011):

Intake capacity (IC): calculated based on DIM, energy corrected milk yield (ECM), and BW, but **depends also on parity and breed**

Feed fill value (FV): concentrate = constant

forage = calculated from organic matter digestibility (OMD), fermentation products, and neutral detergent fibre (NDF) content

Feed intake models –

Short model description

TDMI-index (Huhtanen et al. 2011):

Sum of silage dry matter index (**SDMI**) and concentrate dry matter index (**CDMI**), corrected based on standardized ECM, BW, lactation stage, and the **TDMI** index of the ration

SDMI: calculated based on D-value, concentration of total acid, dry matter, NDF, and proportion of regrowth, legume, and whole-crop silage

CDMI: calculated based on allocated concentrate DM, supplementary concentrate crude protein (CP>170 g/kg DM), and content of NDF and fat in concentrate

Feed intake models –

Short model description

Zom (Zom et al, 2012)

Feed intake capacity (FIC) based on parity, DIM, and days in gestation and **does not** include **daily milk yield** and **BW**

Feed Satiety Value (SV): based on type of forage, contents of DM, CP, crude fiber (CF), and OMD

DLG (Gruber et al., 2004)

Incl. DIM, breed, parity, BW, MY, and country. The diet characteristics: proportion of concentrate in the mixed ratio (DMI_c, % in ration/day), net energy (NE), and value of forage (NEL_f; MJ NE/kg DM).

Material and methods –

Data, feed and housing

96 treatment means from 14 Scandinavian experiments

3 breeds: 59 Danish Holstein, 16 Jersey, and 21 Danish/Swedish Red

Total of 1055 lactating dairy cows, distributed on primi- and multiparous cows entered between 25 and 275 DIM

Housing as either tied up or loose housing, all fed as TMR

Forage share (% of DM)		OMD (%)		NDF (g/kg DM)		CP (g/kg DM)		Sugar + starch (g/kg DM)	
Mean	SD	Mean	SD	mean	SD	mean	SD	mean	SD
58	8.5	75	2.2	339	20	161	19	209	42

Material and methods –

Statistical criterion for model evaluation

$$MSPE = \sum (A - P)^2 / n$$

MSPE = mean square prediction error

A = actual DMI, P = predicted DMI, n = number of pairs of A and P being compared

$$MSPE = (\bar{A} - \bar{P})^2 + S_P^2(1 - b)^2 + S_A^2(1 - r^2)$$

mean bias   = ECT   +   ER   +   ED

Where $\bar{A}$ is mean of the actual DMI, $\bar{P}$ is mean of the predicted DMI, S_A^2 is the variation of actual DMI, S_P^2 is the variation of predicted DMI, b is the slope of the regression of A on P with intercept zero, and r is the correlation coefficient of A and P

