Faculty of Agricultural and Nutritional Sciences

Christian-Albrechts-University of Kiel
Institute of Animal Breeding and Husbandry

Relationship between milk yield, water intake and feed intake

E. Kramer[1], E. Stamer[2] and J. Krieter[1]

[1]Institute of Animal Breeding and Husbandry
Christian-Albrechts-University of Kiel
[2]TiDa Tier und Daten GmbH

Introduction

- **Necessity of sufficient water supply to avoid negative effects on animal health, performance and welfare (MURPHY, 1992; LEJEUNE et al., 2001)**
- **Strong relationship between water intake and feed intake (MURPHY, 1992)**
- **Objective of this study:**

→ **Analysis of the general relationship between milk yield, water intake and feed intake**

→ **Are the relationships constant during the course of lactation?**

Data description

- **Dairy research farm Futterkamp of the chamber of agriculture in Schleswig-Holstein**
- **Research herd: 70 dairy cows, divided into two feeding groups (Group A and Group B)**
- **Data collection period: March 2005 - February 2007**

Data recording (Futterkamp)

Parameter	Recording frequency
Milk yield	each milking
Milk solids	weekly
- Fat-%. protein-%	
- SCC and urea content	
Live weight	each milking
Water intake	each visit at the water trough
Feed intake	each visit at the feeding trough
Activity	cumulative yields at each hour
Reproduction (calving, pregnancy,insemination)	permanently
Health (treatments of diseases)	
Body condition score	monthly

Data

Means ($\bar{x}$), standard deviations (s) and range (minimum, maximum) of the analysed traits[1)]

trait	n	$\bar{x}$	σ	Min	Max
milk yield (kg)	35,771	34.9	7.7	5.8	61.5
water intake (kg)	39,131	84.3	18.5	10.7	160.8
feed intake (kg DM)	39,062	20.3	3.9	2.8	35.9

[1)]Accounted lactation days: 6 - 230

Fixed Regression Model

$$y_{ijkl} = \mu + LNR_i + GTT_j + \sum_{m=1}^{4} b_{im} * x_{ijklm}(d) + c_k + e_{ijkl}$$

y_{ijkl} = observation of milk yield, feed intake or water intake

LNR_i = fixed effect of the i-th lactation (i=1,.., 3)

GTT_j = fixed effect of the j-th test day within feeding group (j~1,..,1200)

b_{im} = fixed effect on day of lactation within the i-th lactation

c_k = random effect of the k-th cow (k=1,.., 225)

with: $x_{ijkl0}(d) = 1,\ x_{ijkl1}(d) = \frac{d}{305},\ x_{ijkl2}(d) = \left(\frac{d}{305}\right)^2,$

$x_{ijkl3}(d) = \ln\frac{305}{d}$ und $x_{ijkl4}(d) = \left(\ln\frac{305}{d}\right)^2$

Random Regression Model

$$y_{ijkl} = \mu + LNR_i + GTT_j + \sum_{m=1}^{4} b_{im} * x_{ijklm}(d) + \sum_{m=0}^{4} c_{km} * x_{ijklm}(d) + e_{ijkl}$$