Results –
Observed minus predicted versus predicted DMI
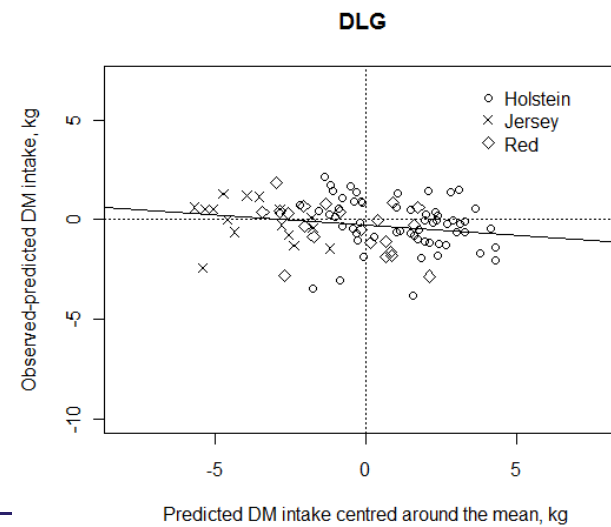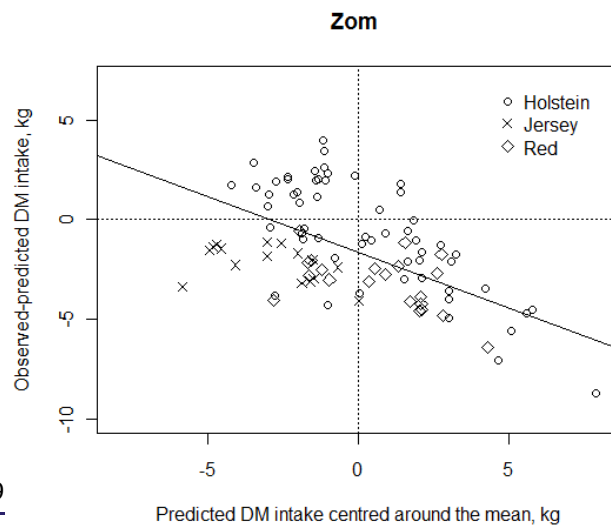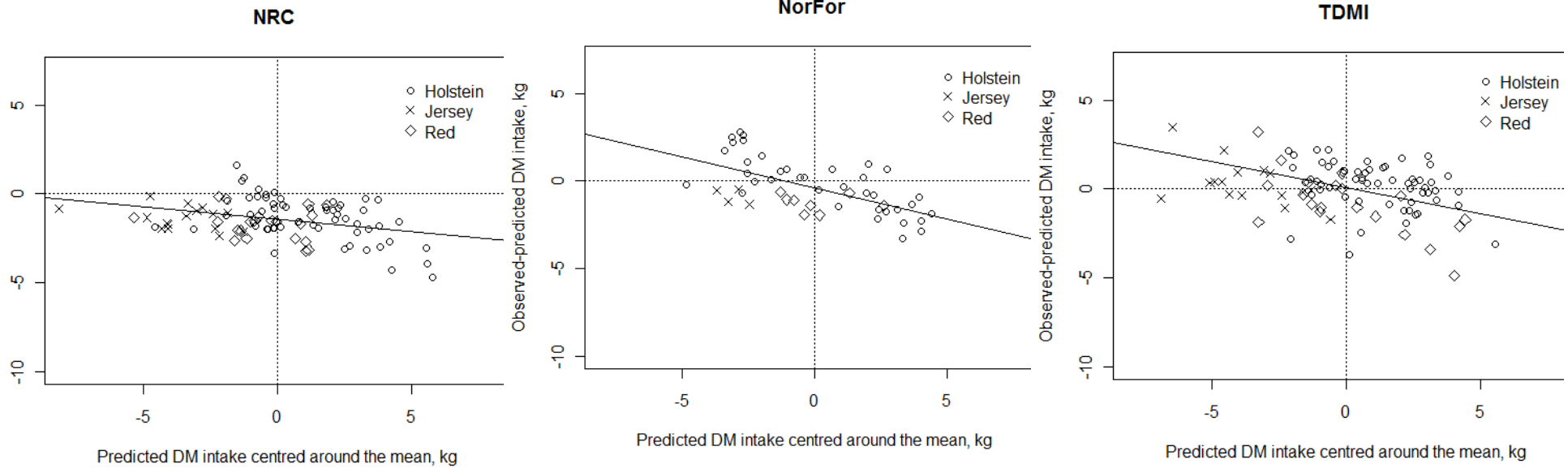
Results –
Evaluation criteria

Models[1]	Mean DMI (kg DM/day)			Evaluation criteria				
	pred.	Obs.	n	RMSPE (%)	MSPE	ECT	ER	ED
NRC	21.7	20.3	96	9%	3.25	2.09	0.14	1.03
NorFor	21.7	20.3	49	7%	2.28	0.15	0.82	1.31
TDMI	20.2	20.3	96	8%	2.94	0.01	0.66	2.27
Zom	21.9	20.3	96	16%	9.91	2.65	2.74	4.52
DLG	20.5	20.3	96	6%	1.53	0.06	0.06	1.41

[1]NorFor (Volden, 2011), NRC (NRC, 2001), TDMI (Huhtanen et al., 2011),
Zom (Zom et al., 2012), and DLG (Gruber et al., 2004)

Discussion –

What is most surprising?

The NRC model, despite a general over prediction of DMI, and without inputs of dietary characteristics, predicts feed intake with a lower RMSPE compared with the Zom model

And is there an explanation?

The use of interpolated crude fiber (CF) values from feed table in the Zom model. This may induce a minor error on CF compared to analysed CF

The lack of production traits in the estimation of intake capacity have shown not to be the course of inaccurate predictions

Conclusion –

Preliminary

The DLG, NorFor, and TDMI models produce the most accurate prediction of DMI in Scandinavian dairy cows fed typical TMR, with the DLG model resulting in the prediction with most error located in ED

Models including production characteristics, e.g. BW and ECM, appear in general more robust than models without

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Thank you for listening ☺

Questions?

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