y_{ijkl} = observation of milk yield, feed intake or water intake

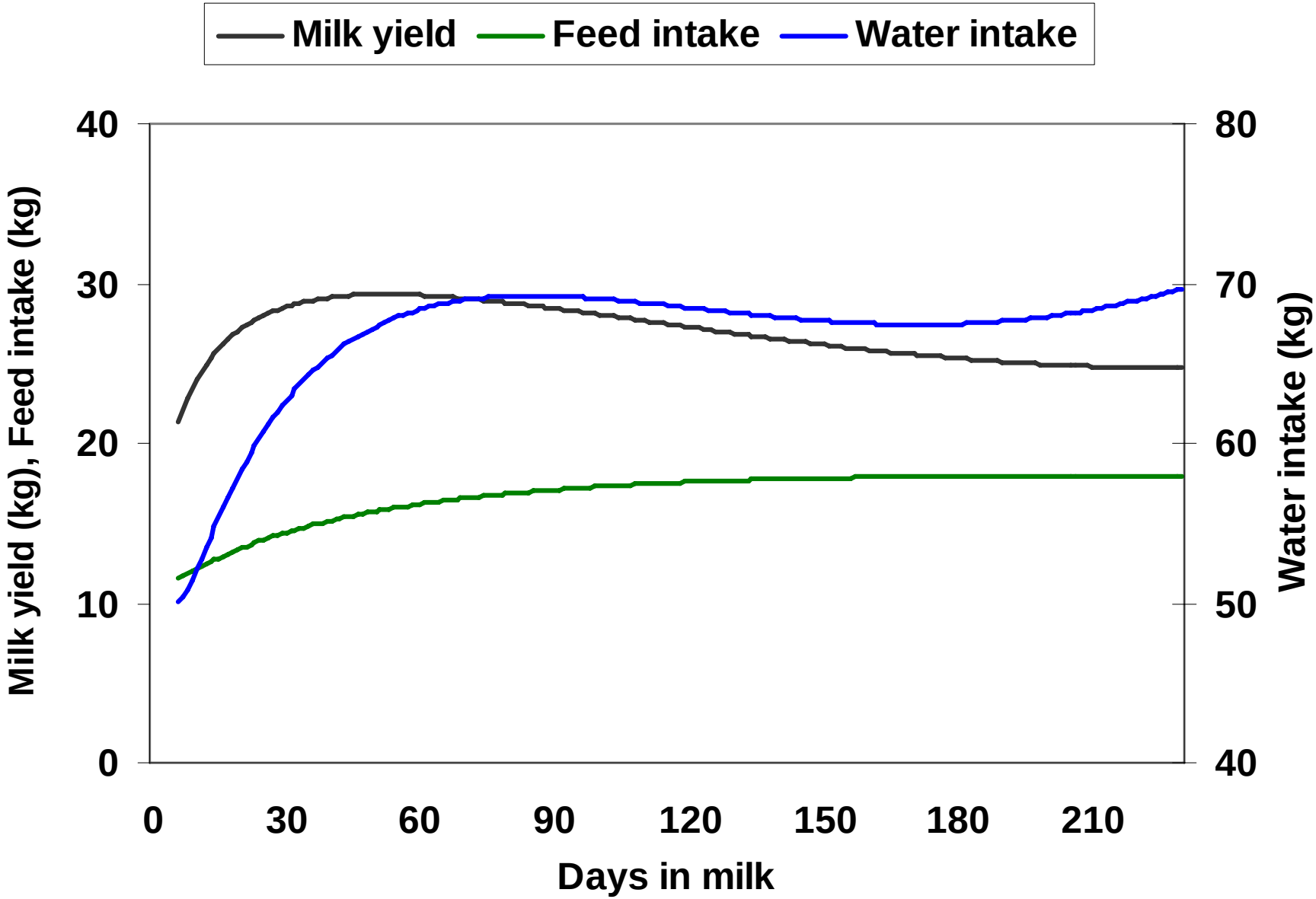
c_{km} = random random regression coefficients for the cow effect of the k-th cow

with:

$$x_{ijkl0}(d) = 1, \quad x_{ijkl1}(d) = \frac{d}{305}, \quad x_{ijkl2}(d) = \left(\frac{d}{305}\right)^2,$$

$$x_{ijkl3}(d) = \ln\frac{305}{d} \quad \text{und} \quad x_{ijkl4}(d) = \left(\ln\frac{305}{d}\right)^2$$

Lactation curves for primiparous cows



Variance components with Model I

Repeatabilities (diagonal) and correlations (cow effects) for milk yield, feed intake and water intake

		MY	FI	WI
MY	milk yield (kg)	0.76 (0.01)[1)]	0.59 (0.03)	0.73 (0.02)
FI	feed intake (kg)		0.34 (0.02)	0.73 (0.02)
WI	water intake (kg)			0.41 (0.02)

1) standard errors in parentheses

Variance components with Model II

Repeatabilities (diagonal) and correlations (cow effects) within the traits at different stages of lactations

Lactation section	I	IV	VII
a) milk yield			
I	0.79	0.51	0.46
IV		0.85	0.62
VII			0.92
b) feed intake			
I	0.49	0.43	0.43
IV		0.45	0.70
VII			0.50
c) water intake			
I	0.46	0.56	0.47
IV		0.49	0.76
VII			0.52

Variance components with Model II

Correlations (cow effects) between the traits at different stages of lactation

Traits \ Lactation section	I	II	III	IV	V	VI	VII
Milk Yield – Water Intake	0.13	0.62	0.76	0.79	0.80	0.81	0.84
Milk Yield – Feed Intake	0.48	0.65	0.75	0.74	0.66	0.75	0.93
Water Intake – Feed Intake	0.82	0.81	0.80	0.79	0.78	0.77	0.76

Conclusion

- **Correlations between milk yield, feed intake and water intake estimated with the FR Model on a moderate to high level**
- **Almost constant repeatabilities in the course of lactation after using the RR Model**
- **Correlations within a trait and between the traits not constant in the course of lactation**
- **Traits at the beginning and at the end of the lactation genetically not identical ?**

→ **RR models should be used for analysis**

Thank you for attention!

Cow: „Endy“; Owner + Breeder.: E. Kramer. Dorenborg